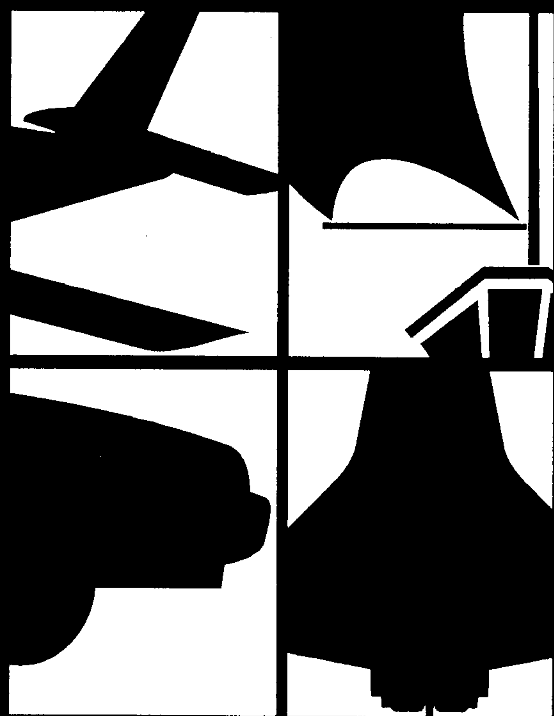
Transportation Systems



Technology Education
Course #8126

Summer 1998

Public Schools of North Carolina
State Board of Education
Department of Public Instruction

Summer 1998

FOREWORD

This curriculum guide has been developed to help teachers offer a focused, demanding, and interesting course which addresses the essential core concepts and principles of transportation systems. This guide includes specific learning objectives, evaluation tools, recommended activities, equipment and supply list, a bibliography of reference media and the names and addresses of media vendors.

The Transportation Systems course offers students the opportunity to learn and apply fundamental principles of transportation systems. This is a demanding course requiring students to develop a common vocabulary and literacy of transportation terms, concepts, and related scientific and technical principles. Students in turn apply these math, science, and technical concepts to the design of experiments and the development of models. Students design and build models (or actual) transportation vehicles from one of the four modes of transportation systems (land, water, air or space). Students also address the historical and contemporary importance of transportation systems to society, focus on related safety issues, technological assessment, communication skills and the application of quality tools.

It is our goal to provide the children of our state education of the highest quality. As this guide reflects our goal of continuous improvement, we encourage you to communicate to us ways to improve the material within this publication. Your suggestions will be appreciated.

Phillip J. Kirk, Jr.
Phillip J. Kirk, Jr.
Chairman, State Board of Education

Michael E. Ward
Mike Ward, State Superintendent
North Carolina Department of Public Instruction

ACKNOWLEDGMENTS

This guide is dedicated to Dr. Eddie Butler whose fine service to the students and teachers of North Carolina will always be felt.

The Division of Instructional and Accountability Services and the Technology Education staff wish to give special thanks to the individuals who spent many hours developing the Transportation Systems course. The process included a review of international literature, review of suggestions offered by teachers and administrators from throughout the state, and many hours spent in constructive debate and discussion.
Previous teams include the following people:

Dr. Eddie Butler	Assistant Professor, TE	ASU
Bob Calhoun	Technology Ed. Teacher	Ashe Co. Career Center
Aaron Clark	Doctoral Student, TE	NCSU
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Deborah Levin	Textile Engineering	NCSU
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The curriculum development team for the 1998 edition of Transportation Systems were the following individuals:

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Tom Shown	Technology Consultant	NCDPI
Linda Trogdon	Professional Staff	NCSU
Charleen Yount	Graduate Student	NCSU

Finally, we extend our thanks to the teachers, directors, and others who have taken their time to critique our progress and offer suggestion during this process. Our work is better for their effort.

Tom Shown	Consultant, Technology Education	NCDPI
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TABLE OF CONTENTS

Using the Curriculum Guide

Purpose

The **Transportation Systems Curriculum Guide** has been developed as a resource for teachers to use in planning and implementing a competency-based instructional management technology education program in their school. This guide is one tool used in the VoCATS process.

Description

Transportation Systems has been designed to be a one unit course (135-180 hours in length). The following description is from the North Carolina Vocational and Technical Education Programs of Studies and Support Services Guide:

CHECK THIS OUT
Students continue to build on their knowledge of transportation systems by experimenting with increasingly complex systems and concepts. Guidance, intermodal and urban transportation systems are explored. Students continue to seek solutions to problems through research and design, prototype development and experimentation.

General Instruction

This course may be taught using individualized (modular), whole class, or small team strategies or a combination of each. Regardless of which method is used, it is essential that the activities reflect the competencies and objectives of this course. If you choose to use commercial curriculum or modules to teach this course, please compare the curriculum content and student outcomes as outlined in this guide to the commercial curriculum. If there is not a great degree of curriculum congruency between the two, you should reconsider the purchasing of the commercial curriculum.

The course demands much from the student and teacher in terms of its complexity of materials and brevity of time in which the materials are to be mastered. Because of time limitations and the amount of material to be covered, one can not teach objectives as discrete units of instructions. Objectives must be taught concurrently within the larger context of activities. This allows for the efficient use of time as well as reflect good pedagogy.

Blueprint

The blueprint (See the Transportation Systems Blueprint on the following pages) lists the competencies the student is to attain. Competencies are mastered when a student masters the objectives which make up the competency.
Suggested time in hours is offered as a general rule-of-thumb for teachers to use in planning and not an absolute requirement. Course eight is the degree of importance given to each objective in relation to the entire course of study. This in turn will determine the number of test-items per objective on any test developed by the state department. For example, on a state pre/post 100 item assessment, a cognitive objective having a value of 10% with 10 test-items representing that objective.

Units of Instruction

The Units of Instruction section is designed to give the teacher detailed information directly correlated to the blueprint and test-item bank. It attempts to explain in more detail what information or behavior the student is expected to know or do. It lists the resource and page number on which more detailed can be found. This section has all the VoCATS multiple-choice and performance test-items (by objective) and offers the teacher suggested activities and strategies.

Each student is held accountable for the information found within units A through D. The information in the first four units is basic and prerequisite to Unit E in which the student designs and develops a model (or actual) transportation vehicle or model transportation system.

In Unit A, the student learns to appreciate the social, economic importance and environmental impacts of transportation systems. Each student or student team is required to complete a simple technological assessment on an aspect of transportation systems. Throughout the course students are expected to work well with others and apply appropriate teaming skills. Students are also expected to follow all safety rules and procedures.

In Unit B, students learn about scientific and technical terms and concepts directly related to transportation systems. Student design and perform experiments which may be used to help them in the design of their transportation vehicles and systems. A clear understanding of science and technical principles will enable a student to be more intelligent, deliberate and focused in their design and construction of their transportation model rather than design simple by trial and error.

In Unit C, each student develops an experiment related to a historical development within transportation. This may be done in conjunction with the exploration of the science and technical principles found in Unit B. Every student will also evaluate his or her personal interests and attributes with regards to transportation occupations.

Unit D contains fundamental terms and principles related to vehicular sub-systems. This information will help students in the design and evaluation of their vehicles by giving them a organizational structure for all vehicular and transportation support systems.

Unit E contains the culminating activities for the course and is the major unit receiving 48% of the course weight and time. Using all their accumulated knowledge of science and technical principles and concepts related to transportation systems, students design then build a transportation vehicles or system. Upon the completion of their project, students evaluate and present a report about their work.

<u>Bibliography/References (Appendix A)</u>

This section provides the texts' author(s), name of the texts, and publishers of the texts listed within the Units of Instruction "Resources" column.

<u>Vendor's Addresses for Texts, Literature, and Film (Appendix B)</u>

All texts, literature, software, and videos may be purchased through one of the resources listed.

<u>Equipment List (Appendix C)</u>

The equipment list gives the minimum number of tools, equipment, and software necessary for the instruction of Transportation Systems. If you have any questions regarding any aspect of this course, including equipment needs, please call one of your technology consultants.

<u>Design Brief (Appendix D)</u>

The purpose of a design brief is to help clarify and focus one's work. The design brief outline enclosed within this curriculum guide is to serve as a tool to help students identify, research, develop experiments, and design and execute models and/or prototypes.

Transportation Systems Curriculum Products Evaluation Form (Appendix E)

We sincerely want your thoughtful suggestions for improving the curriculum products. Please take 15 minutes to respond to us on ways to improve our work.

Transparencies (Appendix F)

Transparencies have been provided to assist the teacher during instruction.

Detailed Major Mode Activities (Appendix G)

For competency six, we have provided detailed activities for each of the four major modes of activities: land, water, air, and space. Teachers and students may use these activities to guide them in their design, development and evaluation of the major projects. Please feel free to modify as needed.

TECHNOLOGY EDUCATION
COURSE BLUEPRINT for 8126 TRANSPORTATION SYSTEMS
(Recommended Hours of Instruction: 135-180)

Summer 1998

Comp# Obj.#	Unit Titles / Competency and Objective Statements (The student will be able to:)	Time Hrs.	Cog	Perf	Type Behavior	Integrated Skill Area	Core Supp
1	2	3	4	5	6	7	8
	Transportation Systems Course		**38%**	**62%**			
A	**INTRODUCTION**						
001.	**Assess the role and importance of transportation systems to society.**	**6**	**3%**	**2%**	**C3P**	**SC | SS**	**Core**
001.01	Define transportation systems and explain their importance to society.	1	1%		C1	SC	Core
001.02	Identify and define the four major modes of transportation and their intermodal relationship.	1	1%		C1	SC	Core
001.03	Identify and define the six major transportation vehicular sub-systems.	1	1%		C1	SC	Core
001.04	Conduct and present a technology assessment on the impact of a transportation system or sub-system.	3		2%	C3P	SC | SS	Core
002.	**Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**	**6**	**3%**	**2%**	**C3P**	**C | H**	**Core**
002.01	Identify and explain management skills and quality tools.	1	2%		C1	C	Core
002.02	Apply management skills and quality tools effectively.	2		1%	C3P	C	Core
002.03	Explain classroom and laboratory safety rules and procedures.	1	1%		C1	C | H	Core
002.04	Apply classroom and laboratory safety rules and procedures appropriately.	2		1%	C3P	C | H	Core
B	**SCIENTIFIC AND TECHNICAL CONCEPTS AND PRINCIPLES**						
003.	**Define and apply scientific and technical concepts and principles used in the design of vehicular transportation systems.**	**23**	**12%**	**6%**	**C3P**	**SC**	**Core**
003.01	Define and explain scientific and technical concepts and principles related to the design of vehicular transportation systems.	12	10%		C1	SC	Core
003.02	Explain essential transportation design concepts.	1	2%		C1	SC	Core
003.03	Using a design brief, conduct, and evaluate lab experiments relating to scientific principles found within transportation systems.	10		6%	C3P	SC	Core

C	**HISTORICAL DEVELOPMENTS AND TRENDS**						
004.	**Analyze important historical developments and trends in transportation systems.**	**6**	**2%**	**4%**	**C3P**	**C | SC | SS**	**Core**
004.01	Organize and explain major developments in the evolution of transportation systems.	1	2%		C1	SC | SS	Core
004.02	Analyze the foundational technical developments of transportation systems.	4		2%	C3P	SC | SS	Core
004.03	Evaluate personal interests and attributes in relation to transportation occupations.	1		2%	C3P	C	Core
D	**VEHICULAR SYSTEMS AND SUB-SYSTEMS**						
005.	**Explain the fundamental concepts and principles of transportation vehicular sub-systems.**	**30**	**18%**		**C1**	**SC**	**Core**
005.01	Explain the fundamental concepts, principles and applications of transportation propulsion systems.	5	3%		C1	SC	Core
005.02	Explain the fundamental concepts, principles and applications of transportation guidance systems.	5	3%		C1	SC	Core
005.03	Explain the fundamental concepts, principles and applications of transportation control systems.	5	3%		C1	SC	Core
005.04	Explain the fundamental concepts, principles and applications of transportation suspension systems.	5	3%		C1	SC	Core
005.05	Explain the fundamental concepts, principles and applications of transportation structural systems.	5	3%		C1	SC	Core
005.06	Explain the fundamental concepts, principles and applications of transportation support systems.	5	3%		C1	SC	Core
E	**FABRICATION OF TRANSPORTATION VEHICLES**						
006.	**Design, produce and evaluate a transportation vehicle or system.**	**64**		**48%**	**C3P**	**SC**	**Core**
006.01	Design a transportation vehicle or system.	15		16%	C3P	SC	Core
006.02	Produce a transportation vehicle or system.	39		16%	C3P	SC	Core
006.03	Evaluate a transportation vehicle or system.	10		16%	C3P	SC	Core

UNIT A

INTRODUCTION

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **001.00: Assess the role and importance of transportation systems to society.**

OBJECTIVE: **001.01: Define transportation systems and explain their importance to society.**

OUTLINE	**RESOURCES**
Purpose: Essential definitions, purposes, and types of transportation are foundational elements in the study and understanding of transportation systems. It is important to establish these at the beginning to develop a common base of knowledge that will support subsequent learning.	
A. Discuss the major definitions of transportation systems:	
A system is a combination of parts working together for a common purpose or goal.	
Mention entropy, the inter-relationship of parts to the whole, natural vs. man-made systems.	
Transportation is defined as any technology that is used to move people and products within a society.	R2/3
There are three main purposes of transportation: for personal benefit, for commercial gain, for government service or defense.	
B. Advantages: Speed, people, product movement, general improvement of our lives.	R2/31:35
C. Disadvantages: Pollution, dangerous energy consumption	R2/31;35
1. Excess speeds is the primary cause of accidents	CG
2. Internal combustion engines produce carbon monoxide	CG

3. One half of all transportation energy is consumed by automobiles — R1/111
4. Transportation consumes the highest amount of controlled energy of the four basic systems — CG
5. Transportation consumes around 15% of average adults income — CG
6. Air pollution caused by transportation systems may change environment — CG
7. All land transportation systems consume large amounts of land — CG
8. Transportation systems consume 25% of all energy — R1/51
9. Transportation systems produce the most carbon monoxide of all industries — CG

D. Importance of transportation: five major reasons — R2/32
1. Economic
2. Tech. Interdependence
3. Improve life
4. Satisfy human needs
5. Solves problems (sewage)
6. Strategic Defense

E. Define and give examples of major related systems — R1/247; R2/30
1. Communication systems
    a. Radio, Radar, GPS and VOR communication systems
2. Manufacturing and maintenance systems
    a. Make and repair devices used in transportation systems
3. Structural systems
    a. Roads, bridges, tunnels, sea and air ports, space stations, etc.
4. Legal and governing systems

Activity

A. Purpose

Essential definitions, purposes, and types of transportation are foundational elements in the study and understanding of transportation systems. It is important to establish these at the beginning to develop a common base of knowledge that will support subsequent learning.

B. Activities

Using the provided overheads, review definitions and the importance of transportation to society. Use handout to look at impacts on the environment, society and the economy.

C. Problem

Students must understand relevant definitions of transportation as fundamental rules of all systems and sub-systems of transportation, using overheads and handouts to aid in this.

D. Materials and Equipment

1. Paper and pencils
2. Overheads and handouts

TEACHER INSTRUCTIONS:

1. Start by using resources to identify the major definitions of transportation as a system.

2. Go over the three main purposes of transportation which are: personal, commercial and government.

3. List advantages and disadvantages of transportation.

4. Why is transportation important-look at the five major reasons.

5. Give examples of the related systems of technology.

STUDENT INSTRUCTIONS:

You will be taking notes and using class discussion and lecture to facilitate learning the basics of transportation.

Other Suggest Activities:

-View James Burke's Connection Series stressing interconnections between all four systems.
-Have students complete Student Activities Manual Exercise "What is Transportation System" R-la.
-Have students list Inputs into a transportation system from the

Students Activities Manual R-la.
-Construct a Cause and Effect Diagram about a transportation area.

VoCATS QUESTIONS

FOR

OBJECTIVE

1.01

1. Transportation consumes:

A. 50% of the typical America's free time.

B. Less energy than the residential sector.

C. 5% of all the energy consumed in the United States.

D. 25% of all the energy consumed in the United States.

2. The cost of transportation makes a large economic impact on people's lives. What percentage of personal income do average American adults spend on transportation?

A. 9%

B. 15%

C. 28%

D. 42%

3. All land transportation systems (highway, rail, and pipeline) share one major environmental and economic impact:

A. Very high air pollution

B. High rates of fatal accidents

C. The consumption of large amounts of land

D. Noise pollution

4. Technology used to move people and products is one definition of:

A. Communication

B. Manufacturing

C. Structural Systems

D. Transportation

5. Out of all the energy used in transportation systems, over half is used by:

A. Railroads

B. Airplanes

C. Automobiles

D. Pipelines

6. Which of the following have caused the greatest increase in automobile accidents?

A. Foreign imports

B. Excess speeds

C. Vehicle system failures

D. Poorly maintained roads

7. Transportation systems produce more of this than any other industry.

A. Methane gas

B. Carbon dioxide

C. Carbon monoxide

D. Ozone

8. Generally, North Carolina's transportation systems:

A. Improve our quality of life

B. Make people poorer

C. Have little affect upon the environment

D. Are a very small portion of the state budget

9. An efficient transportation system contributes to which of the following?

A. Social needs

B. Economic needs

C. Strategic defense

D. All of the above

10. A combination of parts or sub-systems working together for a common purpose defines:

A. Transportation

B. System

C. Process

D. Knowledge

11. Transportation systems depend on the other systems of technology. Of the four systems of technology, which would not be integrated with transportation?

A. Communication systems

B. Manufacturing systems

C. Construction structural systems

D. Systems model

12. Entropy is a process of making something more random as a

result of some kind of human or naturally occurring interaction. Which of the following is/are the best example(s) of entropy in a transportation system?

A. Exhaust emitted from the tailpipe of a car

B. 25% of input energy in a gasoline engine is lost because of entropy

C. Thermal energy from transportation systems

D. All of the above

13. Transportation is best defined as:

A. Automobiles

B. Any technology that is used to move people and products within a society

C. A system that moves only people within a society

D. Oil flowing through a pipeline

14. Transportation systems do all of the following EXCEPT:

A. Improve the quality of life through greater choices

B. Satisfy human needs like the need for leisure

C. Provide Americans with 50% of all the jobs in the U.S.

D. Provide for strategic defense

15. Without the automobile, which of the following structures would NOT be needed in your community?

A. ATM machines

B. Local tire company

C. Filling station

D. All of the above

16. As a civilized society develops, its transportation system:

A. Changes the way in which people live

B. Decreases the interchange of ideas

C. Decreases the need for more possessions

D. Does not effect the society at all

17. One advantage of transportation is:

A. Pollution

B. Increased speed

C. Congested product movement

D. General lack of improvement in our lives

18. Which of the following is not an advantage of transportation?

A. Speed

B. People movement

C. Product movement

D. Uses up about 25% of fossil fuels

19. One disadvantage of transportation is:

A. The great number of accidents

B. Better national defense

C. Increased independence for people

D. Increased commercial gain

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **001.00: Assess the role and importance of transportation systems to society.**

OBJECTIVE: **001.02: Identify and define the four major modes of transportation and their intermodal relationship.**

OUTLINE	**RESOURCES**
Purpose: In order to understand a transportation system, the four modes and their intermodal relationship must first be understood.	
A. List and describe five types of transportation: land, water, air, space, and intermodal.	R1/7;9 R2/23; 24
1. Types of transportation	
2. Advantages and Disadvantages of transportation systems	
a. Water transportation is less expensive than truck or airplanes but is slow and therefore used mostly for freight	
3. Advantages and Disadvantages of each mode.	
a. Land	
-Some Advantages: automobiles are east to operate,affordable, and convenient.	R1/110
-Some Disadvantages: roadways for automobiles consume excessive amounts of land.	R1/108

-conventional land vehicles consume a large proportions of earth's fossil fuels. R1/108; R1/111
-fixed route vehicles are inconvenient compared to automobiles. Fixed route vehicles have only one degree of freedom. R/108; R/203

b. Water
-Some Advantages: generally does not pollute the environment compared to other modes. R1/134
-large amounts of bulk cargo are easy to move with large vessels. R1/134
-vessels are more safely powered with nuclear energy compared to other modes. R1/56
-Some Disadvantages: Should a vessel lose power or take on water, passengers are placed at risk. CG
-barges and tankers pose a risk for oil spills. CG

c. Air
-Some Advantages: aircraft generally travel faster than land and water vehicles. R2/112
-some aircraft offer three degrees of freedom. R1/203
-Some Disadvantages: far heavier than air vehicles, engine failure can be catastrophic. CG
-jet airplanes consume relatively high amounts of fuel.

d. Space
-Some Advantages: manned vehicles allow human travel in hostile environments. R1/150
-remote control is possible with manned and unmanned vehicles. CG
-supports global communication and transportation systems. CG
-allows for scientific and technical processes that would normally be impossible on earth. CG
-provides three degrees of freedom. R1/203
-Some Disadvantages: launch vehicles require large amounts of fuel to escape earth's gravity. R3/168
-weightlessness is inconvenient and uncomfortable R1/150
-for human travel, the vehicle must protect against pressure loss, radiation, temperature extremes, and it must include oxygen generators. R1/150

B. Define land transportation R1/107

1. Definition: Land Transportation refers to all methods of transport where the vehicles travel upon or are supported by the earth.

2. Three types of land transportation systems R2/24

EXAMPLES: Pipelines - most efficient for moving fluids, quiet, and have low theft rate CG
Car - most flexible
Order of most efficient (ton per mile) to lease-rail, truck, bus, car, plane CG
Trucks consume more energy than rail, pipelines CG

C. Define water transportation R1/55; R2/25

1. Definition: Transportation through and supported by water. R1/288
2. List three types of water transportation vehicles and the importance of each R1/55; R2/25
   a. Hovercrafts ride on a cushion on air R1/131
   b. Boats float on top of water
   c. Submarines travel under the water

D. Define air transportation R1/55; 37-42

1. Definition: Air transportation refers to a craft which operates in the earth's atmosphere R2/25; 27 R1/142

2. List three types of air transportation vehicles and the importance of each
   a. Vertical take-off by helicopter
   b. Lighter-than-air example is a (blimp, dirigible, or balloon) R2/27
   c. Helium is used to float dirigibles R1/138
   d. Dirigibles can lift heaviest loads R1/137
   e. Heavier-than-air example is a (airplane, glider, jet) R1/137

E. Define space transportation

1. Definition: Space transportation is the use of rockets and orbiting vehicles to explore the regions beyond the limits of the R1/125; R1/56 147-155

atmosphere.

2. List two types of space transportation vehicles and the importance of each. R2/27

Examples: Unmanned and manned

F. Intermodal R1/159

1. Definition R1/82
   a. Intermodal is the use of more than one mode of transportation
   b. Requires a great deal of planning and coordination
2. List two examples of the use of intermodal transportation R1/161

   Examples: Movement of goods such as produce (use of trucks, conveyors, and ships)
   Movement of people in cities (mass transportation, elevators, and escalators)
   a. TOFC stands for "Truck on Flat Car"
   b. COFC stands for "Container on Flat Car" R1/161

Activities:

A. Purpose

In order to understand a transportation system, the four modes and their intermodal relationship must first be understood.

B. Activities

1. Demonstrate intermodal relationships, and services to identify all modes that might be used to transport them.

2. Working as team members, use SimCity 2000 simulation software to look at the effects city size and city lives have on a mode of transportation over a given period of time.

C. Problem

Students will look at the transportation modes involved in different cargos and services as well as work in teams using simulation software to evaluate effects of city size and lives.

D. Materials and Equipment

1. Pencil and paper

2. SimCity software

TEACHER INSTRUCTIONS:

Use the appropriate overhead response sheet to elaborate on what the point of view of the engineer is and the citizen effected is.

STUDENT INSTRUCTIONS:

1. List the cargos and services of various items and determine the modes each has to go through to reach its destination.

2. Use SimCity 2000 software to look at the effects city size and lives have on a mode over a certain period of time using the overhead.

Other Suggested Activities:

Look at inland and ocean; what goods do you ship inland and what ones to via ocean?

Explain the difference between Lighter-than-air and Heavier-than-air. Balloons, airships vs. passenger planes, cargo planes, military planes.

Explain unmanned vs. manned space transportation. Missiles, satellites, space probes vs. vehicular units, shuttle units.

Intermodal cargo transportation vs. intermodal passenger transportation. Go over the "grain" example in R1/160, for cargo and plan a family vacation overseas for passenger.

Look at random route, fixed route, vehicular systems, stationary systems; What types of transportation technologies do each of these categories permit? For example, random route can be bicycle, bus, car, truck, van.R2.24.

From the Student Activities Manual for R-la, do the following activities:

Water Transportation
Air Transportation
Space Transportation
Land Transportation
Intermodal Transportation System

Layout cities and their transportation systems to scale.

Show transportation of goods and services through the use of intermodal systems.

Layout pipelines showing the transportation of materials.

Interrelationship between modes: Look at the following cargoes and services to identify all modes that might be used to transport them.

Cargos and Services	Transportation Mode(s) involved
.Dairy products	
.Produce	
.Clothing	
.Construction materials	
.printed materials	
.mail	
.radio/T.V.	
.Raw materials	
.Gasoline	
.Tourists	

Work as members of a team. Use SimCity 2000 simulation software to look at the effects city size and city lives have on a mode of transportation (could be a part of your major transportation project) over a given period of time. An overhead is provided for this.

VoCATS QUESTIONS

FOR

OBJECTIVE 1.02

1. An example of intermodal transportation is the movement of:

A. Oil through a pipeline

B. Airfreight

C. People on trains and escalators

D. Cyclists

2. A water vessel that rides on a cushion of air is a:

A. Hydrofoil

B. Hovercraft

C. Jet ski

D. Gunwale

3. Freight, transported to a harbor by rail, is taken by boat to another destination. This product movement is an example of:

A. Interim transportation

B. Multi-method transportation

C. Intermodal transportation

D. Intracoastal transportation

4. At the present usage rates, which of the following methods of transporting freight consumes as much energy as all of the other three combined?

A. Pipeline

B. Railroad

C. Waterway

D. Truck

5. In air transportation, an example of a vertical take-off vehicle is a:

A. Helicopter

B. Rocket

C. Glider

D. Piper Cub

6. A dirigible is a rigid lighter-than-air vehicle kept afloat by:

A. Hot air

B. Propane

C. Nitrogen

D. Helium

7. Low noise output, low theft rate, and no traffic congestion are special advantages of:

A. Highway trucking systems

B. Pipeline systems

C. Railroad systems

D. Intercostal waterways

8. The type of transportation that operates in the earth's atmosphere is:

A. Air transportation

B. Space transportation

C. Suspension transportation

D. Take-off transportation

9. Because of its cost effectiveness and relative slowness, most water transportation business involves the movement of:

A. People

B. Coal

C. Freight

D. None of the above

10. An example of a heavier-than-air craft is a:

A. Glider

B. Balloon

C. Dirigible

D. Blimp

11. The aircraft which can lift and transport the heaviest loads is a:

A. Dirigible

B. Helicopter

C. Hovercraft

D. Commercial plane

12. When compared to commuter trains, the private automobile has the following advantage:

A. Reduced pollution

B. Reduced traffic congestion

C. Increased flexibility

D. Reduced accidents

13. Which of the following is a disadvantage of shipping cargo by water?

A. Slow travel

B. More expensive

C. High theft rate

D. All of the above

14. Which of the following is an advantage of shipping cargo by water?

A. Relatively low cost

B. Ability to move large volumes and bulky materials

C. Movement between continents

D. All of the above

15. Ability to carry large and heavy loads at a low cost per mile and low pollution are special advantages of:

A. Highway trucking systems

B. Railroad systems

C. Air freight systems

D. Hovercraft

16. One mode of lighter-than-air transportation is:

A. Hydrofoils

B. Hovercrafts

C. Airfoils

D. Dirigibles

17. You are in charge of creating a transportation system for moving water from a lake to the city. Which of the following would probably be the most efficient means of moving the water?

A. Truck

B. Train

C. Buses

D. Pipeline

18. Intermodal transportation requires a significant amount of:

A. Time and money

B. Planning and coordination

C. Goods and services

D. Advertising

19. You have a very large cargo to transport from Raleigh, NC to Atlanta, Ga. Which of the following modes of transportation will be the most efficient?

A. Car

B. Bus

C. Airplane

D. Railroad

20. Air transportation refers to a craft which operates in the earth's atmosphere. It is divided into two categories, one of which is lighter-than-air, the other is:

A. Balloons

B. Heavier-than air

C. Military planes

D. Space transportation

21. A good example of an air transportation vehicle is:

A. Missile

B. Satellite

C. Cargo plane

D. Shuttle

22. Space transportation is divided into manned and unmanned; an example of manned is:

A. Missiles

B. Space probes

C. Vehicular units

D. Deep space probes

23. Which of these is NOT a good example of intermodal transportation?

A. Is the use of more than one mode of transportation

B. Requires a great deal planning and coordination

C. Relies on the use of a single mode of transportation

D. Movement of goods such as produce

24. Which of the following are NOT methods of intermodal transportation?

A. Walking

B. COFC

C. TOFC

D. Shipping container-ships

COURSE: Transportation Systems

UNIT A: **Introduction**

COMPETENCY: **001.00: Assess the role and importance of transportation systems to society.**

OBJECTIVE: **001.03: Identify and define the six major transportation vehicular sub-systems.**

OUTLINE	RESOURCES

Purpose: In order to design, produce, and evaluate a vehicular sub-system, the student must first understand its basic elements (sub-systems).

A. Define vehicular systems: A vehicular system is a collection of separate systems (or subsystems) that allow the vehicle or machine to move through its environment.

B. Define vehicular propulsion systems: The vehicle's propulsion system are those parts of the vehicle which enable a system to move. — R1/173; R2/28; R1/286; R1/165
Examples: sails, jet engines, electric motors

C. Define vehicular guidance systems: Guidance systems are those parts of the vehicle which provide information required by a vehicle to follow a particular path or perform certain operations. — R1/284
Examples: compasses, maps, road signs

D. Define vehicular control systems: Control systems are the parts of vehicles that are used to change a vehicle's direction and/or speed. — R1/203; R/29
Examples: gas pedal, rudders, steering wheels

E. Define vehicular suspension systems: Suspension systems are the parts of vehicles that support, and/or suspend the vehicle in its environment. — R1/219; R2/29-30; R1/219; 1/168
Examples: Helicopter rotors, springs of cars, airplane wings, boat hulls, electro-magnetic fields (Maglev vehicles)

F. Define vehicular structural systems: Structural systems are the parts of a vehicle that hold other vehicular systems and the loads they will carry. Examples: car frame and body, fuselage, boat hulls R1/233; R2/30

G. Define vehicular support system: Support systems are those external operations that maintain transportation systems. These include maintenance, life support, economic, and legal support systems. Examples: airport, trainstation, and gas station R1/169; 247

Activities:

A. Purpose

In order to design, produce, and evaluate a vehicular subsystem, the student must first understand its basic elements.

B. Activities

1. Define and explain the six vehicular sub-subsystems.

2. Have students identify vehicular sub-systems of various transportation vehicles.

C. Problem

The six major sub-systems of a vehicle must be understood.

D. Materials and Equipment

Paper and pencils

TEACHER INSTRUCTIONS:

Thoroughly go over the six vehicular systems.

STUDENT INSTRUCTIONS:

You will be able to define the six major systems of a vehicle.

Other Suggested Activities:

Define and explain the six vehicular sub-systems (see Transparencies). Have students identify vehicular sub-systems of various transportation vehicles.

Secure a picture of a vehicle and draw arrows to its
-Supplement overhead transparencies through students developing physical models.
-Review Student Activities Manual Section 5 from R-la.

-Supplement overhead transparencies through students developing physical models.
-Review Student Activities Manual Section 5 from R-la.

Go over internal combustion engines as main source of personnel travel.

Hide something in the school yard and give azimuth reading and a compass to find its proper location.

Design the most effective braking device for a mouse-trap powered car.

Build various wing shapes for a plane or hull designs for a boat, and if possible, wind-tunnel test these ideas out.

Develop CAD drawings of the cross-sections of various model vehicles.

Pick a mode of transportation and come up with as many support systems as you can for that mode.

VoCATS QUESTIONS

FOR

OBJECTIVE 1.03

1. Sails, jet engines, and electric motors are examples of:

A. Propulsion systems

B. Guidance systems

C. Control systems

D. Suspension system

2. The parts of a vehicle that hold the things to be carried and the rest of the vehicle's systems are called its:

A. Suspension system

B. Control system

C. Structural system

D. Storage system

3. The parts of a vehicle that support the vehicle in its environment (such as the wings on an airplane) are called the:

A. Control system

B. Suspension system

C. Guidance system

D. Conversion system

4. Stabilizer bars, springs, and tires are all part of a car's:

A. Control system

B. Guidance system

C. Suspension system

D. Conversion system

5. The parts of a vehicle that are used to change a vehicle's direction and speed are part of the vehicle's:

A. Propulsion system

B. Suspension system

C. Guidance system

D. Control system

6. The system of a vehicle, that converts energy to produce power, that moves the vehicle is called its:

A. Control system

B. Suspension system

C. Conversion system

D. Propulsion system

7. No transportation vehicle could move without a source of:

A. Compression

B. Combustion

C. Traction

D. Propulsion

8. A car's body is an example of a:

A. Suspension system

B. Control system

C. Storage system

D. Structural system

9. Engines, magnetic levitation and nuclear energy are used in which system?

A. Propulsion system

B. Combustion system

C. Exhaustion system

D. Conversion system

10. Information required by a vehicle to follow a particular path or to perform a certain task is provided by a/an:

A. Coordinate

B. Operator manual

C. Guidance system

D. Control system

11. While riding her bicycle to the store, Gina sees a sign indicating road construction ahead. The sign is an example of which system?

A. Propulsion system

B. Suspension system

C. Guidance system

D. Control system

12. Examples of propulsion systems can be all of the following except:

A. Sails

B. Wheels

C. Jet engines

D. Electric motors

13. An example of a guidance system is a:

A. Compass

B. Boat hull

C. Car frame and body

D. Fuselage

14. Vehicular control systems allow direction and/or speed changes; which of the following best relates to control systems?

A. An aircraft fuselage

B. Degrees of freedom

C. External operations that support transportation systems

D. A navigator

15. Vehicular structural systems are an important sub-system; which analogy best finishes the statement: a fuselage is to an airplane as a/an:

A. Hull is to a boat

B. A tire is to a car

C. Engine is to gasoline

D. Steering wheel is to a bike

16. Vehicular support systems are crucial in the areas of:

A. Maintenance

B. Life support

C. Legal support

D. All of the above

17. The conversion and transmission of energy is the function of what vehicular subsystem?

A. Control

B. Guidance

C. Suspension

D. Propulsion

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **001.00: Assess the role and importance of transportation systems to society.**

OBJECTIVE: **001.04: Conduct and present a technology assessment on the impact of a transportation system or subsystem.**

OUTLINE	RESOURCES

A. Purpose

In order to make wise decisions, each citizen must have a basic understanding of the impacts transportation systems (and subsystems) place upon society, the economy, and the environment as well as a basic understanding of the technology assessment process. These two activities will help students develop both of the above skills.

B. Activities

Technology Assessment Questionnaire (Interview)
Technology Assessment Activity

C. Problem

Students will perform one or both of the following activities focusing on the impacts of transportation systems (or subsystems) upon society, the economy, and the environment. You may substitute one or both of the activities for another technology assessment activity related to transportation systems.

D. Materials and Equipment

1. Paper and pencils

2. Tape recorders and/or camcorders may also be used in the interviewing process.

THE INTERVIEW

Teacher Instructions:

Before starting either activity, review the concepts and principles of technology assessment as found in the **Fundamentals of Technology** curriculum.

The first suggested activity requires the student to interview (see Interview Form -1) an older member of their family or an older friend of the family. The interview will focus on transportation systems or subsystem (car, planes, roads, transmission system) from a historical perspective. The interview should help the student gain a better, more complete, complex, and intimate understanding of how changes in transportation technology has effected individuals and society. Upon completion of the interview, the student is required to give a five minute presentation sharing his or her insights with their class.

1. Review with the students the concepts and principles of technology assessment and interviewing etiquette. If a tape-recorder is to be used, the student should first ask for the interviewee's permission.

2. Provide the students with copies of the questionnaire.

3. Review with the students the Interview Form - 1.

4. Explain precisely what is expected of each student in performing the questionnaire and how much time will be allotted to complete the task.

5. Explain the criteria you will be using for assessing the questionnaire activity.

6. Have the students present their findings to a small group or the entire class.

7. You may use the following criteria for assessing the questionnaire activity.

Student Instructions:

1. You will be interviewing family members or others about the ways different transportation technologies impacted their lives. The purpose of this activity is to give you a deeper appreciation of how technology influences the way people live and how it has changed over the years.

2. Make sure you understand your teacher's instructions, knowing exactly what is expected of you, how much time you will be allotted, and how your project will be assessed.

3. Using the questionnaire provided by your teacher, interview the individual(s) you have selected.

4. Upon completion of the interview(s), write a summary of the information you have gathered. You may be asked to share this information with a small group or the entire class.

5. Your project will be assessed using the following criteria.

Evaluation

Interview (Thorough and interesting)	0-40 points

Summary (Clear, comprehensive, insightful and interesting)	0-40 points
Report (Clear, comprehensive, insightful and interesting)	0-20 points
Total Possible Points	100

QUESTIONNAIRE

Use this questionnaire as a guide for your interview. Explain to the person you are interviewing that the purpose of the interview is to help you better understand how transportation technology has changed over the years and how transportation technology effects our lives. If you plan to use a tape-recorder or camcorder, first ask for the permission of the person you will be interviewing.

Upon completion of the interview, write a brief summary of what you have learned.

Complete the following: Interviewer:____________________

Date: ____________________

1) Name of person being interviewed:______________________________

2) City of Residence:____

3) Relationship to Interviewer:____________ 4)Date of Birth________

5) Place of Birth:____

6) Residence(s) as a child:______________________________________

7) What are your first recollections of cars and how did they influence your life?

8) What are your first recollections of trains and how did they influence your life?

9) What are your first recollections of planes and how did they influence your life?

10) Do you recall getting your first car (or other "first" experience such as first plane ride). Please describe it.

11) What is the most valuable aspect of transportation systems to you personally and why? (Example: My car because I need it to travel to work).

12) What do you think are the most positive impacts of our modern transportation systems?

13) What do you think are the most negative impacts of our modern transportation systems?

14) Finally, do you have any other memories or insights related to transportation that you would like to share?

TECHNOLOGY ASSESSMENT

Teacher Instructions:

The second suggested activity requires student teams to weight the consequences a transportation system or subsystem could have upon society, the economy, and the environment (such as a highway through wood lands or an urban community, or the impacts of any one of the vehicular systems (automobiles, trains, planes, ships). Teams will identify and define transportation systems impacts then research the major issues involved. Teams will divide to support or define their findings and finally present their findings to the rest of their class.

1. Review with the students the concepts and principles of technology assessment.

2. Divide the class into teams of 6 to 10 students each.

3. Choose or permit the teams to choose (using brainstorming and nominal group technique) a technology impact issue related to transportation. See above examples. Students should 1)identify a problem, and 2)define the problem.
4. Divide each team into two groups, one to oppose the implementation of a proposed (or already implemented transportation system project, the other to support the project).
5. Provide sufficient time for student research and teaming.
6. Have each team present their arguments, pro and con, to the entire class regarding the implementation of the transportation technology.
7. Provide time for the rest of the class to offer their insights on the issues as well as their opinions to the strengths and weaknesses of the presenting team's arguments.
8. Briefly review what is expected of each student, how much time they will be given to complete the task, and how they will be evaluated.
9. You may use the following criteria for assessing this activity.

Student Instructions:

You will perform a technology assessment on a transportation systems or subsystems. You will identify and define for study an aspect of transportation technology for the purpose of identifying positive and negative impacts of the technology in question upon society, the economy, and the environment. You will work as a member of a team. Examples of possible studies include:

The effect automobile emissions have upon the health of people and the environment of a city.

The effect boat gasoline engines upon the health of lakes or ponds.

The effect of major highways through a community.

1. Review the concepts and principles of technology assessment.
2. Ask your teacher to clarify any questions you have about technology assessment or your assignment.
3. Working with a team, identify an aspect of transportation technology which impacts upon our society, the economy, and the environment.
   Note: You may wish to use Brainstorming to help identify the above as well as the Nominal Group Technique to help you agree upon the focus of your team's study.
4. Using available resources, research the positive and negative impacts that the technology in question has upon society, the economy, and environment. You are encouraged to use Force Field Analysis and Cause and Effect Diagram quality tools in this process. You may choose some on economic impacts, and so on). Your teacher may have explicit instructions regarding how the team is divided.
5. Once sufficient information has been gathered, prepare a typed written report, explaining the positive and

   negative impacts of the transportation technology in question on our society, economy and environment. The report should have a summary which offers a conclusion as to the overall positive or negative impacts this technology has upon these three areas as well as suggesting the acceptance, rejection, or change of the technology in question.
6. Present your findings to other groups or the entire

class.

7. You will be assessed using the following criteria.

Evaluation

Problem identification and statement (Clear, appropriate, reasonable)	0-15 points
Research (Thorough, effective, documented)	0-30 points
Report (Clear, comprehensive, well written. Arguments are well supported and convincing)	0-40 points
Group/Class Presentation (Clear, well organized, interesting well argued)	0-15 points
Total Possible Points	100

Other Suggested Activities:

-Have Students complete the "An Historic Land Transportation Vehicle" for the Student Activities Manual R-la.

-Have students develop a multimedia presentation on their assessment.

VoCATS QUESTIONS

FOR

OBJECTIVE 1.04

INSTRUCTIONS TO THE STUDENT: Use the following instructions and the form provided by your teacher to conduct a technology assessment questionnaire:

(1). You will be interviewing family members or others about the ways different transportation technologies impacted their lives. The purpose of this activity is to give you a deeper appreciation of how technology influences the way people live and how it has changed over the years.

(2). Make sure you understand your teacher's instructions, knowing exactly what is expected of you, how much time you will be allotted, and how your project will be assessed.

(3). Using the questionnaire provided by your teacher, interview the individual(s) you have selected.

(4). Upon completion of the interview(s), write a summary of the information you have gathered. You may be asked to share this information with a small group or the entire class.

INSTRUCTIONS TO THE STUDENT: Perform a technology assessment on a transportation system or subsystem. Identify positive and negative impacts of the technology in question upon society, the economy, and the environment.

You will perform a technology assessment on a transportation system or subsystem. You will identify and define for study an aspect of transportation technology for the purpose of identifying positive and negative impacts of the technology in question upon society, the economy, and the environment. You will work as a member of a team. Examples of possible studies include.:

The effective automobile emissions have upon the health of people and the environment of a city.

The effect boat gasoline engines have upon the health of lakes and ponds.

The effect of major highways through a community.

1. Review the concepts and principles of technology assessment.
2. Ask your teacher to clarify any questions you have about technology assessment or your assignment.
3. Working with a team, identify an aspect of transportation technology which impacts upon our society, the economy, and the environment. NOTE: You may wish to use Brainstorming to help identify the above as well as the Nominal Group Technique to help you agree upon the focus of your team's study.
4. Using available resources, research the positive and negative impacts that the technology in question has upon society, the economy, and environment. You are encouraged to use Force Field Analysis and Cause and Effect Diagram quality tools in this process. You may choose to divide the team up to accomplish different tasks (some focus on the societal impacts,some on economic impacts, and so on). Your teacher may have explicit instructions regarding how the team is divided.
5. Once sufficient information has been gathered, prepare a typed written report, explaining the positive and negative impacts of the transportation technology in question on our society, economy and environment. The report should have a summary which offers a conclusion as to the overall positive or negative impacts this technology has upon these three areas as well as suggesting the acceptance, rejection, or change of the technology in question.
6. Present your findings to other groups or the entire class.

COURSE: Transportation System

UNIT A: Introduction

COMPETENCY: 002.00: Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.

OBJECTIVE: 002.01: Identify and explain management skills and quality tools.

OUTLINE	RESOURCES

Purpose: The SCANS report stressed the need for all workers to have problem solving skills. A methodical, well thought out process increases the likelihood of success in the solving of problems. These problem solving skills should be used throughout the course in the many activities the students will be engaged. Insist that students master the DEAL method and grow in their ability to manage the DEAL and other appropriate problem solving strategies.

A. List and explain the steps of the DEAL Problem Solving Method — CG

1. Define
2. Explore
3. Act
4. Look

B. Management provides the vision, guidance, and direction for the activity to be solved. — CG

1. Planning-setting goals for company and course of action to implement goals.
2. Organizing-involves structuring the company to meet the planning goals by establishing a plan of work.
3. Implementing-involves initiating the work related to an action plan, this causes plans to take form. Products and structures are built and services provided.
4. Controlling-compares results against the plan of work. Ensures that resources are used properly and outputs meet stated standards.

C. Quality Tools — CG

1. Brainstorming — CG
2. Nominal Group Technique — CG
3. Fishbone Diagram (Cause and Effect) — CG
4. General Team Guidelines — CG
5. Concept Mapping — CG

TOOLS OF PROBLEM SOLVING

Defining the Problem

Central to the process of problem solving is to first identify what is to be solved. On the surface this may appear to be simple, but it requires careful observation and a critical eye. Taking time to find the root of the problem is extremely important so that the ultimate solution works. Sometimes as a part of identifying a problem we do what is know as faultfinding. **Faultfinding** is the **process of looking for the cause of a malfunction**. If a car will not start, we might look at the electrical system and the fuel system. After a problem has been identified it is necessary to detail exactly what you are going to do. This is typically done by framing what is called a **design brief**. A design brief is **a statement that describes both what must be done and what will be accomplished.**

Once we frame the problem, we must analyze what we know and what we need to know to successfully solve the problem. This is done by **questioning**. For example, if you were asked to fix a bicycle it would be necessary to know how a bicycle works, what the individual parts do, what tools will be needed to fix the bicycle, are the parts readily available and maybe how much money is available. Typically, when you first analyze a problem you are concerned with time, materials and cost -- time it will take to produce the product as well as time to learn what we need to know to successfully solve the problem, material availability and cost of materials.

The next step is to **analyze the variables** that are associated with the problem. What parts of the problem can we change? How are the individual parts interrelated? What might happen when we change one or more of the variables?

REFER TO HANDOUT

Concept Mapping

Variables Worksheet

Exploring Alternatives

It is not difficult to see that the more choices you have, the better the chance is that one of the choices will be a good one. Generating alternative solutions to a problem is a key stage. Generating alternatives takes creative thinking. But, without training and practice, creative thinking does not come easily for most people. This is because for most of our education experiences and decision-making situations, we were taught to look for "right answers" to our problems. We are also taught that not being "right" means failure. In creative thinking we are taught that there are no "right" or "wrong" answers - only answers.

There are some tools that can help you to think creatively. They include **analogies, brainstorming, synectics, sketching and doodling, and giving yourself an incubation period.**

An analogy is a similarity between two unlike thing. In problem solving, using analogies can be very helpful especially when you are dealing with new information. For example, the concept of binary code could be confusing for some people, but if you consider that the 1's and 0's that make up binary code are like "on/off" switches that a computer looks for to stop and stop operations it makes the concept easier to understand. Sometime you can even see similarities between your problem and problems that have occurred in the past.

Brainstorming (refer to TQM)

Synectics is a technique used to view a problem from all possible perspectives. The goal is to make the "familiar strange and the strange familiar". A common technique is to put yourself in the place of the product designed to solve the problem by asking "Who affects me and who do I affect?". This may sound bizarre, but it is an effective strategy for thinking about a problem creatively.

Sketching and Doodling is an effective technique because you can instantly show a person possible solutions without having to explain. Written and spoken language can become confusing. Sketching is the universal language of designers.

Lastly, give yourself time for **incubation**. The mind is always working, even when you are not consciously thinking about a problem. Sometimes you can arrive at good solutions if you just step back from the problem and give your mind a rest or time to "incubate" all of the information associated with the problem. You may have heard people say that they think best while they are jogging or driving home. This is because they have given themselves time for incubation.

Acting on the Best Solution

After exploring all of the possible solutions, it is time to choose what you feel will be the best solution. But how do you determine which is best. In industry, when a team of designers are brainstorming a solution to a problem and have generated a number of possible solutions, they use a method called **weighting**. **Weighting is a process of voting by attaching a level of importance**

to a possible solution. When this is done you consider the pros and cons of each solution and decide which is the best given time, materials and cost.

Once you have weighed all the possible solutions and decide on one you create a **model prototype or mock-up** of the solution. **A prototype is a full-size working model of a product. It looks and works exactly like the product that will be produced**. It is made from the materials that the company plans to use in the final product. <u>The purpose of the proto-type is to test the product further before it is produced for sale.</u> **A mock-up is a model of a product that usually does not work**. The <u>purpose of the mock-up is to provide designers with a three-dimensional view of the product.</u>

<u>Look Back and Evaluate</u>

When modeling and prototyping is completed, the testing and evaluation of the design solution begins. This may be as simple as **applying the specifications** to the end product to see if it does all the things that it is supposed to. But more often it is **performance testing**, as in the case of a practical device. This can be accomplished with **surveys, checklists, and criterion rating.**

TQM TOOLS

Brainstorming:

<u>Purpose/definition:</u>

A "quality" tool designed to help a group generate as many creative ideas and solutions in a short period of time as possible. Process is free of criticism and judgment. Brainstorming encourages the creation of new ideas and helps people escape the "same old way of doing things." It also helps in getting everyone to participate and lessens the tendency of one or two people to dominate the process. It helps group members build on each other's ideas and insights while focusing on a given problem.

<u>Methods of Brainstorming:</u>

Two common methods of brainstorming are structured and unstructured. In structured brainstorming each individual offers an idea in turn. In unstructured brainstorming, team members offer the ideas as they are thought of. Ideas can be said aloud or written on paper (or computer) for all to see.

Process (Structured Method):

1- Identify central question or problem. Make sure everyone knows and agrees with this.
2- Each member share and idea -- criticism is not permitted.
3- Ideas are written down for all to see. Make sure person sharing idea agrees with way it is written by recorder.
4- Keep generating ideas until no more ideas can be generated (generally no longer than 15-20 minutes).
5- Review the ideas making sure each is clear and understood by team members. Combine duplicates.

Note - The Structured Method is applied similarly except that a team member can offer an idea as soon as he or she thinks of it instead of waiting for their turn.

TQM TOOLS

Nominal Group Technique (NGT)

Purpose/definition

The NGT helps a team reach consensus on the issue(s) they are dealing with. It allows each member to rate (give relative value) to the issues, problems or solutions that are being discussed. This is done by each member assigning a number (the highest number given to what is considered most important) to each of the suggestions given. The advantage of this technique is that it makes it more likely that everyone participates, lessens the dominance of some individuals over others, and helps the team clarify and focus on the major issues.

Process

1- Generate a list of ideas, problems, or solutions to be prioritized. Note - written brainstorming method works well using "post-it notes" which can then be posted on a large pad or white board for all to see.

2- Eliminate and combine similar or duplicate ideas and clarify if needed.
3- Give each idea a letter (A,B,C...)
4- Have each team member assign a number (value) of importance to each of the ideas. For example, with five ideas, a member would assign a 5 to the idea she thought best, 4 to the next best solution, and so on. If there are many ideas offered (10 or more) the team may wish to rank order only part of them.
5- Once each member has assigned a value to the items, the facilitator will add the values given for each idea and write down the total points given. The idea(s), solution(s), or problem(s) deemed most important to the group is acted upon.

TQM TOOLS

Cause and Effect Diagram

Purpose/definition

The Cause and Effect Diagram is a graphic tool which is used to analyze possible causes of a problem. It helps focus and clarify the root causes of a problem rather than symptoms, thereby helping the team determine what needs to be done to remedy the situation.

Process (Dispersion Analysis Type)

1- Clearly state the problem (example: Poor Technology Facilities).

2- List the major causal factors for the problem. This may be done using brainstorming and gathering information through surveys.
3- Under each major causal factor, write the reasons for the major cause (for instance: the causes for inadequate funding may be lack of county resources, or the program is not valued by the community or the students or all these and more.
4- Once the team has reached consensus on the causes of the problem, apply the needed quality tools for solving the problem.

TQM TOOLS

GENERAL TEAM GUIDELINES

Purpose/definition:

In group work, it is necessary for the team to function effectively in order to achieve its goals. To function effectively:

1. Each member must display good teaming skills such as treating other members with respect, knowing the rules and how to use appropriate decision-making tools. Each member should have good communication skills also.
2. The team must have a well-defined purpose.
3. Use appropriate "quality tools" to help understand and accomplish the goal(s) it has identified.
4. The team must have measures on which to judge its progress.

Process:

1. First the team must agree to the rules under which they will operate and what is expected from each member. Encourage everyone's participation. Insist everyone behaves in a fair, respectful manner to each other.
2. Determine how decisions will be made (by a simple majority vote, consensus, or using a formal structure such as Robert's Rules of Order). Note these may vary depending upon the activity (brainstorming, NGT "Nominal Group Technique").
3. Each is expected to communicate well (strive to understand as much as to be understood).
4. Determine the leader's and members' roles (who is to do what).
5. Clearly identify as precisely as possible the team's goal(s). Write these goals out so everyone knows exactly what is to be accomplished.
6. Determine what the measures of success are to be (model developed, money raised, membership increased by 25%). Develop a time line for when each sub-activity and the complete project will be completed (see Activity Network Diagram and Gnatt Charts).

7. Use the DEAL Program Solving Method to define the problem, explore to gather as much information as possible and to develop solutions, act on your solutions, and look back and assess your work.
8. Whenever possible use data to determine your outcomes.

Identifying Variables
Concept Mapping

Below, identify all of the variables that are part of the problem. Use a **concept map** to help identify the variables. **A concept map is a graphic representation of the variables associated with a problem and how they relate to each other**. After completing the concept map, fill out the Variables Table. The Variables Table is designed to help predict what might happen when you change one or more of the variables.

Generating a concept map in not difficult, but, as you begin to put ideas down in detail, it takes time and thought. You begin with a word that would represent the topic of the problem. Be careful not to choose a word that will narrow your focus too quickly.

In the example above, the problem is "getting ready for school". "Clothes, school stuff, waking and breakfast" are variables associated with "getting ready for school". The variables associated with "getting ready for school" each have their own variables associated with them. This could go even further by identifying more related variables. The key to this exercise is realizing how one individual variable can affect the greater problem. When you understand this you can begin to predict what might happen when you change one of the variables. For example, if you get to be late, that will affect how or when you wake-up, which may impact the amount of time you have for breakfast.

Identifying Variables
Worksheet

Below, identify the variables listed in your concept map. List **how** each variable can be changed. Lastly, predict what may occur if that variable is changed the way you have outlined.

Variable	How it can be changed	Predicted result of the change

Activities:

A. Purpose

The SCANS report stressed the need for all workers to have problem-solving skills. A methodical, well thought out process increases the likelihood of success in the solving of problems.

B. Activities

Explanation of definition, purpose, and process. Use DEAL problem solver.

C. Problem

Students will understand methods of group management skills. Using DEAL, the class will explore ways to make a car go thirty miles per hour, in theory.

D. Materials and Equipment

1. Paper and pencil
2. DEAL handout sheets
3. Post-it note pads
4. Markers
5. Large chart paper

TEACHER INSTRUCTIONS

Explain the major management skills of the quality tools. Pass out DEAL sheets to every student and explain to them that the problem will be to make a car go thirty miles per hour.

STUDENT INSTRUCTIONS

1. You will take notes over the different quality tools.
2. You will use DEAL to solve the above problem.

Other Suggested Activities:

-Develop a group activity such as a production-line assembly to mass produce rockets, and implement the management processes of: planning, organizing, implementing, and controlling.

-Use Nominal Group Technique to address an issue (problem). For example, your company has just gotten the bid on a highway through a residential area possible negative effects on property owners are: lower property values, excessive noise, loss of tress and natural wildlife. Each group member (property owner) will have to assign a value of importance to these to see what is the most important problem to be solved by lawyers representing their interests.

-Apply quality tools in the operation of a TSA chapter.

-Incorporate quality tools in all group activities.

VoCATS QUESTIONS

FOR

OBJECTIVE 2.01

1. If you were working with a team which wanted to generate as many creative ideas and solutions to a problem as quickly as possible, which of the following "quality tools" would you suggest the team use?

A. Brainstorming

B. Cause and effect diagram

C. Gantt Chart

D. Analytical Criteria Method

2. Which of the following is NOT characteristic of Brainstorming?

A. Free of criticism and judgement

B. Increases the likelihood of one or two people to dominate a group

C. Helps members build on other team members ideas

D. Generated many ideas in a short time

3. Which of the following would come first in Brainstorming?

A. Generate many ideas as quickly as possible

B. Criticize the ideas as quickly as they are offered

C. Explain in detail each idea before going on to the next one

D. Identify exactly what the central question or problem is

4. There are two types of "quality tools" (teaming and analytical). A "teaming tool" is one which helps a team work together well by treating each other with respect and letting everyone participate. An "analytical tool" is one which helps the team understand better whatever it is they are studying. Which of the following is a "teaming tool"?

A. Nominal Group Technique

B. Activity Network Diagram

C. Cause and Effect Diagram

D. None of the above

5. There are two types of "quality tools" (teaming and analytical). A "teaming tool" is one which helps a team work together well. An "analytical tool" is one which helps the team understand better whatever it is they are studying. Which of the following is an "analytical tool"?

A. Nominal Group Technique

B. Brainstorming

C. Cause and Effect Diagram

D. None of the above

6. If you were working with a team which was having trouble reaching an agreement on which goals were most important, which of the following "quality tools" would you suggest the team to use?

A. Brainstorming

B. Nominal Group Technique

C. Flowchart

D. Activity Network Diagram

7. Which of the following is NOT a characteristic of the Nominal Group Technique "quality tool"?

A. It makes it more likely that every team member participates

B. It requires each member to give a "value" to suggestions

C. It helps the team focus on major issues

D. It is very complex and difficult to apply

8. Which of the following is NOT a characteristic of a well organized team?

A. Team has well-defined purpose

B. Team uses "quality tools"

C. A leader who can make the most important decisions for the team

D. The team makes decisions based on data and knowledge-based methods

9. The quality tool used to determine the "Driving Forces" and "Restraining Forces" for a problem or issue is the:

A. Cause and Effect Diagram Method

B. Force Field Analysis Method

C. Nominal Group Technique

D. Run Chart

10. What is the fourth step of the DEAL Problem Solving Method?

A. Learn perceptual patterns

B. Listen to other people's ideas

C. Look back and learn from the effects of your activities

D. List all possible solutions to the problem

11. The quality tool which is designed to give everyone in the group an equal voice is the:

A. Cause and Effect Process

B. Force Field Analysis Method

C. Nominal Group Technique

D. Equal Interaction Method

12. What is the first component of the DEAL approach to problem solving?

A. Dealing with the problem

B. Defining the problem

C. Determining solutions to existing problems

D. Describing possible strategies

13. What is the third component of the DEAL approach to problem

solving?

A. Approaching the problem

B. Activating concepts

C. Acting upon the best possible solutions

D. Analyzing the problem

14. What is the second component of the approach to problem solving?

A. Explore all possible solutions

B. External representation of the problem

C. Explaining details of the problem

D. Extracting data concerning the problem

15. If a complex project needed to be charted out to see sequence and time of each step, which TQM tool would best be used?

A. Gantt chart

B. DEAL problem-solving framework

C. Fishbone diagram

D. Cause and Effect diagram

16. There is a shortage of Technology Education teachers; if we wanted to focus on the root causes of the problem rather than symptoms, which would be the best tool to use?

A. Nominal Group Technique

B. DEAL problem-solving framework

C. Cause and Effect Diagram

D. Gantt Chart

17. When using the DEAL problem-solving method to find out why a computer will not boot up properly, the first step is to:

A. Explore alternatives

B. Acto on the best solution

C. Look back and evaluate

D. Define the problem

18. If you are said to put yourself in the place of the product designed in order to view a problem from all possible perspectives, this is what TQM tool?

A. Brainstorming

B. Sketching and doodling

C. Incubation

D. Synectics

19. If you cannot arrive at a good solution right away, you might choose to step back and give your mind time to rest, this is called:

A. Weighting

B. Prototyping

C. Incubation

D. DEAL problem-solving

20. To consider the pros and cons of a problem, a team of designers would probably:

A. Use the DEAL problem-solver

B. Use weighting

C. Set up a Gantt chart

D. Use the Analytical Criteria method

21. To encourage the creation of new ideas, one would most likely use which tool?

A. Brainstorming

B. Fishbone

C. Flowchart

D. Nominal Group techniques

22. To avoid a win/loose situation in a meeting, which tool could be used to reach a consensus?

A. Nominal Group technique

B. Flowchart

C. DEAL problem-solving

D. Gannt chart

23. After exploring all of the proposed possible solutions, the next step in the DEAL problem-solving process is:

A. Define's the problem

B. Exploring all possible solutions

C. Acting on the best solution

D. Looking back and evaluating

24. Without a management process, the transportation system would be chaotic. Generally, the four functions of management are planning, organizing, implementing and:

A. Communicating

B. Controlling

C. Reviewing

D. Supervising

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **002.00: Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: **002.02: Apply management skills and quality tool effectively.**

OUTLINE	RESOURCES

Purpose: The SCANS report stressed the need for all workers to have problem solving skills. A methodical, well thought out process increases the likelihood of success in the solving of problems. These problem solving skills should be used throughout the course in the many activities the students will be engaged. Insist that each student know and practice the steps used in the DEAL problem solving method (see Fundamentals of Technology 002.02).

Activity:

Use appropriate quality tools (DEAL, concept mapping, etc.) for the development of the suggested activities in competency 6.00.

Problem: As appropriate

Materials and Equipment: As needed

TEACHER INSTRUCTIONS

Observe each student(s) behavior as a participating team member. Evaluate the student(s) ability to communicate with others, his/her application of appropriate quality tools and overall effectiveness as a team member. Assess the students using the criteria below.

STUDENT INSTRUCTIONS

You will be expected to communicate and work well with others. You will also be expected to apply appropriate quality tools as you work through your team project. You will be assessed using the criteria below.

Evaluation

Communicated effectively as a team member 0-30 points

Identified and applied appropriate quality tools	0-30 points
Overall, effectively participated, planned, organized and implemented project	0-40 points
Total Possible Points	100

Other Suggested Activities:

-Apply quality tools in the operation of a TSA chapter.

-Incorporate quality tools in all group activities.

VoCATS QUESTIONS

FOR

OBJECTIVE 2.02

INSTRUCTIONS TO THE STUDENT: Apply appropriate communication and quality tools while working on projects with other classmates. You will be expected to communicate and work well with others. You will also be expected to apply appropriate quality tools as you work through your team project(s). You will be assessed using the standard criteria provided by your teacher.

TEACHER INSTRUCTIONS: Observe each student(s) behavior as a participating team member. Evaluate the student(s) ability to communicate with others, his/her application of appropriate quality tools and overall effectiveness as a team member. Assess the students using the criteria below.

Evaluation:

Communicated effectively as a team member	0-30 points
Identified and applied appropriate quality tools	0-30 points
Overall, effectively participated, planned, organized and implemented project	0-40 points
Total Possible Points	100

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **002.00: Participate in a responsible and efficient manner a an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: **002.03: Explain classroom and laboratory safety rules and procedures.**

OUTLINE	RESOURCES

A. Purpose

This is not meant to be an all inclusive list of safety precautions. The teacher is responsible for maintaining a safety program. See OSHA regulations on the internet, at the library, and in cooperation with your local administrators, supervisors, safety personnel, and curriculum specialists. FR2

Pass out the parental permission form, general safety rules, and personnel system sheet to students. Document and teach general safety. Document and teach specific safety for circumstances and equipment that relate to the nature of the transportation systems curriculum and activities. Provide this instruction where prudent throughout the course of study. **This includes developing safe procedures for testing student solutions to transportation problems; especially when the students design the solution testing ideas.**

Activities:

TEACHER INSTRUCTIONS

Provide safety instruction. Explain the importance of the permission form and the importance of students returning to you with the parent's or guardian's signature. Explain that students must pass all safety tests (both written and performance) with 100% accuracy before they are allowed to work in the lab or operate specific tools, machines and equipment. Read and introduce all of the general safety rules. Get students to understand the reasons that each rule is necessary. Make it clear that good and responsible student behavior and a well run personnel system are important for lab safety.

Take students on a tour of the lab. Explain how each general rule comes into play or consideration in the various areas of the lab. Indicate the locations of first aid kits, eye washes, fire extinguishes, fire blanket, fire alarms, emergency exits, etc. Conduct discussions during the tour on hypothetical safety situations that give the students a feel for the application and purpose of the safety rules. Make sure that students are taking good notes during the tour and discussion by stopping intermittently and prompting their note taking.

Conduct safety lectures and demonstrations for specific machine and tool safety and for specific transportation-related circumstances and equipment.

Other Suggested Activities:

-Explain all general rules prior to any lab activities, placing strong emphasis on safety and proper cleanup/tool storage. Explain all specific rules as instruction dictates.

-State that the Parental Permission Form must be signed by the student and the parent/guardian before any tool usage occurs.

-Once students are deemed competent in all safety practices, have each student demonstrate a safety practice.

-Have students make a safety poster related to one of the major safety concepts.

B.	Safety rules-general and specific	FR3-15-20
	1. All tools should be properly stored when not not in use	R3/231
	2. Ask your teacher when in doubt about the operation of any machinery	FR2/18; R3/232
	3. Safety glasses must be worn at all times in the lab and when launching model rockets	FR2/18
	4. Leave space for fuel expansion when filling fuel tanks	R3/234
	5. When working with machinery and electrical equipment:	
	a. Remove all jewelry	R3/231
	b. Tie back long hair	R3/231
	c. Wear safety glasses (include face shields when grinding)	R3/231
	d. Wear snug (not loose) fitting clothes	
	6. Batteries should be stored in well ventilated areas	R3/235
	7. Push a wrench with an opened hand	R3/232
	8. Keep rags off of hot engines	R3/233
	9. Engine parts should be cleaned with kerosene	R3/233
	10. Carbon monoxide poisoning symptoms include headache, nausea, ringing ears, and tiredness	R1/xii

11. Wear safety glasses at all times in the laboratory. Wear goggles when spectacles are needed to correct vision. Wear safety goggles when chemicals, or other materials that could defeat glasses, are in use.
12. Safety glasses should be cleaned after each use. Where ultraviolet light is used to clean glasses, a sign should indicate the use of the light, and cleaning should be done while the safety glasses cabinet door is closed.
13. Report all accidents no matter how small.
14. Students must conduct themselves in a calm, responsible manner; no horseplay is allowed

15. Remove jewelry, ties and other loose clothing. Roll up your sleeves, and restrain or tie back long hair.
16. No one should work in the lab if they are in poor health, experiencing dizziness, on medications or under the influence of alcohol or narcotics.
17. Operate hand tools so they do not move toward the hands or body.
18. Use clamps to hold work securely.
19. Maintain the condition of hand tools and keep the blades of cutting tools sharp and ground at the correct angles.
20. Do not allow chisels to "mushroom".
21. Discard or repair damaged hand tools.
22. If a machine is not working properly, tell the instructor and ask him/her to disconnect the power to the machine, lock-out the machine and tag-out the machine with a blue maintenance tag.
23. Do not use a tool or machine unless you have passed its written and performance safety tests with 100% accuracy.
24. Only use a tool for its intended purpose
25. Store oily or dirty rage in a flammable materials trans can
26. Always ask the instructor's permission before using a tool or machine
27. If you do not understand how to properly operate a tool or machine, ask the instructor
28. Never run in the laboratory
29. Use appropriate personal safety protective clothing such as aprons, gloves and face shield when needed for operations such as welding or heat treating
30. Always wear hearing protection when loud tools, machines and devices are in use
31. Always leave the guards for machines in place
32. Never alter a machine from the manufacturer's specifications
33. Anchor bench-top and portable machines according to manufacturers' specifications
34. Make sure that electrical cords are not in the way of cutting tools and machines and that the cords are well maintained

35. Let machines and blades come to a complete stop before leaving them
36. Disconnect/unplug the electrical power to a machine before making adjustments to it

37. Before using a machine, make sure that the parts and blades turn freely and correctly
38. Keep work surfaces and floors clear of stock, tools, and debris
39. Deep the work surfaces of machines clear of stock, tools, and debris
40. Do not use the extension cords beyond the electrical current and length specified
41. Do not allow extension cords to cross foot traffic aisles
42. No student should enter a safety zone while another student is operating/working in that zone
43. Do not talk to someone who is operating tools, equipment, or machines
44. Report all safety violations
45. Material or stock should be stored in such a way that edges do not hang out in the aisles and stored in racks that are stable
46. Brooms and dust brushes should be stored so they do not hang out in the aisles.
47. Lift heave loads with you legs, not you back. Use a lift, cart, hand truck, etc. when possible to move heave loads
48. Learn emergency escape plans for each room in the laboratory
49. Keep fire extinguishes in good condition, label with a safety sign, and keep objects out of the way of fire extinguishes
50. Do not block fire alarms with objects, equipment, etc.
51. All tools should be stored when not in use
52. Use a brush to clean off machines, not your hands

C. Additional General Safety Rules for Teachers

1. Develop and maintain a safety education documentation system that includes videos of your safety instruction to you students.

   Hazard Material Sheets: lesson plans for all safety instruction - safety tests for each and every student - maintenance records - manufacturer safety rules for each machine and piece of equipment - records of regular safety inspections - records of physical plant repairs/ inspections - parental consent forms signed by parents - student agreement for behavior - lesson plan and tests on classroom behavior for each student - emergency escape routes posted and filed - accidents and follow-ups to accidents - discipline for each student - inventory of laboratory posted - filed and implemented personnel system for the operation and clean-up of the laboratory

2. Make sure that ladders to lofts, stairs, and other ways are well maintained and in compliance with OSHA regulations
3. Make sure that students are taught general safety rules for your laboratory and pass the general safety test with 100% accuracy before they are permitted to work in the laboratory
4. Make sure that students are taught specific safety rules for each piece of equipment and each hand tool. Make sure that they pass a safety test for the specific equipment with 100% accuracy
5. Post the general safety rules throughout the lab
6. Post specific safety rules at the location of machines and equipment
7. Use the OSHA safety color coded system
8. Post general safety signs at key locations in the laboratory. For example, post the safety glasses sign at the entrance to the laboratory
9. Arrange equipment in a way that the operation of machines do not interfere with each other
10. Use safety tape or yellow and black tape to designate safe work zones around each machine and work area
11. Aisles should be at least three feet wide
12. Trash cans and waste containers should be placed throughout the lab but should not interfere with the flow of traffic
13. Make sure that stationary machines are anchored to the laboratory floor to prevent the machine from vibrating out of position and to prevent top-heavy machines from turning over
14. Maintain first aid kits, and indicate their locations in the lab with a safety sign
15. Keep eyewashes well maintained, free of clogs, and filled with fresh water. Label their locations and keep them free of obstacles
16. If a machine is not working properly, disable the power to the machine, lock-out the machine and tag-out the machine with a blue maintenance tag
17. Be sure the laboratory is well ventilated
18. Be sure the laboratory is well lit
19. Never allow students to work in the laboratory unless the

teacher is there to supervise them

20. Always stay with your students in the laboratory room where they are working
21. Always correct students for misbehavior and document the incidents
22. Report and document all accidents no matter how small, and follow-up on the accident to make sure that the student has received proper care
23. Correct students who violate safety rules, and document every violation. Punitive measures should be taken against students who repeatedly violate safety rules. Serious misbehavior should not be tolerated. Work with your administrator to maintain this part of your safety system. Consider whether or not a student requires further safety instruction and testing
24. Avoid arrangements of the lab that create blind spots so students are visible to the teacher
25. Make sure that emergency exits and emergency exit signs are visible and unobstructed
26. Allow each student who passes a safety test for a piece of equipment to first try using the device in your immediate presence. This is like a practice safety test or performance measure. Document the performance. If the student needs practice, arrange supervised practice before allowing the student to operate the equipment on a general basis
27. Develop an emergency procedure plan for contacting administrators and emergency personnel

D. Intermodal-Related Safety Rules for Students and Teacher

1. When operating remote control vehicles, be sure that they cannot contact unstable objects that can fall on someone
2. When retrofitting remote control vehicles and other devices of similar mechanical design, be careful not to get your fingers caught in the mechanism
3. Store flammable materials and hazardous materials in their original correct containers with labeling that is in compliance with hazardous materials handling regulations, including poison prevention telephone number
4. Store flammable materials in an approved flammable materials cabinet that is ventilated to the outside of the building
5. Use chemicals associated with transportation technologies in well ventilated areas

6. Use explosion proof lighting in areas where flammable materials are in use
7. Dispose of chemicals, including motor oil, using approved containers, labels, and methods
8. Where a wind tunnel is used to test airfoils and vehicle designs, no one should stand at either end of the tunnel (neither intake nor exhaust)
9. Guards should be in place to prevent debris from coming in and going out of the tunnel
10. Test objects should be secured in place in the tunnel
11. Hearing protection should be used when a wind tunnel becomes loud
12. Where turning or other machining is done on transportation-related devices, coolants and lubricants should be used, and cutting tools should be kept sharp and in good condition
13. Where a garage door is in use, safety procedures for its use should be posted and known by the students
14. Batteries should be stored in well ventilated areas, and should be properly disposed of

E. Land Transportation-Related Safety Rules for Students and Teacher

1. When students build and test working models of maglev vehicles, be sure that propellers are firmly attached to electric motors. As always, safety glasses must be worn at all times in the laboratory
2. When testing maglev vehicles on a two-rail track, do not place your hands or body across both rails to avoid the danger of electrical shock
3. For maglev vehicle testing, and anytime a power supply is used, make sure that the electrical current is set very low, and that the voltage is only high enough to drive the particular device
4. When testing maglev vehicles, do not set the vehicle on the track while the power supply is in operation. Place the vehicle on the track, and then connect the electrical power
5. Where pits are in use for transportation-related laboratory work, the pit should be fitted with safety rails, OSHA safety color coding, and a safety procedure for working in the pit should be posted and learned by all students
6. No person should be in the pit when a vehicle or other

device is being positioned over the pit

7. CO2 power model race cars must have a minimum of 3 mm of thickness where the CO2 cartridge is mounted in the vehicle. The depth of the cartridge compartment must be 50-52 mm
8. The teacher should load vehicles into position for launching. No student should load and launch vehicles
9. Only a remote controlled (can be mechanical) launching device should be used to burst seals on cartridges
10. CO2 cars should be guided by a guideline
11. Cushions should be provided at the end of the race way to stop cars without splintering and flying debris endangering spectators
12. All spectators should stand clear of the race way
13. Where automobile lifts are in use, automatic safety controls should be used, the pneumatic and/or electromechanical system should be in good operating condition, OSHA safety color coding should be used, and a safety procedure for working the lift should be posted and learned by all students
14. Where automobile are subject of laboratory work, precautions should be employed to ensure that the vehicle will remain in a fixed position and will not roll on to a person

F. Air Transportation-Related Safety Rules for Students and Teacher

1. When operating remote control air vehicles, manual gliders, self-propelled aircraft, working model rockets, and similar technologies, be sure that observers and operators are positioned out of the way

G. Water Transportation-Related Safety Rules for Students and Teacher

1. Where remote controlled boats are in use, the teacher should assume that no student knows how to swim. It is prudent to let the teacher launch vessels where the depth of the water is unknown or the depth is greater than the height of the student
2. Where students are near the water, throwable floatation, a long pole, and a real boat should be available for rescuing students and for retrieving stranded R/C boats

3. Spectators should not play around at the edge of the water

H. Space Transportation-Related Safety Rules for Students and Teacher
   1. When students make their own rocket vehicles, be sure that the rocket weight is matched to the appropriate model rocket engine
   2. When students make their own rocket vehicles (or use a kit), be sure to test each rocket for stability
   3. When launching and recovering model rockets be sure to obey all of the manufacturer's safety rules. This includes following specifications for launch site layout, correct weather conditions, countdown procedures, and rocket launching equipment installation and operation

VoCATS QUESTIONS

FOR

OBJECTIVE 2.03

1. When finished working with sharp-pointed or sharp-edged tools, put them:

A. In any available drawer

B. On the edge of the work table

C. On the floor next to your feet

D. In their proper storage area

2. Before using tools or machines which can cause injury you should always:

A. Review the appropriate safety manual

B. Ask a friend for help

C. Ask your teacher for permission

D. Check the condition of all circuit-breakers connected to the equipment

3. Safety glasses must be worn:

A. Only when operating a machine

B. Only when one is producing dust or metal particles

C. Only when grinding metals

D. Whenever one is in the technology lab

4. Which of the following is the most important safety consideration to observe while launching model rockets?

A. The launch team should wear leather gloves

B. Everyone must wear safety glasses

C. The launch pad must be made of asbestos

D. There must be at least an 8-mile-per-hour wind to prevent rockets from landing on the observation team

5. When refueling a fuel tank it should:

A. Be filled to the very top

B. Have space left for fuel expansion

C. Never be touched on the spout

D. Be filled quickly

6. If you are not sure how to use a laboratory machine you should:

A. Ask your teacher for help

B. Experiment with the machine by yourself until it works

C. Take the machine apart to see how it works

D. Ask someone else to work the machine for you

7. When working around machinery or electrical equipment one must:

A. Remove all jewelry

B. Tie back long hair

C. Wear safety glasses

D. Do all of the above

8. Charged batteries should be kept:

A. In well ventilated areas

B. In sealed containers

C. Near a heat source

D. Near welding stations

9. When loosening a stuck bolt or nut, you should push the wrench with:

A. All fingers wrapped tightly around the handle

B. A slightly larger wrench

C. An open hand

D. A hammer, screwdriver, or lever

10. A hot engine should:

A. Only be touched safely on the cylinders

B. Not be covered with rags

C. Only be touched safely on the exhaust system

D. Be covered with plastic sheets

11. In a technology lab, when should both safety glasses and face shields be worn?

A. When performing any type of lab work

B. When working with motors or engines

C. When working with sharp-pointed or sharp-edged tools

D. When working with grinders

12. Engines parts should be cleaned with:

A. Gasoline

B. Kerosene

C. Neoprene

D. Ethylene

13. A headache, nausea, ringing in the ears, and tiredness are symptoms of:

A. Carbon monoxide poisoning

B. Food poisoning

C. Electrical shock

D. None of the above

14. When lifting something heavy:

A. Avoid using your back muscles

B. Lift with your back not your legs

C. Drag it across the floor to where you want it

D. All of the above

15. Which of the following are appropriate lab rules?

A. Accidents are reported at once

B. No running in the lab

C. No horseplay is allowed

D. All of the above

16. When you first come to technology education class, what is one of the first things you should learn?

A. Emergency escape routes

B. How to use the wind tunnel

C. What projects will be assigned

D. How to measure

17. When you set down a large piece of plywood or move a cart of material out of the way, be sure that:

A. You get help moving it

B. You do not block access to the fire extinguisher or fire alarm

C. The material does not go to waste

D. It is stored correctly at the end of class

18. When you finish using a tool:

A. Put it back in storage

B. Give it to someone who will eventually need it

C. Leave it where you are working; you might need it again

D. Coat it with oil to prevent rusting

19. When you are using the portable electric tools and the only electrical outlet is across the room from where you want to work, you should be careful to make sure:

A. If you use several extension cords to reach that you are not exceeding their usage specifications

B. You use tow prong cords only

C. The extension cords do not cross walk aisles

D. Both A and C

20. When you see your friend sawing wood, and you want to say something important to your friend, you should:

A. Walk up to the machine

B. Go ahead and talk to your friend so he or she will know about the important information

C. Wait until your friend is finished working

D. Both A and B

21. You just finished cutting a large sheet of plywood. When you go store it:

A. Bend over to pick it up

B. Squat down, with your back straight, to pick it up

C. Store it in the correct rack in a stable position

D. Both B and C

22. After you finish cleaning the lab, what should you do with the broom?

A. Leave it for the next class

B. Hang it up so no one trips over it

C. Lean it against the machine that makes the most mess

D. Let a friend hang it up; teamwork is important

23. Your teacher has several bench-top band saws, and the one you want to use was just moved to another workbench. Make sure:

A. The power is on

B. The speed is set high

C. The speed is set low

D. It is anchored correctly

24. You just finished sawing a piece of plastic. Now you need to glue it to something. What should you do before you leave the machine?

A. Make sure it comes to a complete stop

B. Blow the dust off of the machine

C. Leave the leftover stock at the machine for someone else to use

D. Remove the blade

25. When your friend turned on the tablesaw, the blade cut into the guard. What did your friend do wrong?

A. He did not remove the old stock from another cut

B. He did not make sure the blade turned freely

C. He set the guard with the power cord unplugged

D. He set the angle of the blade too far over

26. When you turned on the saw, a piece of wood flew across the lab. What did you do wrong?

A. Had the blade set too high

B. Did not make sure the blade turned freely

C. Did not use a guard

D. Did not clear the machine table of old stock and debris

27. You know what your design is for your problem solution, and you know what machine operation needs to be done first. Next:

A. Go make the cut

B. Set up the machine correctly

C. Clamp the work piece onto the machine table

D. Ask your instructor's permission to use the machine

28. When using machines that tend to spray material or use heat, wear safety glasses and:

A. Loose clothing

B. A face shield

C. Fire proof clothing

D. Always wear gloves no matter what the operation

29. You are in a hurry because you have to turn in your project in five minutes or the teacher will count it as a zero. Which of the following statements are important to remember in this

situation?

A. Never run in the lab

B. Do not hurry with the operations you need to finish

C. The project grade is not as important as everyone's safety

D. All of the above

30. When using a machine which normally generates high decibels:

A. Wear hearing protection

B. Turn the machine off

C. Do not use the machine

D. Complain to the instructor

31. If you are using a razor tool like an Exacto knife, and you are using a steel rule to guide the cut, you should hold the steel rule:

A. Loosely

B. With your had behind the direction of the cut

C. With your hand in front of the direction of the cut

D. Ask your friend to hold the steel rule

32. If you are trying to drill or cut something and you are afraid it will spin or slide on the table, you should:

A. Ask a friend to hold the work for you

B. Try holding the work real firmly

C. Push the work up against the wall to hold it still

D. Use clamps to hold the work securely

33. If you scored 90% of the questions on the drill safety test correctly, then you:

A. cannot use the drill press until you score 100% correctly

B. Should be able to use the drill press because 90% is an "A"

C. Could still use the drill press because you could pass the performance (hands-on) test

D. Could just avoid ever using the machine because you do not want to study for a re-test

34. If you saw that the and saw blade is broken:

A. Replace the blade since you know where the new blades are stored.

B. Tell the instructor

C. Remove the bad blade

D. None of the above

35. When you were placing oil on the piston of the small engine, some drops spilled on the floor. What is your reaction?

A. Clean up all spills immediately

B. Clean with soap and water

C. It is normal to have oil on the floor in transportation class

D. Clean it up after you finish the lesson

36. Once you wipe oil off of an engine part:

A. Toss the rag in the sawdust bin to absorb the oil

B. Toss the rag in the trash can

C. Toss the rag in the flammable materials trash can

D. Wash it in the sink

37. If you do not understand how to operate a machine:

A. Use it anyway

B. Ask you instructor

C. Experiment with how it works

D. Watch others use it

38. If everyone is getting ready to do lab work but no one has started any machines:

A. Safety glasses are not needed

B. Only wear your glasses when machines start

C. Wear safety glasses at all times anyway

D. Safety glasses are not required for hand tools

39. If you get a small splinter in your finger from a piece of wood in the lab, and it does not bleed, then you should:

A. Not worry about it

B. Wash the wound

C. Dress the wound

D. Tell your instructor

40. If someone insults you during lab work, how should you react?

A. Stay clam

B. Never be afraid to show your emotions

C. Argue with the person

D. Ask your friends to watch out for you

41. There is a special event at school today, and you wear your tie and your new class ring. You have to do lab work, so you remove your tie but do not worry about your ring. Which statement below is most correct about lab safety?

A. The ring should also be removed; it could get caught in something

B. Leave the ring on; its small and should not get caught

C. It is unreasonable to be asked to remove either of these items

D. None of the above

42. You had a terrible cold and headache one morning, so before you left for school, your parents gave you aspirin and a cold pill. They made you feel better, but before technology education class the pills also made you feel just a little dizzy or light headed. What statement below is the most correct with regard to safety?

A. Do not worry about it

B. Work in the lab anyway; your lab assignment is due

C. Do not work in the lab, and tell your teacher about the medicine

D. Just have a friend keep an eye on you

COURSE: **Transportation Systems**

UNIT A: **Introduction**

COMPETENCY: **002.00: Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: **002.04: Apply classroom and laboratory safety rules and procedures appropriately.**

OUTLINE	RESOURCES

A. Purpose

It is important for everyone understands and follows acceptable safety practices for general safety and for transportation safety.

Activities

As a performance measure, students should demonstrate a general safety scenario. Students should demonstrate the safe operation of each machine or equipment to the teacher in a performance test after passing the specific written safety test with 100% accuracy.

TEACHER INSTRUCTIONS

It is the individual instructor's responsibility to teach general and specific safety rules. Specific safety rules include those on specific machines or stations unique to that instructor's lab. Teachers should require that students make 100% on the safety test to work in the lab or use hazardous equipment. The instructor should keep the student's tests on file for the remainder of the year, and if a student is injured, the records should be kept longer. The teacher should also fill out a school accident report if any injuries take place.

Two safety forms are provided for the teacher in this curriculum guide. It is suggested that the teacher:

1. Have students sign Student Safety Agreement
2. Have parents sign Technology Education Agreement

STUDENT INSTRUCTIONS

You will be expected to be knowledgeable about safety rules and safe practices. You will also be expected to apply the safety rules and exhibit safe behavior in the transportation lab as you work on your assigned projects.

1. Read and sign the Student Safety Agreement
2. Have your parents or guardians sign the Technology Education Agreement
3. You will be assessed using the criteria below

Evaluation:

Exhibited appropriate classroom and lab behavior	0-50 points
Demonstrated safe behavior related to techniques, tools, and equipment	0-50 points
Total Possible Points	100

Other Suggested Activities:

-Once students are deemed competent in all safety practices, have each student demonstrate a safety practice.
-Have student make a safety poster related to one of the major safety concepts.

TECHNOLOGY EDUCATION AGREEMENT

To:__________________________
(Parent or Guardian)

______________________________ is enrolled in our Technology
(Name of Student)
Education Program and will have the opportunity to use various tools and equipment. Appropriate instruction in safe operation of these tools and equipment is given and close supervision is maintained at all times. Although every precaution is taken to prevent accidents, a certain risk is involved due to the nature of the class, the age of the student and the learning environment.

We are asking for your cooperation in impressing upon your child the importance of being careful, listening and following the teacher's instructions. We believe this will back up the instruction that is given in school.

We welcome your visit in our school and in the Technology Education Department to see our program. These visits may be arranged by calling:__________________________.

Thank you very much for your help and assistance in providing your child with the "real world" experience of Technology Education in a safe working environment.

****

I have read the above and I understand the type of program that __________________________ is taking. I will stress the safety
(Name of Student)
aspects of this program to my child and will encourage my child to participate fully in the Technology Education Program.

Parent or Guardian Signature:_______________________Date:__________

Home Phone:______________________Work:______________________________

Please identify any health problems which may have a bearing on your child's participation in this class:

____

****

I agree to observe all safety rules and procedures for safe operation. I will conduct myself properly. I will wear approved eye protection as required in the lab.

Student's Signature________________________________Date:____________

STUDENT SAFETY AGREEMENT FOR TRANSPORTATION SYSTEMS

Realizing that safety is very important, I ________________________ agree to:

1. Ask my teacher to approve all work that I plan to do.

2. Report any injuries, however small, immediately to my teacher.

3. Wear suitable eye protection when engaged in any activity where eye injury may happen.

4. Cooperate with my classmates in the safe operation of my lab.

5. Caution any student I see breaking a safety rule.

6. Report to the teacher any equipment which does not seem to work properly.

7. Keep the floor clean of scraps and litter.

8. Not operate any equipment while under the influence of prescription or non-prescription drugs.

9. Immediately wipe up any liquids spilled on the floor.

10. Know and practice procedures to follow in case of fire, tornado, or other disaster.

11. Verify that equipment and personnel are properly grounded in order to prevent electric shock and/or damage to the equipment.

12. Never divulge personal information (such as name, address, and phone numbers) while working on the Internet if I am unsure of how the information will be used.

______________________________ ________________

(Student Signature) (Date)

VoCATS QUESTIONS

FOR

OBJECTIVE 2.04

INSTRUCTIONS TO THE STUDENT: Exhibit appropriate behavior with regards to safety while working in the classroom or laboratory. You will be assessed on your written tests and on your behavior. You will be expected to be knowledgeable about safety rules and safe practices. You will also be expected to apply the safety rules and exhibit safe behavior in the transportation laboratory as you work on your assigned projects. Read and sign the Student Safety Agreement. Have your parents or guardians sign the Technology Education Agreement.

TEACHER INSTRUCTIONS: It is the individual instructor's responsibility to teach general and specific safety rules. Specific safety rules include those on specific machines or stations unique to that instructor's laboratory. Teachers should require that students make 100% on the safety test to work in the laboratory or use hazardous equipment. The instructor should keep the student's tests on file for the remainder of the year, and if a student is injured, the records should be kept longer. The teacher should also fill out a school accident report if any injuries take place.

Two safety forms are provided for the teacher in the curriculum guide. It is suggested that the teacher:

1. Have students sign the Student Safety Agreement
2. Have parents sign the Technology Education Agreement

Use the following criteria for assessing student(s) behavior:

Evaluation:

Exhibited appropriate classroom and lab behavior	0-50 points
Demonstrated safe behavior related to techniques, tools, and equipment	0-50 points
Total Possible Points	100

COURSE: **Transportation Systems**

UNIT B: **Fundamental Scientific and Technical Concepts and Principles Used in the Design of Complex Vehicular**

Transportation Systems.

COMPETENCY: **003.00: Define and apply scientific and technical concepts and principles used in the design of actual and/or model complex vehicular transportation systems.**

OBJECTIVE: **003.01: Define and explain scientific and technical concepts and principles related to the design of actual and/or model complex transportation vehicular systems which are common to modes of transportation.**

OUTLINE	RESOURCES

A. Purpose: Understanding scientific and technical concepts and principles is essential for the intelligent design, development, and evaluation of transportation systems and sub-systems.

B. Scientific and technical concepts and principles
1. Good design is appropriate design. FR6/37
2. Generally, in good design form should always follow function. CG
3. One of the first questions designers should ask themselves when beginning to design a good product is "What purpose will this serve?".
4. The design concept "engineering" refers to how well something is built. CG
5. **Newton's Law's of Motion:** R2/139
   Newton's First Law: Newton's First Law states that a body of mass in a state of rest tends to remain at rest and a body or mass in motion tends to remain in motion, unless acted upon by another force.
   Newton's Second Law: Newton's Second Law states that an unbalance or force on a body tends to produce an acceleration in the direction of the force.
   Newton's Third Law: Newton's Third Law states that for every acting force there is an equal and opposite reacting force.
6. **Bernoulli's principle** states that as the speed R1/226

of fluid, such as air or water, is increased, pressure decreases.

7. The **coefficient of drag** is a number used by automobile designers to indicate how easily a vehicle cuts through the air (i.e. the less wind resistance it will experience and the easier it will move through the air). R2/381; 400

8. **Vortices** are circular patterns of air or water created by the movement of an airfoil or hydrofoil through the air or water. As a foil moves through a fluid, the high pressure on top tends to roll up into rapidly rotating circles or vortices. The vortices created depend upon the wind, water, loading, gross weight and speed of the foil in the fluid it's passing through. R2/407

9. **Aerodynamics** is the study of the air movement and objects moving through the air. CG

10. **Hydrodynamics** is the study of water movement and objects moving through the water. CG

11. **Lift** refers to the upward force generated by the **cambered** shape of an airfoil or hydrofoil which causes the fluid (air or water) flowing across the top of the foil to move faster than that which is flowing on the underside of the foil. As a result, there is less pressure on the top of the foil than on the bottom. Thus the higher pressure below the foil creates the upward force called lift. (See also Bernoulli's Principle R1/266). R1/141

12. **Thrust** is a force that produces motion in a body. Thrust is measured in pounds and newtons. R1/141 151;226 R3/165

13. **Drag** is the force that resists the forward movement of a vehicle. R1/226

14. **Gravity** is a natural force that pulls objects toward the earth. R1/226

15. **Center of gravity** is the point at which all objects are balanced. CG

16. The point at which all aerodynamic forces (lift, thrust, drag and gravity) are working is termed the **center of pressure**. R4/42

17. **Stability** may be greatly influenced by a Guide

vehicles shape, proportions, control system, and center of gravity.

18. **Friction** is created by two surfaces rubbing against each other. R1/45

19. **Centrifugal Force** is a force acting outward- the force exerted by water in the bottom of a bucket being swung around in a circle. R1/90

20. **Centripetal Force** is a force acting inward- the force exerted by a handle of a bucket being swung around in a circle. R1/90

21. **Hydraulics Systems** are those that control and transmit energy through liquids. R1/85

22. **Pneumatic Systems** are those that control and transmit energy through gases. R1/85

23. **Pitch** refers to the movement of an aircraft about its lateral axis, also, the angle of the blades of a propeller on a boat, plane, or fan. R2/83 R2/404

24. **Roll** refers to the movement of an aircraft about its longitudinal axis and the side to side motion of a boat or ship. R2/83

25. **Yaw** refers to the left to right movement of boats and planes. R1/216; R2/84; 121;407

26. **Dynamometer** is a device which attaches to the back of an engine to absorb the power being created by the engine. When an engines run on a dynamometer, it can be loaded to simulate actual working conditions. Torque, horsepower, and fuel consumption can be measured at different RPM's. R3/101 R2/286

27. **Potential Energy** is any form of stored energy and **Kinetic Energy** is energy in motion. R1/17

28. **Power** is the amount of work being done over a period of time.* R3/96 R1/19

29. **Work** is the application of force that moves an object a certain distance.* R3/96 R1/20

30. **Force** is anything that causes an object to move. R3/97 R3/151

31. **Pressure** is a measure of force that is determined by the area over which a force is applied. R3/99
force is applied.

32. **Horsepower** is the standard unit of power.*
R3/97

R2/284

33. **Efficiency** = energy out/energy in X 100%.* R1/49

34. **Mechanical Advantage (actual & theoretical/idea)** is an increase in force provided by a machine.* 3/266 R1/59

35. **Foot-pounds** are units of measurement. One ft-lb. is the amount of force needed to move a 1 lb. load a distance of one ft.* R3/99 R1/19

36. **Torque** is a twisting or turning force. R3/99 R3/165

37. **Newton** (As a measurement of force) 1 pound of force=4.448 newtons. A newton is the amount of force required to impact an acceleration of one meter per second to a mass of one kilogram.* R3/94

38. **Sines and Tangents**
*** See handout for formulas**

39. The least a radio control set will include is a transmitter, servo(s) and receiver. R6/7

40. Generally, **telemetry** refers to the transmission of data by radio waves. R4/46

41. **Electromagnetism** is magnetic force produced through the flow of electricity through a wire. Strong electromagnets can be created using electromagnetism by wrapping an electrical wire around an unmagnetized ferrous metal bar such as iron. R2/337

C. Land Transportation Systems

42. For maglev vehicles, **propulsion** is provided by magnets mounted on the sides of the tracks. R3/410

43. By increasing or decreasing the cycle at which the magnetic polarity is reversed, the speed of a maglev train is made faster or slower. R3/410

44. **Maglev** means magnetically levitated. R3/410

45. **Super-conductors** produce little or no resistance to the flow of electricity. R2/384

46. Regarding magnets, like **polarity** repels, unlike polarity attracts. R3/410

47. Maglev trains are lifted by **magnetic fields of force**. R1/118

48. The magnets which lift a maglev train above the tracks are called **lifting magnets**. R2/385

49. The magnets used to propel a maglev train are called **propulsion magnets**. R2/385

50. On a maglev train system, **levitation magnets** are mounted on the track surface. R3/410

51. On a maglev train system, **support wheels** are used 3/410

when the superconducting magnets are not activated.

52. Three **advantages of maglev vehicles** are: speed, quietness, and smoothness of ride. R3/410
53. Three disadvantages are turning, deceleration, and high energy consumption.
54. **Electro-magnetic induction** occurs when electron flow is brought about by the movement of a conductor through a magnetic filed. R1/78

D. Water Transportation Systems

55. **Prismatic Coefficient "Cp."** is used to compare hull shapes for design purposes. SR4/5
56. Prismatic Coefficient for light air use sailboats should be about 0.48. SR4/6
57. The **center of buoyancy** is the center of a boat's displacement. SR4/3
58. Flat-bottomed boats have a **deadrise angle** of O degrees. SR4/6
59. The **center of flotation** on a boat is analogous to the center of buoyancy. SR4/3
60. The **displacement** of a boat refers to the weight of the water it displaces. SR4/3
61. The greater a vehicles displacement the greater its **buoyancy**. R1/127
62. **Draft** refers to the depth a boat extends below the water. R1/128
63. With regards to sailboats, **center of effort** refers to the center of the sail area. SR4/6
64. A sails **efficiency** is the relationship of the force acting on the sail verses how hard the sail pulls the boat. R1/49
65. the **sail area displacement ratio** is the relationship of sail area to the displacement in cubic feet of the boat. This should be around 20 for high performance racers. SR4/8
66. **Sails** (Mainsail, Jib, and Spinnaker)The mainsail R2/199
    The **Mainsail** provides the main source of propulsion for a sailboat. CG
    The **Jib** is in front and to the side of the CG

mainsail. It accelerates the speed of the wind moving across the back of the mainsail, thereby increasing the lift created by the mainsail.

The **Spinnaker** is a sail that is used only when sailing down wind. It acts like an umbrella would if pointed down wind. CG

67. **Knot** is the common unit of measurement in marine transportation. (1 knot=1.15 mph) R2/83

E. Air Transportation Systems

68. When flying **gliders**, always **launch** into the wind. R6/20
69. When building the **wing(s)** of RC gliders, make sure that each wing is of the same size, shape and weight
70. **Dihedral** is the v-shaped angle that wings have from the center chord out to the tips or when the tips of the wings are higher than the base of the wing attached to the fuselage. CG
71. During the first test flights of a glider, a tendency to **stall** may be prevented by adding weight to the nose. R6/17
72. **Thermal** is a column of warmer air rising above areas of cooler air and may be used to take one's glider to greater heights. R 6 / 5
73. Wings of an RC glider should be built with a **positive angle of incidence**. R6/12
74. When a glider turns downwind, there is a tendency for its **air speed** to **decrease** and its **ground speed** to **increase**. R6/18
75. As air speed decreases across the surface of an airfoil, the likelihood of stall increases
76. The **aspect ratio** is the ratio of a wing's span R2/118

to its cord. The higher the **aspect ratio** of a wing, the higher its efficiency.

77. **Stall** occurs on a plane when the lift generated by the wings becomes so small that it can no longer support the weight of the aircraft. R2/117

78. **Angle of attack** refers to the angle at which an aircraft's wing is in relation to the direction of travel of the aircraft. R2/116

F. Space Transportation Systems

78. Useful information on model rockets can be found on the Internet at NASA's webpage. This address is subject to change. Guide

79. Composite model rocket engines should NOT be **clustered**. R5/17

80. Generally, the higher a model rocket goes, the smaller the chute should be. This increases the likelihood of recovery R5/17

81. When launching on a windless day, the rule of thumb is that the launch field's narrowest width be at least half of the maximum altitude the rocket will reach. R5/13

82. Nylon is one of the best materials for model rocket parachutes. R5/17

83. According to the NAR(National Association of Rocketry),a model rocket may not have more than 4.4 ounces of **propellant**. (125 grams) R5/8

84. The **apogee** of a rocket is its highest altitude reached. In reference to satellites it is the highest point in the satellites orbit. R5/12

85. The **perigee** of a satellite is its lowest point of orbit. R1/151

86. **Geostationary/Geosynchronous orbit** refers to having an equatorial orbit requiring an angular velocity the same as that of the earth, moon, or planet so that the position of a satellite in such an orbit is fixed with respect to the earth, moon, or planet. CG

87. The **NAR Model Rocketry Safety Code** states that model rockets must not weigh more than 53 ounces or 1500 grams at liftoff. R5/7

88. The design of a rocket to produce photographs would call for cameras to be placed opposite each other near the nosecone. R5/21

89. Model rocket transmitters consist of a **RF, sensor, modulator,** and **power supply systems**. R5/39

90. A "high-powered" model rocket is defined as one propelled by an engine or engines providing a total impulse of more than 20 Newton-seconds (D-size engine). R5/8

91. To determine the altitude of a photograph one would use the **formula H=OF/I**,
    - **H** is the height of the camera above the surface,
    - **O** is the size of the object on the ground shown in the photo,
    - **F** is the focal length of the camera,
    - **I** is the size of the same objects' image as measured on the negative.

92. In powered flight, a rocket's **center of mass/gravity** must be closer to the nose than the **center of pressure (CP)** or it will become unstable. R4/42

93. Be able to apply the formula for determining flight altitude of model rockets. Distance from launch site multiplied by tangent of angle A. R4/43

* Include Handout Information

Activities: Teach scientific and technical concepts and principles.

Teachers Instructions

1. Place transparency of terms from 3.01 on over head or board.
2. Have students copy information into their notebooks.
3. Have students form groups of two or three.
4. Have students choose several scientific and technical concepts and principles from objective 3.01 that are closely related.
5. Have students plan an experiment using the design brief that will demonstrate the concepts and principles they choose. Encourage students to use visual aids and multimedia.
6. Set deadlines for different sections of the design brief to be completed by the students.
7. Have students present their demonstration to the class.

Student Directions

Participate as a group member in the investigation and demonstration of the effects of various technical concepts and principles dealing with transportation systems.

1. Research information dealing with scientific and technical concepts and principles that are closely related to each other from the list provided by your instructor.
2. Using the design brief outline, design an experiment that will demonstrate and explain the scientific and technical concepts and principles you have chosen.
3. Prepare visual aids and multimedia to help explain your scientific and technical concepts and principles.
4. Demonstrate your experiment to the class.
5. Prepare several questions to quiz the class with during a question/answer session you will provide for the class. Be prepared to answer questions presented to you by the class.

Evaluation

Design Brief	60 points possible
Problem identification & definition	3 pts.
Clearly stated & covers topic	
Research and review of literature	12 pts.

3 sources minimum

Evaluation of appropriate systems	3 pts.
Plan of work	12 pts.
All duties delegated and carried out	
Expected outcomes	3 pts.
Evaluation criteria for demonstration developed by group on a 100 point scale	3 pts.
Evaluation of process	12 pts.
Drawings and bibliography	12 pts.
Demonstration of experiment	40 points possible
Presentation	10 pts.
Visual aids	10 pts.
Demonstration	10 pts.
Question & answer session	10 pts.
Total Points Possible	100 pts

Materials Needed

1.) Scientific and technical concepts and principles from objective 3.01 or overhead with same objective 3.01.
2.) Design brief outline and explanation.

Suggested Activities:

R1b 24-25	R3c 25-27	R3c 147-153
R1b 38-41	R3c 129-133	R3c 271-273
R1b 59-62	R3c 139-140	

Other Suggested Activities:

-Design and test boat hulls; as seen in TSM Connection Activities
-Design and test an air foil
-Design and test a vehicle model for automobiles-crash testing.
-Make a mouse trap car; make and design the cars to stop and move a certain direction.
-Apply various hydraulic and pneumatic circuits: i.e. dumptruck, backhoe, power brake, wing-flaps.
-Ramp testing for friction
-Make a paper hovercraft for testing pressure.

VoCATS QUESTIONS

FOR

OBJECTIVE 3.01

1. The depth a vessel sits in the water is referred to as its:

A. Ballast

B. Displacement

C. Draft

D. Lift

2. Hydraulic systems control and transmit energy through:

A. Liquids

B. Gases

C. Solids

D. Hydrometers

3. The three axis upon which an aircraft rotates are: roll, pitch, and:

A. Rise

B. Wave

C. Lift

D. Yaw

4. Air that slows down a speeding automobile, forcing the driver to accelerate to maintain a steady speed is called:

A. Planetary force

B. Residual friction

C. Aerodynamic drag

D. Acceleration constant

5. A good example of torque is a:

A. Piston

B. "Maglev" train

C. Door knob

D. Latch

6. If a boat is moving 32 miles per hour (mph), its speed in knots is:

A. 36.8 knots

B. 27.82 knots

C. 0.03 knots

D. 33.15 knots

7. Power can be measured using the following formula:

A. P = w x t

B. P = t/w

C. P = w/t

D. P = t + w

8. If 80 units of work are applied to a mechanical system that lifts 20 units of weight, the system is said to be:

A. 4% efficient

B. 25% efficient

C. 40% efficient

D. 100% efficient

9. The greater amount of water displaced by the hull of a ship the greater the vessel's:

A. Buoyancy

B. Speed

C. Flotation

D. Draft

10. The formula for calculating the actual mechanical advantage is:

A. Output / x 100%

B. Productivity x efficiency

C. Input / output x 100%

D. Efficiency / productivity

11. The upward force that an airplane's wings produce to keep it in the air is called:

A. Lift

B. Pressure

C. Thrust

D. Suspension

12. "The amount of work accomplished in a given period of time" is a good definition of:

A. Effort

B. Energy

C. Power

D. Torque

13. The equation for force is:

A. Length x distance

B. Length x weight

C. Pressure x distance

D. Pressure x area

14. A satellite put into orbit will continue to orbit at a constant speed, unless acted upon by another force. The satellite's orbit is an example of:

A. Newton's first law of motion

B. Newton's second law of motion

C. Newton's third law of motion

D. Newton's fourth law of motion

15. A book sitting of the edge of a desk is an example of:

A. Mechanical energy

B. Gravitational energy

C. Kinetic energy

D. Potential energy

16. The side to side movement on a boat is called:

A. Pitch

B. Keel

C. Tramp

D. Roll

17. The two forces which an aircraft must overcome in order to fly are:

A. Gravity and thrust

B. Drag and gravity

C. Thrust and lift

D. Drag and lift

18. The energy from a car's engine drives a crankshaft which spins and produces power in the form of:

A. Effort

B. Friction

C. Torque

D. Pressure

19. Which of the following vessels displaces the LEAST amount of water?

A. Barge

B. Kayak

C. Oil tanker "with full shipment of oil"

D. Tugboat

20. Which force keeps water in a bucket when it is whirled around rapidly?

A. Coefficient of drag

B. Centrifugal force

C. Centripetal force

D. Geosynchrous orbit

21. A twisting or turning force is called:

A. Centripetal force

B. Diametric force

C. Torque

D. Distortion

22. In a space vehicle's orbit around the earth, the point at which the vehicle is farthest from the earth is called the:

A. Perigee

B. Apogee

C. Exosphere

D. Mesosphere

23. A solid object placed in a fluid less dense that itself will:

A. Sink

B. Float

C. Condense

D. None of the above

24. Which law of motion states that an unbalance of force on a body tends to produce an acceleration in the direction of force?

A. Newton's first law of motion

B. Newton's second law of motion

C. Newton's third law of motion

D. Newton's fourth law of motion

25. The energy required to lift 33,000 pounds exactly 1 foot in 1 minute is:

A. 1/3 Hp.

B. 1 Hp.

C. 3 Hp.

D. 33 Hp.

26. The force that resists the forward motion of an aircraft is called:

A. Gravity

B. Thrust

C. Drag

D. Lift

27. During flight, an aircraft can keep increasing its angle of attack until it:

A. Ices

B. Stalls

C. Turns over

D. Crashes

28. The natural force that tries to pull a plane to the ground is called:

A. Weight

B. Gravity

C. Pressure

D. Drag

29. The amount of energy a machine or engine successfully converts into usable energy is expressed in terms of the machine or engine's:

A. Motion

B. Combustion

C. Power

D. Efficiency

30. The force produced by a plane or rocket's propulsion system is called:

A. Thrust

B. Lift

C. Longitudinal

D. Reciprocating

31. Which law of motion states that a body or mass in motion tends to remain in motion, unless acted upon by another force?

A. Newton's first law of motion

B. Newton's second law of motion

C. Newton's third law of motion

D. Newton's fourth law of motion

32. The production of electricity through the use of magnets or when a conductor passes through a magnetic field is

electromagnetic:

A. Induction

B. Radiation

C. Valence

D. Flux

33. The device used to measure how much work an engine can produce in a unit of time is called a:

A. Dynamometer

B. Hydrometer

C. Tachometer

D. Torque wrench

34. Which law of motion states that for every acting force there is an equal and opposite reacting force?

A. Newton's first law of motion

B. Newton's second law of motion

C. Newton's third law of motion

D. Newton's fourth law of motion

35. In space vehicle's orbit around the earth, the point at which the vehicle is closest to the earth is called the:

A. Perigee

B. Apogee

C. Exosphere

D. Mesosphere

36. On a ship's propeller the angle of its blades is referred to as its:

A. Pitch

B. Law

C. Center

D. Roll

37. A household furnace consumes 50,000 BTUs each hour. The furnace actually outputs 42,000 BTUs into the home during this time. The efficiency of the furnace is:

A. 84%

B. 19%

C. 92%

D. 8%

38. A falling rock is an example of:

A. Mechanical energy

B. Gravitational energy

C. Kinetic energy

D. Potential energy

39. Pneumatic Systems control and transmit energy through:

A. Liquids such as water or oil

B. Gases such as air

C. Solids such as copper

D. Pneumatism

40. Motion that produces a desired outcome including the factors force multiplied by distance is:

A. Effort

B. Energy

C. Power

D. Work

41. The stability of a vehicle may be influenced by its:

A. Shape

B. Proportions

C. Control system

D. All of the above

42. When two surfaces are rubbing against each other, what is created?

A. Lift

B. Friction

C. Roll

D. Centrifugal force

43. Centripetal Force is:

A. A force acting outward, such as the force exerted by water in the bottom of a bucket being swung around in a circle

B. A force acting inward, such as the force exerted by the handle of a bucket being swung around in a circle

C. A force that causes things to move, such as the force you exert on a car seat as the car accelerates.

D. A force created by an airplane wing as air moves faster across the top than it moves across the bottom

44. A Dynamometer is a device that can measure the:

A. Efficiency of a sail on a sailboat and give the designer the Prismatic Coefficient

B. Aerodynamic drag of a vehicle and can show how air currents move across around a vehicle with the use of smoke streams

C. Hydrodynamic efficiency of a model boat hull so designers can compare different shaped hulls without the expense of constructing full size hulls and extensive testing

D. Torque, horsepower, and fuel consumption of engines at different Rpm's and work loads by simulating actual working conditions

45. An example of potential energy would be a book:

A. Being raised to a shelf

B. Sitting on a shelf

C. Falling to the ground

D. Striking the ground

46. Anything that causes an object to move can be thought of as:

A. Horsepower

B. Torque

C. Force

D. Energy

47. An increase in force provided by a machine is a good definition of:

A. Efficiency

B. Work

C. A transmission

D. Mechanical advantage

48. A unit of measurement that will move a one pound load a distance of one foot is:

A. A newton

B. A foot-pound

C. One horsepower

D. One revolution per minute

49. The unit of measurement that will impact an acceleration of

one meter per second to a mass of one kilogram is a:

A. Newton

B. Meter-kilogram

C. Metric-ton

D. Metric equivalent of one horsepower

50. A disadvantage of maglev vehicles is:

A. Steering

B. Deceleration

C. High energy consumption

D. None of the above

51. According to Ted Brewer in his book Understanding Boat Design 4th Edition, a good Prismatic Coefficient for a light air sailboat is:

A. .48

B. .62

C. .78

D. .92

52. The center of flotation is analogous to the center of:

A. Pressure

B. Gravity

C. Buoyancy

D. Effort

53. The displacement of a boat refers to the:

A. Weight of the water it moves when placed into the water

B. Depth of boat sits below the surface of the water

C. Length times the width times the depth of a boat in the water

D. Shape of the hull below the water

54. A good sail area to displacement ratio for high performance sailboat racer would be:

A. 15 to 16

B. 16 to 17

C. 17 to 18

D. 20 or more

55. The mainsail of a sailboat:

A. Provides the main source of power for a sailboat

B. Is used primarily for sailing down wind

C. Is placed to the front and side of the boat

D. None of the above

56. The jib or a sailboat:

A. Provides the main source of power for a sailboat

B. Is primarily used for sailing down wind

C. Accelerates wind traveling across the back of the mainsail thereby increasing lift

D. All of the above

57. The spinnaker of a sailboat:

A. Provides the main source of power for a sailboat

B. Is primarily used for sailing down wind

C. Accelerates wind traveling across the back of the mainsail thereby increasing lift

D. All of the above

58. When building for an RC glider:

A. Start at the wing tips and work to the fuselage

B. Make sure that you use a lot of glue

C. Assemble the wings before placing camber on them

D. Make sure that both halves are balanced

59. The angle at which an aircraft's wing is in relation to the direction of travel of the aircraft is referred to as the:

A. Angle of attack

B. Aspect ration

C. Angle of incidence

D. Dihedral

60. A satellite having an equatorial orbit with an angular velocity the same as the earth, moon, or planet it is orbiting so that the position of the satellite is such an orbit is fixed with respect to that earth, moon, or planet is called:

A. Geostationary orbit

B. Geosynchronous orbit

C. Both A and B

D. Neither A nor B

61. In powered flight, if a rocket's center of gravity is farther from the nose that the center of pressure, the rocket will:

A. Fly smoothly

B. Become unstable

C. Move at its top speed

D. Have a low coefficient of drag

62. Telemetry refers to the:

A. Transmission of data usually by radio

B. Science of using telescopes to observe things such as planets

C. Method of location of space vehicles through triangulation

D. None of the above

63. Whether one is working with RC cars, boats, or planes, a RC set would include:

A. Transmitter, servo(s) and modulator

B. Transmitter, servo(s) and receiver

C. Transducer, servo(s) and resistor

D. Transducer, servo(s) and emitter

64. Which design criteria are most important for what one is designing will follow the fundamental principle of design that states "form follows":

A. Function

B. Aesthetics

C. Cost

D. Environmental impacts

65. Using an altitude tracker from 500' from your launch site, you launch a model rocket and track it to a maximum height which reads 45 degrees. How high did the rocket go?

A. 200 feet

B. 300 feet

C. 400 feet

D. 500 feet

66. In the design of transportation vehicles "vortices" refer to the:

A. Buoyancy of vessels in water

B. Patterns made by the fluid or air passing over or around the

vehicle

C. Ratio of the lift to the coefficient of drag of airfoils

D. Amount of air needed by an engine for its most efficient operation

67. What does the concept "engineering" refer to in criteria for good design?

A. How well is something built

B. How beautiful is it

C. How comfortable is it

D. How much will it cost

68. To increase the efficiency of Maglev vehicles, it is best to design bodies which have:

A. High drag indexes

B. Low drag indexes

C. A low coefficient of drag

D. A high coefficient of drag

69. The point at which all aerodynamic forces (thrust, drag, lift, and gravity) are working is termed center of:

A. Effort

B. Pressure

C. Balance

D. Gravity

70. The coefficient of drag is:

A. A number used by automobile designers to indicate how easily a vehicle cuts through the air

B. Is the angle a plane's wing meets the air

C. Is the resistance given as a factor of a product of a

vehicle's curvature

D. The water's resistance to the surface of a boat or ship

71. How much force on a sail verses how hard the sail pulls the boat is a question of the sail's:

A. Efficiency

B. Aerodynamic drag

C. Vortexes

D. Buoyancy

72. NASA can be accessed on the Internet and is an excellent source of scientific information. It is of special interest to designers of:

A. RC cars

B. RC boats

C. Model rockets

D. Model maglev trains

73. Bernoulli found that as the speed of a fluid is increased, its pressure is decreased. This makes which of the following possible?

A. Flight

B. Solar powered vehicles

C. Electric motors

D. Submarines

74. The aspect ratio refers to the:

A. Angle a plane cuts through the air compared to its thrust

B. Ration of a wing's span to its cord

C. Ratio of a ship's weight to what it can carry

D. Ratio of rocket's angle of re-entry to its speed

75. The higher the aspect ratio the grater the:

A. Plane's drag

B. Wing's efficiency

C. Tonnage a ship can carry

D. Rocket's re-entry speed

76. According to the NC Transportation Curriculum, when designers begin to design good products one of the first questions that should be asked is:

A. How much money will I make from this product

B. What purpose will this product serve

C. What will the aesthetic appeal of this product be

D. How can we market this product

77. It is important for someone studying transportation to understand Aerodynamics because:

A. Most forms of transportation will be affected by moving through air or air movement

B. A large number of transportation systems control and transmit energy through gases such as air

C. Transportation systems such as barges, ships, and submarines must travel through water

D. Almost all forms of transportation will use liquids to transmit and control energy

78. When designing and studying transportation systems it is important to understand hydronamics because:

A. Many transportation systems use liquids to transmit and control energy

B. Many transportation systems use gases such as air to control and transmit energy

C. Land and air forms of transportation are affected by hydronamics to a great degree

D. The study of water movement and objects moving through water constitute a large section of transportation

79. Center of gravity is:

A. The center of the thing that pulls us to the ground

B. The point at which all objects are balanced

C. The point at which all Aerodynamic forces are working

D. Analogous to the center of buoyancy on a hot air balloon

80. A land vehicle which uses magnetic fields to lift itself above the track it travels, is called a:

A. Monorail

B. Maglev train

C. Subway

D. Hovercraft

81. What is the correct term for the magnets which lift and maintain maglev trains above the track?

A. Positron

B. Negative force magnets

C. Lifting magnets

D. Repelling magnets

82. Magnets used in maglev vehicles used to propel the vehicles forward are called:

A. Positron magnets

B. Propulsion magnets

C. Conducting magnets

D. Repelling magnets

83. The material that produces little or no resistance to the flow of electricity and is used in making improved and highly efficient magnets are:

A. Super-conductors

B. Super-insulators

C. Electromagnetic converters

D. Nuclear magnetic generators

84. Instead of pounding along on tires or rails, maglev vehicles float on:

A. A hydroplane of water

B. A magnetic force field

C. A pneumatic bi-rail

D. Lift generated by Mag-wings

85. The superconducting magnets of the maglev train induce magnetism of the same polarity in the levitation magnet. As a result, the two sets of magnets:

A. Repel each other and push the train upward

B. Induce each other, and generate an electrical current to move the train

C. Attract each other, until they touch

D. Induce each other, and generate a nuclear reaction which propels the train

86. The three major advantages to using maglev trains are:

A. Speed, durability, and cost

B. Cost, size, and shape

C. Speed, quietness, and smoothness of ride

D. Speed, size, and cost

87. In geosynchronous orbit, a satellite:

A. Is always over the same spot on the earth

B. Is always moving randomly over the earth

C. Rotates, or spins, with respect to itself

D. Has no power

88. The speed of a maglev train is made faster or slower by the:

A. Size of the propulsion magnets used

B. Speed at which the polarity is reversed

C. Size of the levitation magnet

D. Direction of the thruster

89. The term "maglev" means magnetically:

A. Levitated

B. Launched

C. Levered

D. Leveled

90. In a maglev train system, the component that is used only

when the superconducting magnets are NOT activated are the:

A. Propulsion coils

B. Suspension coils

C. Guideways

D. Support wheels

91. The "center of buoyancy" is the center of the:

A. Main mast

B. Boat

C. Boat's displacement

D. None of the above

92. The "prismatic coefficient" is used to:

A. Compare the efficiency of sail shapes

B. Compare hull shapes

C. Estimate wind speeds

D. Determine the lift generated by sails

93. Center of Effort refers to the:

A. Amount of force applied by the wind on a sail

B. Amount of force needed to move a boat through the water

C. Center of the sail area

D. Center of balance of a boat

94. When the tip of each wing is higher than the center of the wing, this is referred to as:

A. Diangular

B. Dihedral

C. Transverse

D. Negative coefficient

95. The advantage of dihedral design is that it:

A. Reduces roll

B. Increases speed

C. Decreases yaw

D. Increases thrust

96. An RC glider can rise on a column of warm air to great altitudes. This column of air is called a/an:

A. Riser

B. Inversion

C. Thermal

D. Conversion

97. When constructing an RC glider, it is important that the wing has a:

A. Negative angle of incidence as well as the horizontal stabilizer

B. Negative angle of incidence and the horizontal stabilizer a positive angle

C. Positive angle of incidence as well as the horizontal stabilizer

D. Positive angle of incidence and the horizontal stabilizer a negative angle

98. When first testing your RC glider, you should launch:

A. From a hill top

B. Into a thermal

C. On a football field

D. With the wind

99. During the first test flight of your RC glider, if the plane stalls, you should:

A. Add nose weight

B. Reduce nose weight

C. Add left or right rudder

D. Use larger surgical tubing

100. As a glider turns downwind, it has a tendency for its airspeed (speed in relation to the air) to:

A. Increase

B. Decrease

C. Remain the same

D. Increase its lift

101. The NAR safety code for model rocketry states that a model rocket must not weigh more than:

A. 16 ounces at liftoff

B. 32 ounces at liftoff

C. 3.3 pounds at liftoff

D. 5 pounds at liftoff

102. According to the NAR, a model rocket may not have more than:

A. 4.4 ounces of propellant

B. 8 ounces of propellant

C. 16 ounces of propellant

D. 32 ounces of propellant

103. When preparing for rocketry photography, such as launching Astrocams, it is best to position the cameras:

A. At opposite ends of the rocket

B. Near the nosecone, opposite each other

C. On the shroud lines

D. At the bottom of the rocket, opposite each other

104. Clustering engines together in high-power rocketry should only be done with:

A. E20 composite engines

B. F40 composite engines

C. Black power engines

D. No type of engine, clustering is against the law

105. When launching rockets, the launch site must be a field which is wide enough. On a day with little wind, a good rule-of-thumb is that the field at its most narrow dimension must be at least:

A. 25 feet

B. 50 feet

C. 100 feet

D. Half of the maximum altitude the rocket will reach

106. In model rocketry, the best parachutes are made from:

A. Cotton

B. Nylon

C. Polyester

D. Wool

107. The formula H=OF/I (H is the height of the camera above the surface, O is the size of the object on the ground shown in the photo, F is the focal length of the camera, and I is the size of the same object's image as measured on the negative). This formula is used to measure the:

A. Size of the rocket

B. Altitude at which a photo was taken

C. Weight of the rocket

D. Type and size of engine(s) needed for the rocket

108. A "highpowered" model rocket is defined as a rocket propelled by one or more engines that provide a total impulse of more than:

A. 20 newton-seconds

B. 100 newton-seconds

C. 200 newton-seconds

D. 1000 newton-seconds

109. A typical model rocket transmitter can be divided into four basic sections which are:

A. RF section, modulator, controller, and AC power supply

B. RF section, transceiver, sensor, and AC power supply

C. RF section, modulator, sensor, and power supply

D. RF section, modulator, decoder, and controller

110. The apogee of a rocket is:

A. Connected to the nosecone

B. Its highest altitude reached

C. part of the electronic ignition system

D. Its angle of attack as it goes through the air

111. Generally, the higher a model rocket goes, the:

A. Smaller the parachute should be

B. Larger the parachute should be

C. Less number of shroud lines needed

D. Greater number of shroud lines needed

112. Constructing air planes with smooth-surfaced materials helps to reduce:

A. Drag

B. Lift

C. Thrust

D. Propulsion

113. Because of the shape of an airfoil relative wind moves at a greater velocity over the top of the airfoil. This is the key principle in causing:

A. Thrust

B. Drag

C. Lift

D. Both A and B

114. Bernoulli's principle states that as the speed of fluid:

A. Increases, pressure decreases

B. Decreases, pressure decreases

C. Stays constant, pressure increases

D. Stays constant, pressure decreases

115. Coefficient of drag is best reduced on a vehicle by:

A. Increasing its front profile

B. Increasing its wind resistance

C. Decreasing its front profile

D. Applying a heavy clear coat finish

116. Drag is the force that:

A. Resists the forward movement of a vehicle

B. Resists the rearward movement of a vehicle

C. Speeds up the forward movement of a vehicle

D. Speeds up the rearward movement of a vehicle

117. Stability may be greatly influenced by a vehicle's:

A. Shape

B. Proportions

C. Control system

D. All of the above

118. Work is force x distance; if a girl pushes a box with 50 pounds of force and moves it a distance of 0 feet, how much work has been done?

A. 0 foot pounds

B. 5 foot pounds

C. 50 foot pounds

D. 500 foot pounds

119. Torque is a force which is said to be:

A. Linear

B. Rotary

C. Oscillating

D. None of the above

120. An advantage of a maglev vehicle is its:

A. Speed

B. Energy needs

C. Power

D. Three degrees of freedom

121. A disadvantage of a maglev vehicle is its:

A. Slow

B. Noise

C. Bumpy ride

D. High energy consumption

122. Several types of sails are used on sailboats today. Which of the following is not used?

A. Mainsail

B. Jib

C. Spinnaker

D. Tacker

123. If a boat is traveling 20 knots, it is moving about:

A. 5 mph

B. 10 mph

C. 23 mph

D. 53 mph

124. A thermal is a column of:

A. Cool air rising

B. Warm air rising

C. Cool air falling

D. Warm air falling

125. Stall occurs on a plane when which of the following occurs?

A. When the plane is level with the ground

B. When the plane is slowly descending

C. When the plane is pitching very steeply

D. When the plane is on the ground

126. Generally the higher a model rocket goes the:

A. Smaller the chute should be

B. Larger the chute should be

C. Shorter the shroud lines must be

D. Longer the shroud lines should be

127. According to the NAR a model rocket may not have more than how many ounces of solid propellant:

A. 16 ounces

B. 20 ounces

C. 4 ounces

D. 1.0 ounces

128. Model rocket transmitters consist of all of the following except:

A. RF

B. Sensor

C. Modulator

D. Igniter

COURSE: **Transportation Systems**

UNIT B: **Fundamental Scientific and Technical Concepts and Principles Used in the Design of Complex Vehicular Transportation Systems.**

COMPETENCY: **003.00: Define and apply scientific and technical concepts and principles used in the design of actual and/or model complex vehicular transportation systems.**

OBJECTIVE: **003.02: Explain essential transportation design concepts.**

OUTLINE	RESOURCES

A. Purpose: Understanding fundamental design concepts is essential for the intelligent design, development, and evaluation of transportation systems and subsystems.
CG

B. Engineering Criteria
   1. Aesthetics and ergonomic
      a. Safety
      b. Comfort
      c. Efficiency

UNIT B

SCIENTIFIC AND TECHNICAL CONCEPTS AND PRINCIPLES

d. Beauty

2. Cost (How much to make and operate?).

CG

3. Engineering: How well is it built (materials, methods, and artisanship?).

   How good is the design?

   a. Material
   b. Manufacturing process
   c. Artisanship

4. Performance (How well does it do what it is supposed

CG to do?).

5. Environmental and social impacts (What are the impacts on the environment and society?).

C. Design-is the process of conceiving,inventing, and
CG organizing ideas mentally and communicating these
ideas to others in a form that is easily understood.

Two primary purposes of design include:

Personal Expression - Artistic/Form
Product/Process Development - Technical/Function

D. Product/Process Development is the primary design
CG type used in transportation. Two classifications for product development include:
Aesthetic - concerned with the look and feel of a product.
Functional - concerned with the function or mechanics of a product or process.

E. Both aesthetic and functional design concepts and
CG interrelated elements are critical to the design process. Listed below are those elements:
Unity-use of similar elements throughout the design
Style-addition of decoration to a product and linked to marketing
Line-another characteristic of a product, used to emphasize intended function
Space-relationship of a product to its background, and its negative elements

Mass-provides a sense of weight or heaviness
Proportion-relationship of the smaller elements to the whole design
Balance-gives the product equilibrium
Contrast-feature used to emphasize or de-emphasize certain design elements
Color-used to evoke emotion, weight, and enhance design form

F. Both aesthetic and functional design concepts
CG
are used during the Engineering (transportation systems included) Design Cycle. This cycle is defined as one process associated with the entire business, or enterprise, from receipt of the order or idea, to maintenance of the product, including all stages in between.

G. Design Cycle and Process. Listed below are the
CG
steps used by most manufactures:

Ideation-	problem identification
	preliminary ideas
	preliminary design
Refinement-	modeling
	design analysis
	design visualization
Implementation-	servicing
	financing
	marketing
	producing
	planning
	documenting

Activities: Teach fundamental design concepts with examples.

Teacher Directions
1.) Pass out Essential Transportation Design Concepts handout.
2.) Instruct students to use the Essential Transportation Design Concepts outline to design "The Next Hottest" form of personal transportation.
3.) Give recent examples: Windsurfer=Surfboard+Free Sail; Inline Skates-Ice Skates+Roller Skates; Snowboard=Skateboard+Skis;

Ultralight=Hang Glider+Powered Flight; Sky Surfing=Skydiving+snowboarding+Videography.

Student Directions

1.) It is your job to design "The Next Hottest" form of personal transportation.
2.) Use the Essential Transportation Design Concepts outline to design "The Next Hottest" form of personal transportation.

Evaluation

Safety	10 pts.
Comfort	10 pts.
Efficiency	10 pts.
Beauty	10 pts

Function 60 pts. total

Engineering Criteria:

Cost	10 pts.
Engineering	20 pts.
Performance	20 pts.
Environmental	10 pts.

Materials

1.) Outline of objective 3.02 to hand out to students.

Suggested Activities

1.) Have students use the Design Brief Outline (Comp. 6.00) to design and fabricate their "The Next Hottest" form of personal transportation.
2.) Research copy right laws and procedures and use the Implementation step of the Design Cycle and Process (obj. 3.2) to bring their "Next Hottest" form of personal transportation to market and make some money off of it, thereby becoming a teen guru of coolness.

Other Suggested Activities:

-Design and test boat hulls; as seen in TSM Connection Activities.
-Design and test an air foil.
-Design and test a vehicle model for automobiles-crash testing.
-Make a mouse trap car; make and design the cars to stop and move a certain direction.
-Apply various hydraulic and pneumatic circuits: i.e. dumptruck, backhoe, power brake, wing-flaps.
-Ramp testing for friction.
-Make a paper hovercraft for testing pressure.
-Appropriate TSA contests and activities.

VoCATS QUESTIONS

FOR

OBJECTIVE 3.02

1. In design, the process of conceiving and conveying ideas, has two main functions. They are:

A. To allow for artistic form

B. To allow for technical function

C. Both A and B

D. None of the above

2. Aesthetic form is concerned with the:

A. Look and feel of a product

B. Ergonomics of a product

C. Function of a product

D. Mechanics of a product

3. Functionality of a product is concerned with the:

A. Look and feel of a product

B. Ergonomics of a product

C. Function of a product

D. Aesthetics of a product

4. Aesthetic design concepts have related elements. Which of the following is NOT an aesthetic element?

A. Style

B. Line

C. Mass

D. Cost

5. The design element balance, is defined as:

A. A sense of weight or heaviness

B. Product equilibrium

C. That which is used to evoke emotion

D. The use of similar elements throughout the design

6. The Design Cycle and Process is made up of which of the following processes?

A. Ideation

B. Refinement

C. Implementation

D. All of the above

7. During the design cycle and process, the first stage is which of the following?

A. Problem identification

B. Design analysis

C. Planning

D. Modeling

8. The refinement process during the design cycle includes which of the following?

A. Marketing

B. Design visualization

C. Documenting

D. Financing

9. During the implementation stage of the design cycle, which element is included?

A. Problem identification

B. Design analysis

C. Servicing

D. Research and design

10. What is the process of conceiving, inventing, and organizing ideas mentally and communicating these ideas to others in a form that is easily understood?

A. Drafting

B. Protyping

C. Manufacturing

D. Design

11. Which design concept is concerned with the look and feel of a product?

A. Aesthetic

B. Function

C. Comfort

D. Materials

12. Which design concept is concerned with the mechanics of a product or process?

A. Design

B. Function

C. Manufacturing

D. Production

13. Which of the following design elements is used in the design process to give the design equilibrium?

A. Unity

B. Color

C. Balance

D. Mass

14. Which of the following design elements is used in the design process to evoke emotion, weight, and enhance design form?

A. Utility

B. Engineering

C. Efficiency

D. Color

15. Which of the following design elements is used in the design process to emphasize or de-emphasize certain design elements?

A. Contrast

B. Proportion

C. Space

D. Style

16. Which of the following design elements is used in the design process to provide a sense of weight or heaviness?

A. Unity

B. Mass

C. Proportion

D. Space

17. Which of the following design elements is used in the design process to ensure similar elements are used throughout the design?

A. Proportion

B. Space

C. Unity

D. Balance

18. During the design process, engineering criteria for the aesthetics an ergonomics of a product includes which element?

A. Unity

B. Material

C. Primary design

D. Safety

19. Ergonomics in the design process includes all of the following EXCEPT:

A. Function

B. Comfort

C. Aesthetics

D. Beauty

20. During the refinement stage of the design cycle, which of the following is considered during this stage?

A. Style

B. Design analysis

C. Financing

D. Space

21. When evaluating the design of a product, considering how well the product works is called:

A. Development

B. Efficiency

C. Performance

D. Manufacturing process

22. A Design Brief is used before the fabrication of a vehicle. The first step is the development of a design brief is:

A. To give a clear statement of the problem

B. The research and review of literature

C. Determine the specific design elements you will focus on

D. List the step-by-step process involved

23. The third step in the development of a Design Brief is:

A. The research and review of literature

B. To give a clear statement of the problem

C. Determine the specific design elements you will focus on

D. List the step-by-step process involved

24. The final section of the Design Brief contains the:

A. Evaluation Criteria

B. Drawings, Bibliography, and Attachments

C. Plan of Work

D. Research and Review of Literature

COURSE:	**Transportation Systems**
UNIT B:	**Fundamental Scientific and Technical Concepts and Principles Used in the Design of Complex Vehicular Transportation Systems.**
COMPETENCY:	**003.00: Define and apply scientific and technical concepts and principles used in the design of actual and/or model complex vehicular transportation systems.**
OBJECTIVE:	**003.03: Using a design brief, conduct, and evaluate lab experiments relating to scientific principles found within transportation systems.**

OUTLINE RESOURCES

A. Purpose

The purpose of any experiment is to better understand the concepts and principles you are going to be working with. By using a **Design Brief** you can better identify and define a problem, focus on important factors related to the problem and problem solutions, and successfully plan the solution to the identified problem. Use of a **Design Brief** increases the efficiency of the problem solver and the quality of the solution.

B. Activities

Experimentation dealing with key scientific and technical concepts and principles directly related to the student's planned complex transportation vehicular system.

C. Problem

Working individually or as a team have the students conduct the following or comparable experiments.

1. Land transportation experiment

<u>Friction</u>

Following a design brief outline, make two land vehicles that are the same in all aspects except friction on axles. One set made with no friction reduction methods and the second with friction reduction methods (such as bushings, bearings, and/or lubrications). Test by rolling the two different types down a ramp and record the distances traveled. Construct a graph of all vehicles and compare.

2. Water transportation experiment

<u>Displacement, Draft, and Buoyancy</u>

Place different shaped objects in a tank very full of water. Catch the water that flows out of the tank. This is **Displacement**. Weigh the water and record the weight. Weigh the object. If the object weighs more than the water it displaced it will sink. If it weighs less, it will float. This is **Buoyancy**. If it weighs less than the water it displaced determines how much more weight the object could possibly carry without sinking. If this were a boat, this would be the load it could carry. Mark a line on the objects that float and add weight to them until they float even with the line. This line becomes the waterline and the depth that the object sets below the water is the **Draft** of an object.

3. Air transportation experiment

<u>Pitch, Roll, and Yaw</u>

Construct paper gliders from a stiff paper. Cut elevators, ailerons, and a rudder. Manipulate the control flaps on each glider to demonstrate changes in pitch, roll and yaw.

4. Space transportation experiment

<u>Stability of Rockets</u>

Place a rocket engine in the rocket you have constructed. Tie a five-foot long string around the fuselage so that the rocket's nosecone is 10 degrees below horizontal. Tape the string to the fuselage so it will not slip. Stand in an open area and swing the rocket around over your head. Observe the way the rocket files. If it flies smoothly with the nose cone forward, then it is a stable rocket. If it wobbles, or flies sideways, or backwards, it is unstable and can be dangerous to launch. All custom made rockets should be tested for stability before launching to prevent possible injury or damage to the rocket or property.

D. Materials and Equipment

<u>Materials and Equipment for friction experiment</u>
2 - CO2 car body blank
4 - Axles
Ramp
Drill press
Various bearings
Various bushing materials
Several types of lubricants
Design Brief Outline
Graph Paper

<u>Materials and Equipment for Displacement, Draft and Buoyancy Experiment</u>
Water tank (large enough to test all the objects you intend to test)
Several objects that will sink and float
Marker (for marking a waterline)
Jar to catch the overflow of water
A spout attached to the tank to direct overflow into a jar

Scales
Weights (small and large)
Design Brief Outline

<u>Materials and Equipment for Pitch, Roll, and Yaw Experiment</u>
Stiff paper (colored construction paper works well)
Scissors
Paper clips (to weight the nose of the gliders)
Tape
Design Brief Outline

<u>Materials and Equipment for Stability of Rockets Experiment</u>
Model rocket
Five foot length of string
Tape
Design Brief Outline

TEACHER INSTRUCTIONS:

Use the appropriate student instructions for each mode. Explain to the students the step by step procedures to follow and how they will be evaluated for the activity. Evaluate using the following design criteria.

STUDENT INSTRUCTIONS:

<u>Air Transportation Experiment</u>
<u>Pitch, Roll, and Yaw Experiment</u>
1. Use glider plan handout to make test glider from stiff construction paper.
2. Trim the glider by placing a paper clip on the nose and move it froward and back until the glider glides smoothly in a straight line.
3. Cut elevators, ailerons and a rudder in the glider.
4. Manipulate each individually and record what the gilder does.

<u>Space Transportation Experiment</u>
<u>Stability of Rockets</u>
1. Place a model rocket engine that you intend to launch your rocket with into your rocket. (*Note-different size rocket engines weigh different amounts. A rocket may be stable with one size engine but not with another).
2. Tie a loop in the end of a string.

3. Place the loop around the fuselage of the rocket so that the rocket balances with the nose cone 10 degrees down from horizontal.
4. Tape the string to the fuselage so it won't slip.
5. Swing the rocket around above your head. The longer the string and the slower you can swing the rocket the better.
6. Record how the rocket flies.

<u>Water Transportation Experiment</u>
<u>Buoyancy, Displacement, and Draft Experiment</u>

1. Bring several differently shaped objects or boat hull designs to school to test.
2. Locate, build or modify a tank that yo can fill to the point that it just doesn't overflow and that you can catch the overflow in a jar.
3. Weigh the jar and record its weight.
4. Fill the tank with water and place a jar so it will catch the overflow water.
5. Place an object in the water.
6. Wait until all the water that is going to has drained into the jar.
7. Weigh the water and jar. Subtract the weight of the empty jar. Record the weight of the water displaced.
8. Weigh the object. Record its weight.
9. Repeat steps 4-8 with several different objects. What did you notice. Record your conclusions in the appropriate section of the Design Brief.
10. With the objects that sank, record how much weight would have to be removed from them to float.
11. With the objects that float, how much more weight can they carry before they sink.
12. On the objects that float, mark a line at the water level (the point around the object that the water is when the object is floating calmly in the tank).
13. Take the object and measure the distance the object had sank below the water. This is the objects Draft.

<u>Land Transportation Experiment</u>
1. Make two land vehicles that are the same in all aspects except friction on axles. One set made with no friction reduction methods and the second with friction reduction methods (such as bushings, bearings, and/or lubrications).
2. Test by rolling the two different types down a ramp and record

the distances traveled.
3. Construct a graph of all vehicles and compare.

Evaluation Criteria:

Problem Identification and Definition	5 pts.
Research and Review of Literature	20 pts.
Evaluation of Appropriate Systems	5 pts.
Plan of Work	20 pts.
Expected Outcomes	5 pts.
Evaluation Criteria	5 pts.
Evaluation	20 pts.
Drawings and Bibliography	20 pts.
Overall Design Brief Total:	100 points

Suggested References

Technology, Science, Mathematics Connection Activities: A Teacher's Resource Binder, by James LaPorte & Mark Sanders. Glencoe/McGraw-Hill: New York, 1996.

Other Suggested Activities

- Design and test boat hulls; as seen in TSM Connection Activities.
- Design and test an air foil.
- Design and test a vehicle model for automobiles-crash testing.
- Make a mouse trap car; make and design the cars to stop and move a certain direction.
- Apply various hydraulic and pneumatic circuits: i.e. dumptruck, backhoe, power brake, wing-flaps.
- Ramp testing for friction.
- Make a paper hovercraft for testing pressure.

VoCATS QUESTIONS

FOR

OBJECTIVE 3.03

INSTRUCTIONS TO THE STUDENT: Using a simple design brief, conduct and evaluate a lab experiment relating to a scientific principle found within transportation systems. Identify and define the problem you wish to focus on and obtain the teachers permission before proceeding with he research and experiment(s).

Select a scientific phenomena or technical principle related to transportation systems. Using the design brief provided to you by your teacher, follow the outline. Ask your teacher to explain any instructions you find confusing. Once you have identified and defined a problem, receive your teacher's permission before proceeding on to your research and laboratory experiment(s). Make sure you understand what is expected of you and how your experiment will be assessed.

TEACHER INSTRUCTIONS: Have the students perform laboratory experiments on a scientific phenomena related to transportation systems. Provide each student or student teams a copy of the simple design brief outline (evaluation criteria). You may shorten the design brief as you see fit or give them the complete design brief found within your curriculum guide. Require the student to submit their problem to you for approval before they begin their research and lab experiments. See the curriculum guides for sample activities. Use the following criteria for evaluation and modify as needed.

UNIT C

HISTORICAL DEVELOPMENT AND TRENDS

Evaluation:

Problem identification and definition	5 points
Research and review of literature	15 points
Plan of work	15 points
Expected outcomes of experiment	5 points
Student's written evaluation of the experiment	15 points
Student's oral report and demonstration of the experiment	15 points
Creativity and ingenuity of experiment	15 points
Experiment success (clearly demonstrated scientific or principle)	15 points
Total Possible Points	100

COURSE: **Transportation Systems**

UNIT C: **Historical Developments and Trends of Transportation Systems**

COMPETENCY: **004.00: Analyze important historical developments and trends in transportation systems.**

OBJECTIVE: **004.01: Organize and explain major developments in the evolution of transportation systems.**

OBJECTIVE RESOURCES

A. Purpose

Transportation technology has had an impact on our society throughout history. This activity is designed to create an awareness of the foundational technical developments that have shaped modern transportation technology.

B. Recognize and explain the importance of transportation developments including the following:
Major (significant and transformational) developments of transportation systems.

1.	The Wheel - On flat terrain, the wheel is more efficient and faster than a sled.	CG
2.	The Sail - Lateen sail improved efficiency and freedom of movement.	CG
3.	The Steam Engine - Central importance to industrial revolution, ships and trains.	R1/173
4.	The hot-air balloon - The Montgolfier Brothers fly first one in 1783.	R1/135
5.	The first powered heavier-than-air flight - Wright Brothers - 1903.	R1/136
6.	Ford Model T (Freedom of movement for citizens)	R1/110
7.	Robert Goddard launches the first liquid fueled rocket - 1926.	R1/147
8.	The first satellite - Russian Sputnik 1 - 1957.	R1/148
9.	The first human in space - Russia's Yuri Gagarin.	R1/148
10.	The first lunar landing - Neil Armstrong & Edwin Aldrin - 1969.	CG
11.	The dugout canoe-preceded the wheel, horse, and sailing vessels.	CG
12.	Subways - Development depended on electric propulsion.	CG
13.	The first steam locomotive - Less expensive, more reliable than horse drawn vehicles - important role in settlement of the West - 1825.	CG
14.	Unmanned space flight (Mariner & Pioneer) - Allow gathering of information from distances to far for manned space flight.	CG
15.	Modern commercial jet airplanes such as the Boeing 747 travel at over 300 mph.	CG
16.	The Quadrant - Early sailors used this for determining latitude.	CG
17.	Pack animals - can carry more weight than humans (a camel can carry up to 1000 lbs.)	CG
18.	The Compass - Allows for maintaining a constant course of travel.	CG
19.	Steamships - Were less expensive and more reliably	CG

powered than sailing ships.
20. Roman Roads - Allowed for increased trade and communications and movement of troops. CG

Activity:

The students will design a timeline that will illustrate the identified technical developments and present this information to the class for discussion. See 4.02 Performance Activity.

Other Suggested Activities:

-Research, design, and make a historical transportation device
-Make a 3-D timeline (i.e. use pictures, etc.)

VoCATS QUESTIONS

FOR

OBJECTIVE 4.01

1. The first powered flight was accomplished by:

A. Orville and Wilbur Wright

B. Otto Lilienthal

C. Hugo Junkers

D. Charles Lindbergh

2. What two inventions set the stage for automobiles?

A. The carriage and the bicycle

B. The steamboat and the bicycle

C. The steamboat and the carriage

D. The electric motor and the bicycle

3. Henry Ford made the automobile:

A. Affordable

B. Hard to operate

C. A luxury only the upper-class could afford

D. Expensive

4. In 1919, American Dr. Robert H. Goddard published a book, <u>A Method of Reaching Extreme Altitudes</u>; he designed and launched the first:

A. I.C.B.M.

B. Liquid-fueled rocket

C. Satellite

D. None of the above

5. Which of the following statements concerning space mode is NOT true?

A. First satellite is the Russian SputnikI

B. First lunar landing is Neil Armstrong and Edwin Aldrin

C. First casualties of the space program happened on Apollo 13

D. First human space flight is Russia's Yuri Gagarin

6. The development of the hot air balloon:

A. Made the Montgolifier Brothers famous

B. Allowed for its use in war

C. Started a new tourist industry

D. Showed that cold air rises

7. The launch of the first liquid fueled rocket by Robert Goddard:

A. Was the beginning of the space race

B. Proved that the US was better than Russia

C. Proved that liquid rockets were better than solid fueled rockets

D. Paved the way for manned and unmanned space vehicles

8. Robert Goddard launched the first:

A. Glider

B. Kite

C. Hot air balloon

D. Liquid fueled rocket

9. The launch of SputnikI started the:

A. First World War

B. Space age

C. Information age

D. Communication age

10. The first powered heavier-than-air flight was made by:

A. John Glenn

B. The Wright Brothers

C. The Montgolfier Brothers

D. Amelia Earhart

11. Because they were more reliable and less expensive, sailing ships were replaced by:

A. Steamships

B. Airplanes

C. Trains

D. Submarines

12. The development of electric power for propulsion allowed for the construction of:

A. Super trains

B. Steamboats

C. Subways

D. Automobiles

13. Which mode of transportation played an important role in the settlement of the west?

A. Railroads

B. Highways

C. Canals

D. None of the above

14. What is the advantage of railroads?

A. Less expensive than trucking

B. More reliable than most cars

C. Used to carry large shipments over long distances

D. All of the above

15. Yuri Gagarin was the first:

A. To break the sound barrier

B. Man to sail across the Atlantic

C. Human in space

D. Man to ride in a hot-air balloon

16. This invention helped sailors maintain a constant course:

A. Compass

B. Quadrant

C. Ballast

D. Telescope

17. Air transportation is the fastest mode of travel because:

A. Airplanes can fly in a straight line

B. Most planes are much faster than land vehicles

C. There are no speed limits

D. All of the above

18. Henry Ford's use of the assembly line to produce Model Ts made them:

A. More expensive

B. Cost the same

C. Less expensive

D. None of the above

19. The rise of the Roman Empire depended on their:

A. Chariots

B. Coliseums

C. Monotheism

D. Roads

TEACHER INSTRUCTIONS: Before starting either activity, review the concepts and principles of technology assessment as found in the Fundamentals of Technology curriculum.

The first suggested activity requires the student to interview (see Interview Form -1) an older member of their family or an older friend of the family. The interview will focus on transportation systems or subsystems (cars, planes, roads, transmission system) from a historical perspective. The interview should help the student gain a better, more complete, complex, and intimate understanding of how changes in transportation technology has effected individuals and society. Upon completion of the interview, the student is required to give a five minute presentation sharing his or her insights with the class.

1. Review with the students the concepts and principles of technology assessment and interviewing etiquette. If a tape-recorded is to be used, the student should first ask for the interviewee's permission.
2. Provide the students with copies of the questionnaire.
3. Review with the students the Interview Form - 1.
4. Explain precisely what is expected of each student in performing the questionnaire and how much time will be allotted to complete the task.

5. Explain the criteria you will be using for assessing the questionnaire activity.
6. Have the students present their findings to a small group or the entire class.
7. Use the following criteria for assessing the questionnaire activity.

Evaluation:

Interview (Thorough and interesting)	0-40 points
Summary (Clear, comprehensive, insightful and interesting)	0-40 points
Report (Clear, comprehensive, insightful and interesting)	0-20 points
Total Possible Points	100 points

COURSE: **Transportation Systems**

UNIT C: **Historical Developments and Trends of Transportation Systems**

COMPETENCY: **004.00: Analyze important historical developments and trends in transportation systems.**

OBJECTIVE: **004.02: Analyze the foundational technical developments of transportation systems.**

OBJECTIVE	RESOURCES

A. Purpose:

Transportation technology has had an impact on our society throughout history. This activity is designed to create an awareness of the foundational technical developments that have shaped modern transportation technology.

B. Working as individuals or team members have the students complete the following: CG

1. Evaluate the social, economic, and environment impacts of the device.
2. Write a technical report reporting on the preceding information.
3. Present the research finding to the class using appropriate presentation media.

<u>TIMELINE ACTIVITY</u>

Purpose:

To allow students an opportunity to illustrate significant technical developments and present this information to the class.

Activity:

Timeline

Problem:

Make a timeline covering the years specified by your teacher and give a presentation on an event in history.

Materials:

Paper
Pencil
Ruler

Evaluation:

Timeline = 50 pts.
a. neatness = 10 pts.
b. effort = 10 pts.
c. 1pt/date = 30 pts.

Presentation = 50 pts.
a. use of media = 25 pts.
b. explanation = 25 pts.

TEACHER INSTRUCTIONS;

1. Obtain materials for students.
2. Provide resources for research on historical event (i.e. text books, library, magazines, internet)
3. You may either use list in the curriculum guide or have students find their own dates.
4. Students may want to make models, posters or use multimedia for their presentations.

STUDENT INSTRUCTIONS:

1. Work in groups of two. Measure and cut 1.5m of adding machine paper.
2. Use a meter stick to draw a line on the paper.
3. Use a scale of 5cm = 100 years.
4. Chart each of the following events in history at the appropriate place on the timeline. Write the date and event at each location.

* 1725 Steam engine developed
* 1769 First steam powered land vehicle (car)
* 1783 First hot-air balloon flight
* 1807 Robert Fulton and his steamboat make their first successful voyage

* 1828 First passenger railroad is begun
* 1838 **Sirius**, a British ship, is the first steam powered ship to cross the Atlantic
* 1857 First passenger elevator is installed in New York
* 1869 First transcontinental railroad is completed
* 1880 First electric cars appear in Europe
* 1893 The Duryeas build the first successful American gasoline-powered car
* 1897 The first practical subway is opened in Boston

* 1902 Using assembly line, Oldsmobile increases production from 425 to 5,000 cars per year

* 1903 First powered heavier-than-air flight by the Wright brothers
* 1913 Henry Ford reduces production time by using conveyor belts on his assembly line
* 1926 Robert Goddard launches the first liquid fueled rocket
* 1929 Lt. James Dolittle pilots airplane using nothing but instruments
* 1933 The **Autobahn**, a superhighway, is opened in Germany
* 1947 Capt. Charles Yeager breaks the sound barrier
* 1954 The first nuclear-powered submarine, the **Nautilus**, is commissioned
* 1957 The Soviet Union's Sputnik 1 becomes the first artificial satellite to orbit the earth
* 1958 The Federal Aviation Administration (FFA) is established
* 1959 The St. Lawrence Seaway opens
* 1964 Japanese Tokaido "Bullet Train" is opened and travels in excess of 130 mph
* 1969 Neil Armstrong becomes first man to walk on the moon
* 1976 Viking 1 lands on Mars to record data
* 1978 Americans Larry Newman, Maxie Anderson and Ben Abruzzo make the first balloon flight across the Atlantic Ocean
* 1981 The U.S. launches the space shuttle **Columbia**
* 1986 Voyager, piloted by Dick Rutan and Jeana Yeager, makes the first nonstop flight around the world without refueling
* 1987 Japan and West Germany test prototype trains with speeds up to 250 mph
* 1990 World motor vehicle production exceeds 48 million; 20% are made in U.S.

5. Prepare and give a presentation on an event in history.

ACTIVITY:

Have students research identified foundation technical, and historical developments of transportation. Students will identify the significant technical innovation and the significant social, economic, and environment impacts. Use handout on impact of technology.

A. Purpose

Transportation technology has had an impact on our society throughout history. This activity is designed to create an awareness of the foundational technical developments that have shaped modern transportation technology.

B. Activity

Technical Research and Report

C. Problem

Research identified foundation technical, and historical developments of transportation. Students will identify the significant social, economic, and environment impacts.

D. Materials

Paper
Pencil
Access to library
Access to Internet
Classroom resources (textbooks and magazines)

E. Evaluation

1. Research is thorough and focused	20 pts.
2. Experiment has been well thought out and conducted properly. Measurements are accurate and recorded correctly using appropriate quality tools	30 pts.
3. Report is well written, complete, and	30 pts.

technically correct. Bibliography, sketches and appropriate drawings are included

4.	Presentation is clear, well organized, interesting, and has necessary supporting graphics.	20 pts.
	Total Possible Points	100

TEACHER DIRECTIONS

Using the knowledge and insights gained from their previous experiments, the students should research an important transportation historical development. The students should conduct and evaluate laboratory experiments related to this development and present their findings to the class.

Have the student, working individually or in small groups, conduct research, design, conduct, and evaluate laboratory experiments related to the evolution of a transportation vehicular system as well as develop a report which includes sketches, drawings, and a bibliography of research text. Finally, have the students present their finding to the rest of the class.

Encourage the students to use the skills they have already learned from the previous laboratory experiments. An example of an activity could be experimental inquiry into the different types of fuel distribution systems (carburetors, throttle body injection, fuel injection) and how the temperature and humidity affect their operation.

Problem: Research identified foundation technical, and historical developments of transportation. Students will identify the significant social, economic, and environment impacts.

STUDENT INSTRUCTIONS

Working as individuals or team members, complete the following:

1. Evaluate the social, economic, and environment impacts of the device.
2. Write a technical report reporting on the preceding information.

3. Present the research findings to the class using appropriate presentation media.

Evaluation:

1.	Research is thorough and focused	20 pts.
2.	Experiment has been well thought out and conducted properly. Measurements are accurate and recorded correctly using appropriate quality tools	30 pts.
3.	Report is well written, complete, and technically correct. Bibliography, sketches and appropriate drawing are included	30 pts.
4.	Presentation is clear, well organized, interesting, and has necessary supporting graphics	20 pts.
	Total Possible Score	100

Other Suggested Activities:

-Research, design, and make a historical transportation device

-Make a 3-D timeline (i.e. use pictures, etc.)

VoCATS QUESTIONS

FOR

OBJECTIVE 4.02

INSTRUCTIONS TO THE STUDENTS: Analyze a fundamental development in transportation systems. You will be evaluated on your research, experiments, report, and presentation. Using the knowledge and insights gained from your previous experiments, research an important transportation historical development. Conduct and evaluate laboratory experiments related to this development and present your findings to the rest of the class.

TEACHER INSTRUCTIONS: The second suggested activity requires student teams to weight the consequences a transportation system or subsystem could have upon society, the economy, and the environment (such as a highway through wood lands or an urban community, or the impacts of any one of the vehicular systems (automobiles, trains, planes, ships). Teams will identify and define transportation systems impacts then research the major issues involved. Teams will divide to support or defend their findings and finally present their findings to the rest of their class.

1. Review with the students the concepts and principles of technology assessment.
2. Divide the class into teams of 6 or 10 students each.
3. Choose or permit the teams to choose (using brainstorming and nominal group technique) a technology impact issue related to transportation. See above examples. Students should 1) identify a problem, and 2) define the problem.
4. Divide each team into two groups, one to oppose the implementation of a proposed (or already implemented transportation system project), the other to support the project.

   NOTE:
   An alternative to the above is to divide the class into smaller teams of 3 to 5 students and to permit each team to conduct a technology assessment on a system (or subsystem) of transportation. Upon completion of the research, the team will present both pro and con arguments for the transportation issue under study.

5. Provide sufficient time for student research and teaming.
6. Have each team present their arguments, pro and con, to the entire class regarding the implementation of the transportation technology.
7. Provide time for the rest of the class to offer their insights on the issues as well as their opinions to the strengths and weaknesses of the presenting team's arguments.

8. Briefly review what is expected of each student, how much time they will be given to complete the task, and how they will be evaluated.
9. Use the following criteria for assessing this activity.

Evaluation:

Problem Identification and Statement (clear appropriate, reasonable)	0-15 points
Research (thorough, effective, documented)	0-30 points
Report (clear, comprehensive, well written-arguments were well supported and convincing)	0-40 points
Group/Class Presentation (clear, well organized, interesting, well argued)	0-15 points
Total Possible Points	100

TEACHER INSTRUCTIONS: Using the knowledge and insights gained from their previous experiments, the students should research an important transportation historical development. The students should conduct and evaluate laboratory experiments related to this development and present their findings to the class.

Have the students, working individually or in small groups, conduct research, design, conduct, and evaluate laboratory experiments related to the evolution of transportation vehicular systems as well as develop a report which includes sketches, drawings, and a bibliography of research text. Finally, have the students present their findings to the rest of the class.

Encourage the students to use the skills they have already learned from previous laboratory experiments. An example of an activity could be experimental inquiry into the different types of fuel distribution systems (carburetors, throttle body injection, fuel injection) and how the temperature and humidity affect their operation.

Evaluation:

1.	Research is thorough and focused	20 points
2.	Experiment has been well thought out and conducted properly. Measurements are accurate and recorded correctly.	30 points
3.	Report is well written, complete, and technically correct. Bibliography sketches and appropriate drawings are included	30 points
4.	Presentation is clear, well organized, interesting, and has necessary supporting graphics.	20 points
	Total Possible Points	100

COURSE: **Transportation Systems**

UNIT C: **Historical Developments and Trends of Transportation Systems.**

COMPETENCY: **004.00: Analyze important historical developments and trends in transportation systems.**

OBJECTIVE: **004.03: Evaluate personal interests and attributes in relation to transportation.**

OBJECTIVE	RESOURCES

A. Purpose:

An underlying assumption of our technology program (as with all programs within our schools) is to help students become responsible, participating, and successful citizens. Part of this goal can be achieved by helping students identify career opportunities in areas that they have strong interests and aptitudes. The teacher plays a role in bringing this about. Insist that each student reflect upon their interests, skills, further education, and future, in relation to career opportunities.

B. Activity

Research Transportation technology career opportunities and assess one's CDP (Career Development Plan) in relation to those opportunities.

C. Problem

Assess one's career opportunities within the area of Transportation technology.

D. Materials, Equipment, and Resources

1. Access to guidance counselors

2. Internet

3. Newspapers

4. Occupational Outlook Handbooks

5. Speakers from communication occupations

TEACHER INSTRUCTIONS:

1. Review with the students career opportunities within the area of transportation technologies. **R1:** 421-426
2. Permit the students access to the Occupational Outlook

   Handbook, newspaper want ads, the Internet, guidance counselors, and speakers from transportation related occupations.
3. Have the students complete selected (by you) activities from the Transportation Systems Student Activity Manual "Finding a Job", "Personal Information Sheet", "Careers in Transportation", and "Summer Jobs". Modify as necessary.
4. Have the students present a brief report of their research.
5. With the help of their counselors, have the students update their CDP's (Career Development Plan) as necessary.
6. Evaluate their performance using the following criteria:

STUDENT INSTRUCTIONS:

1. Review career opportunities within the area of transportation
2. Research the availability of transportation technology jobs using available resources (such as the Occupational Outlook Handbook, newspaper want ads, the Internet, guidance counselors, and speakers from transportation related occupations.
3. Complete the activities sheets provided by your teacher.
4. Present a brief report on your findings.
5. You will be responsible for explaining the following:
   a. Job title(s)
   b. Description: Skills (technical and personal) required
   c. Education and training required
   d. Salary range
   e. Local job opportunities (of the job(s) you have identified)
   f. Your personal assessment
      1. Does this job fit your interests and capabilities?
      2. Will this job provide you an acceptable income?
6. Update your CDP (Career Development Plan) if required.

7. Your report will be assessed using the following criteria:

Evaluation:

Investigation and Research	0-50 points
Message (report) Design	0-50 points
Report is clearly written and well thought out.	
Total Possible Points	100

Other Suggested Activities:
-Have a guest speaker about careers in transportation
-Visit a transportation facility
-Using available resources, have students update their CDP's in relation to their Transportation Systems course experiences

VoCATS QUESTIONS

FOR

OBJECTIVE 4.03

INSTRUCTIONS TO THE STUDENT: Evaluate your personal interests with regards to transportation occupations. Give a report to your class on your findings. Update your career development plans.

1. Review career opportunities within the area of transportation.
2. Research the availability of transportation technology jobs using available resources (such as the Occupational Outlook Handbook, newspaper want ads, the Internet, guidance counselors, and speakers from transportation related occupations).
3. Complete the activities sheets provided by your teacher.
4. Present a brief report on your findings.
5. You will be responsible for explaining the following:
    A. Job title(s)
    B. Description; Skills (technical and personal)

required

   C. Education and training required
   D. Salary range
   E. Local job opportunities (of the job(s) you have identified)
   F. Your personal assessment
      1. Does this job fit your interests and capabilities?
      2. Will this job provide you an acceptable income?

6. Update your CDP (Career Development Plan) if required.
7. Your report will be assessed using the following criteria.

TEACHER INSTRUCTIONS:

1. Review with the students career opportunities within the area of transportation technologies. (R1: 421-426)
2. Permit the students access to the Occupational Outlook Handbook, newspaper want ads, the Internet, guidance counselors, and speakers from the transportation related occupations.
3. Have the students complete selected (by you) activities from the Transportation Systems Student Activity Manual "Finding a Job", "Personal Information Sheet", "Careers in Transportation", and "Summer Jobs". Modify as necessary.
4. Have the students present a brief report of their research.
5. With the help of their counselors, have the students update their CDP's (Career Development Plan) as necessary.
6. Evaluate their performance using the following criteria:

Evaluation:

Investigation and research	0-50 points
Report - (report was clearly written and thought out).	0-50 points

Total Possible Points	100

UNIT D

VEHICULAR SYSTEMS AND SUB-SYSTEMS

COURSE: **Transportation Systems**

UNIT D: **Vehicular Systems and Sub-Systems**

COMPETENCY: **005.00: Explain the fundamental concepts and principles of transportation vehicular sub-systems.**

OBJECTIVE: **005.01: Explain the fundamental concepts, principles and applications of transportation propulsion systems.**

OBJECTIVE RESOURCES

A. Purpose: Understanding the fundamental concepts and principles of transportation propulsion systems is essential for the intelligent design, development, and evaluation of transportation systems and subsystems.

B. Types of propulsion systems and devices and their uses and theories of operation:

1. Heat engines

   a. External combustion — R3/149
      1. Steam engine engines
         a - Steam engine-reciprocating motion — R3/154
         b - Steam Turbine-rotary motion (power nuclear subs)

   b. Internal combustion engines — R3/154
      1. Gasoline piston engines — R3/159
         a - Pistons produce a reciprocating motion — R3/159
         b - Gasoline engines operate on two-stroke or four-stroke cycles — R3/160
      2. Rotary engines(have no reciprocating parts) — R1/179, 180
         a - Produce rotary motion and run smoother than reciprocating piston engine
      3. Diesel engines
         a - Fuel is ignited in a diesel engine by compression
         b - One advantage of a diesel engine is it's

fuel economy and reliability

c. Reaction Engines R1/180
   1. Types of airstream and rocket engines
   2. Newton's Third Law of Motion (for every CG action there is an equal and opposite reaction)
   3. Reaction engines produce a linear motion called thrust R1/181

   4. Rocket Engines (are by far the most powerful type of internal combustion engines) R1/184

2. Electric motors
   a. Universal
   b. Induction
   c. Electromagnetism (maglev) R1/118, 187/CG
3. Diesel electric motors
   a. Modern locomotives use diesel engines to power electric motors
4. Propellers
   a. Pitch is the angle of the propeller blades
   b. Pitch measurement determine the number of inches it will move forward per rotation
   c. Lower pitch, greater pulling power higher pitch less

Activity:

Four Stroke and Two Stroke small engine maintenance and repair

Study the fundamental concepts, principals, and applications of the internal combustion engine in transportation propulsion systems.

Materials:
-Small engine tools
-Four/Two Stroke engines w/manuals

TEACHER INSTRUCTIONS

1. Review internal combustion engine concepts
2. Identify major parts of Two/Four engines
3. Review procedures and importance of maintenance (changing oil, air filter, etc)
4. Demonstrate the disassembly and assembly of a small engine

STUDENT INSTRUCTIONS:

1. Identify major parts of internal combustion engines
2. Disassemble and assemble a small engine
3. Perform maintenance on a small engine

Evaluation:

Identification	30 pts.
Assembly	40 pts.
Performance Maintenance	30 pts.
	100pts.

Other Suggested Activities:

-Using all required safety precautions, have students conduct experiments using various types os propulsion, such as electric motors, rocket engines, and sails
-Study 4 stroke and 2 stroke small engine maintenance and repair
-Experiment with steam and sterling engines
-Experiment with changing props, gearing, and pitch on propulsion subsystems for each mode
-Make a model steam engine

VoCATS QUESTIONS

FOR

OBJECTIVE 5.01

1. Which of the following engines is an example of an external combustion engine?

A. Diesel engine

B. Steam engine

C. Wankel engine

D. Rocket engine

2. A device that uses steam to produce rotary motion is called a/an:

A. Auxiliary steam engine

B. Stirling cycle engine

C. Steam turbine engine

D. Reciprocating engine

3. Transportation companies have been experimenting with new vehicles that use electromagnetic principles for propulsion and suspension. These systems are generally called:

A. Third rail systems

B. Maglevs

C. Electroprops

D. Polarization Modules

4. In internal combustion engines, pistons produce a:

A. Reciprocating motion

B. Rotary motion

C. Circular motion

D. Linear motion

5. The output of a linear-motion engine, such as a jet engine, is measured as:

A. Velocity

B. Distance

C. Torque

D. Thrust

6. The output of a reciprocating or rotary engine is always measured as:

A. Velocity

B. Distance

C. Torque

D. Thrust

7. The major source of energy for transportation systems is:

A. Nuclear energy

B. Electricity

C. Solar energy

D. Petroleum

8. Which type of sail improved the maneuverability of ships and encouraged increased exploration of uncharted land?

A. Square-rigged

B. Lateen

C. Dhow

D. Slant-rigged

9. All nuclear-fueled ships in the United States Navy are powered by:

A. Reciprocating engines

B. Steam turbine engines

C. Piston engines

D. Stirling engines

10. An example of an external combustion engine is the:

A. Reaction engine

B. Diesel engine

C. Steam engine

D. Rotary engine

11. Diesel-electric propulsion systems are most commonly found in:

A. Ship engines

B. Aircraft engines

C. Truck engines

D. Train engines

12. Friction and centrifugal are two common types of:

A. Clutches

B. Step pulleys

C. Gear teeth

D. Drive shafts

13. Fuel is ignited by the intense heat of compression in:

A. Rotary engines

B. Gasoline engines

C. Diesel engines

D. Four-stroke cycle engines

14. The most powerful internal combustion engine is the:

A. Steam engine

B. Diesel engine

C. Jet engine

D. Rocket engine

15. The main difference between solid rocket engines and liquid rocket engines is:

A. The amount of thrust produced is greater in a solid rocket

B. Liquid rockets are heavier

C. Solid rockets are no longer used

D. A liquid rocket engine may be throttled to control thrust

16. On a sailboat the majority of the wind is captured by the:

A. Mainsail

B. Lateen

C. Jib

D. Spinnaker

17. Nearly all automobiles are powered by:

A. Wankel engines

B. Stirling engines

C. Gasoline engines

D. Two-stroke cycle engines

18. What do many automobiles use to transfer power from the engine to the drive wheels?

A. Pistons

B. Step pulleys

C. Gear teeth

D. Power train

19. The action in a jet engine is:

A. Continuous

B. Non-continuous

C. Reciprocating

D. In the form of torque

20. On a ship's propeller, increasing pitch causes:

A. Greater speed

B. Greater pulling power

C. Lower pulling power

D. Greater slip ratio

21. Wankel engines produce a:

A. Linear motion

B. Rotary motion

C. Reciprocating motion

D. Alternating motion

22. About what percentage of energy produced by burning diesel oil in a diesel engine is converted into motion?

A. 40%

B. 5%

C. 50%

D. 70%

23. How energy efficient are heat engines?

A. Less than 50% efficient

B. Between 50 and 70% efficient

C. Between 70 and 90% efficient

D. Approximately 95% efficient

24. One of the least efficient but most widely used propulsion devices for transportation is the:

A. External rotary combustion engine

B. Internal combustion engine

C. Automatic transmission

D. Electric motor

25. The greatest advantage of the diesel engine is its:

A. Large size

B. Heavy structure

C. Durable casing

D. Fuel economy

26. Two-stroke cycle and four-stroke cycle are types of:

A. Turbojet engines

B. Gasoline piston engines

C. Jet engines

D. Rotary engines

27. Diesel engines are known for:

A. Low weight

B. Power and dependability

C. High operating costs

D. Maintenance problems

28. The force that propels an inflated balloon around a room demonstrates the same principles as a:

A. Diesel engine

B. Piston engine

C. Wankel engine

D. Jet engine

29. An example of an internal combustion engine which produces a linear motion is a:

A. Turbojet engine

B. Gasoline piston engine

C. Jet engine

D. Rotary engine

30. The diesel fuel in modern locomotive engines is burned in an engine which is used to:

A. Turn a generator to make electricity

B. Turn a large, multi-speed transmission to power the wheels

C. Power the compressor section of the turbine drive engine

D. Power the wheels through a special fluid turbine transmission

31. The Wankel engine is:

A. A type of internal combustion engine

B. A type of external combustion engine

C. Obsolete

D. A type of rocket engine

32. Which of the following gear systems would provide the most pushing power for a tow-truck?

A. A motor turning a small gear driving a small gear driving the rear wheels

B. A motor turning a small gear driving a large gear driving the rear wheels

C. A motor turning a large gear driving a large gear driving the rear wheels

D. A motor turning a large gear driving a small gear driving the rear wheels

33. A friction clutch is:

A. Part of the transportation system

B. Widely used in vehicles with manually operated transmissions

C. A mechanical device that separates the power system from the drive system

D. All of the above

34. As a component of fluid power systems, pumps produce and

transmit pressure. The following are different types of pumps EXCEPT:

A. Hydraulic

B. Gear

C. Disk

D. Centrifugal

35. Reciprocating motion is charged to rotary motion in what type of engine(s)?

A. Steam engine

B. Steam turbine

C. Stirling engine

D. Both A and C

36. Some advantages of a diesel engine are all of the following EXCEPT:

A. Their fuel economy and reliability

B. Diesel engines are about 25% more efficient than gasoline engines

C. Their reliability

D. Diesel engines are much heavier in weight than gasoline engines

37. Identify the engine which would fit in the Reaction engines category:

A. Wankel engine

B. Electric engine

C. Ramjet engine

D. Piston engine

38. Induction motors:

A. Use AC current only

B. Use DC or AC current

C. Are more trouble-free than universal motors

D. Both A and C

COURSE: Transportation Systems

UNIT D: Vehicular Systems and Sub-Systems

COMPETENCY: **005.00: Explain the fundamental concepts and principles of transportation vehicular sub-systems.**

OBJECTIVE: **005.02: Explain the fundamental concepts, principles and applications of transportation guidance systems.**

OUTLINE	RESOURCES

A. Purpose: Understanding the fundamental concepts and principles of transportation guidance systems is essential for the intelligent design, development, and evaluation of transportation systems and subsystems.

B. Definition of Guidance-navigation and warning systems

Inform a device or operator the direction, speed, location, (latitude, longitude, altitude, depth) pressure and/or warn of danger.

C. Types of Guidance Systems and there uses and the theories of operation

1. Graphic (maps, charts, and marker) Systems
   a. Road signs and signals and navigational markers
      Purpose: give location, instructions, or warning
      1. Land - road signs, stop lights — R1/191
      2. Sea and air - buoys, lighthouses

   b. Maps and charts — R1/192
      1. General Information
         a. The greater the denominator the less detail but the greater the land area shown — R1/192
         b. There is a total of 360 degrees latitude and longitude — R1/195
      2. Types of maps and charts
         a. Road maps
         b. Aeronautical charts
            1. Show location of radio transmitters
         c. Nautical charts — R1/193-95

1. Show water depths, shipping lanes, and other nautical features

2. Mechanical and electro-mechanical devices
   a. Location, direction, speed, and time devices
      1. Radio (radio transmitters, land-based, government owned) R1/196
      2. Radar (bounces radio waves off objects to determine distance) R1/200
      3. Airspeed indicators (works off of a pressure differential)
      4. Sonar (bounces sound waves off of objects to determine distance or depth) R1/200
      5. Integrating devices R3/108
         1. Computers

3. Navigational Processes and Systems
   a. Dead reckoning R1/197
      Estimate how far and in what direction the vehicle has gone
   b. Piloting R1/197
      1. Uses reading of visible landmarks with compass and chart
   c. VOR (Very High Frequency Omni-directional Range) R1/199
   d. NAVSAT/GPS R1/200
      1. Uses multiple satellites to determining location of vehicle
   e. Omega R1/199
      International system used to aid ships approaching land

Activity:

To master the use of G.P.S. navigation and location technology.

Materials:
G.P.S. unit
Compass

TEACHER INSTRUCTIONS:
1. Review the fundamental concepts of the G.P.S. system

2. Review terminology
    - Almanac Data
    - Bearing
    - Course Made Good (CMG)
    - Crosstrack Error (XTE)
    - Desired Track (DTK)
    - Differential G.P.S. (DPGS)
    - Estimated Time of Arrival (ETA)
    - Estimated Time Enroute (ETE)
    - Grid
    - Ground Speed
    - Latitude
    - Longitude
    - Navigation
    - Position
    - Track (TRK)
    - Universal Transverse Mercator (UTM)
    - Velocity Made Good (VMG)
    - Way point
3. Design a course around the school campus
4. Inform students as to the use of your model of G.P.S.
5. Divide students into groups and allow them to run your course

STUDENT INSTRUCTIONS:

1. Learn how to operate the G.P.S. unit
2. Initialize G.P.S. unit
3. Take a fix
4. Follow course laid out by your teacher

Evaluation:

Identification	50 pts.
Operation of the G.P.S. unit	50 pts.
TOTAL	100pts.

Other Suggested Activities:

-Create a map showing location and orienteering basic skills
-Field trip to the airport
-Contact the civil air patrol for guest speaker
-Run a orienteering course with your students
-Study GPS and have students demonstrate these skills of navigation
-Develop a sign system for the evacuation of a school

VoCATS QUESTIONS

FOR

OBJECTIVE 5.02

1. The location of radio transmitters can be seen on:

A. Aeronautical charts

B. Topo maps

C. Road maps

D. Tourist maps

2. Which method uses a compass to read the bearings of visible landmarks and a chart to determine the vehicles location?

A. Dead reckoning

B. Piloting

C. Circumnavigation

D. VOR

3. A method for determining a vehicle's position by estimating how far and in what direction it has come from its last known position is called:

A. Radio sextant application

B. Piloting

C. Gyro-compassing method

D. Dead reckoning

4. Which guidance system sends out radio waves which bounce off objects and return to a receiver which then determines how far away the objects are?

A. Sonar

B. Radar

C. Loran

D. Omega

5. On a scale map, what decreases as the denominator in the ratio increases?

A. Detail

B. Land area

C. Numerator

D. Chart size

6. A map that is shaped like a sphere is called a/an:

A. Log

B. Nautical chart

C. Globe

D. VOR

7. What guidance device would the average person use to travel across the United States in a car?

A. Compass

B. Light

C. Map

D. Radio

8. How many longitudinal degrees are measured on the globe?

A. 66

B. 90

C. 180

D. 360

9. The development of what instrument allowed early ocean navigators to cross wide bodies of water without having to rely on landmarks?

A. Sundial

B. Telescope

C. Compass

D. Hydrometer

10. Which of the following is an example of a guidance system?

A. Jib

B. Wheel

C. Road sign

D. Rudder

11. A ship would use which of the following to determine the water depth?

A. Sonar

B. Radar

C. Loran

D. Omega

12. What navigational device is designed to point to true north?

A. Sextant

B. Compass

C. Gyrocompass

D. Sonar

13. The relationship of large land masses such as the North American Continent, can be seen on a/an:

A. Globe

B. Aeronautical chart

C. Nautical chart

D. Sextant

14. The navigational system having a very high frequency onmidirectional range is:

A. VOR

B. Loran

C. Omega

D. NAVSAT

15. Guidance systems give a vehicle's operator warning signals, direction, and:

A. Location

B. Pressure

C. Speed

D. All of the above

16. Stop lights, lighthouses, and buoys are all parts of:

A. Suspension systems

B. Control systems

C. Guidance systems

D. Structural systems

17. The navigational system that is widely used worldwide to guide ships and planes that are approaching the coast is:

A. VOR

B. Loran

C. Omega

D. NAVSAT

18. In alerting the device or operator, the purpose of Guidance systems is to:

A. Provide comfort

B. Provide freedom from damage to people or things carried

C. Support the vehicle in its environment

D. Pressure and/or to warn of impending danger

19. Before operating a transportational vehicle, the operator must have these three kinds of guidance information; direction of travel, speed, and:

A. Time of day

B. Traffic

C. Destination

D. Traveling companion

20. How do the Omega and Loran Navigational Systems differ?

A. One guides ships while the other guides planes

B. One uses satellites

C. One is long range

D. One is world wide

21. Lines on the globe that run from North Pole to the South Pole are called:

A. Latitudes

B. Longitudes

C. Pole lines

D. Vertical lines

22. Lines on the Globe that run parallel to the equator are called:

A. Latitudes

B. Longitudes

C. Pole lines

D. Vertical lines

23. What is the process for traveling from one position to another and knowing where you are in relation to your desired course?

A. Latitude

B. Position

C. Navigation

D. G.P.S.

24. Which of the following is NOT an example of a Navigational Marker?

A. Channel markers

B. Road signs

C. Buoys

D. Radial

25. A Gyrocompass points to:

A. True South

B. Geographic South

C. True North

D. Geographic North

26. What type of system is used for navigating ships and submarines?

A. VOR

B. NAVSAT

C. JEER

D. TeleSta

COURSE: Transportation Systems

UNIT D: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles of transportation vehicular sub-systems.

OBJECTIVE: 005.03: Explain the fundamental concepts, principles and applications of transportation control systems.

OUTLINE	RESOURCES
A. Purpose: Understanding the fundamental concepts and principles of transportation control systems is essential for the intelligent design, development, and evaluation of transportation systems and subsystems.	
B. Purpose of Transportation Control Systems	
1. Control systems are designed to control location, speed and/or vehicle direction	R1/203
2. Degrees of freedom Train-1; Car-2; Helicopter-3	R1/203

C. Types of Transportation Control Systems and their uses and theories of operation R1/203-208

1. Speed control systems and devices
   a. Measurement of speed
      1. Land-kilometers per hour or miles per hour
      2. Water-knots
      3. Air-miles per hour and knots

   b. Acceleration
      1. Increase applied forces
         a - Increase fuel
         b - Increase applied energy (sail opened or turned to capture greater lift or glider pitch to use gravity to increase assent or sub use of air tanks)
         c - Change propeller pitch/speed
      2. Increase mechanical advantage (gear up)

   c. Deceleration
      1. Decrease applied forces
         a - Decrease fuel consumption
         b - Decrease applied energy (sail folded or turned to lessen lift, etc.)
         c - Change propeller pitch/speed
      2. Decrease mechanical advantage (gear down)

      3. Braking systems R1/209
         a - Drum
         b - Disc

2. Controlling direction
   a. Fixed rails and guideways (trains, elevators)

   b. Steering systems
      1. Wheel and track (bulldozer, tanks) systems (friction systems) R1/212

      2. Rudders (boats, ships, and planes) R2/121
         (Includes propellers, rotors, ailerons, and elevators)
         (Fluid-aerodynamic/hydrodynamic) (Helicopter cyclical pitch)

3. Change of propulsion direction or application (on or off) from a propulsion fan or jet R1/216

3. Transmission Systems
   a. Clutches - used to engage and disengage power source to wheels, propellers, etc. R1/203
   b. Transmissions
      1. multiply
      2. divide
      3. reverse
      4. mechanical power

Activity:
To build a device using the fundamental concepts, principles and applications of transportation control system

Materials:
RC Radio and Receiver
Servo(s)
Speed Control
Construction material for device

TEACHER INSTRUCTIONS:
1. Review concepts of RC controlled devices
2. Review safety instructions with construction material and equipment
3. Set regulations for the construction of the devices
4. Review steps in keeping a technical log -- see TSA -- RC Challenge

STUDENT INSTRUCTIONS:
1. Start technical log
2. Design the device on paper
3. Get teacher approval before beginning construction
4. After construction demonstrate your device to the class

Evaluation:

Design	20 pts.
Construction	20 pts.
Craftsmanship	5 pts.
Originality	5 pts.

Tech. Log	30 pts.
Solution of Problem Direction	10 pts.
Speed	10 pts.
Total	100pts.

Other Suggested Activities:

-calibration of a speedometer

-chart acceleration as related to fuel consumption

-Using RC controls, design a simple device that can change directions and speed

-Design a device to demonstrate different gearing systems to increase and decrease torque and speed

VoCATS QUESTIONS

FOR

OBJECTIVE 5.03

1. Steering wheels, brakes, and automatic pilots are all examples of transportation:

A. Control systems

B. Support systems

C. Suspension systems

D. Structural systems

2. An airplane relies on:

A. An elevator to change pitch

B. An aileron to change pitch

C. A rudder to change pitch

D. An fuselage to charge pitch

3. Mechanical devices that control the separation and joining of power to drive systems are:

A. Differentials

B. Drive shafts

C. Clutches

D. Brakes

4. If one aileron were lowered and the other raised, the plane would:

A. Dive

B. Climb

C. Roll

D. Stall

5. Tanks and bulldozers can change direction by:

A. Engaging trusters

B. Engaging directional control wheels

C. Making one track go faster than another

D. Reversing their transmission

6. How many degrees of freedom does a train have?

A. One

B. Two

C. Three

D. Four

7. Systems which provide for multiplying, dividing, or reversing the mechanical power coming from engines or motors are called:

A. Transmission systems

B. Suspension systems

C. Hydraulic systems

D. Pneumatic systems

8. Caster is desired in a steering system because it:

A. Is considerably less expensive

B. Is easier to maintain

C. Is considerably stronger than conventional methods

D. Makes it much easier to steer the vehicle

9. The small rotor on the rear of a helicopter is used to offset what forces caused by the main rotor?

A. Pitch

B. List

C. Roll

D. Torque

10. To control direction, which vehicles use a fixed rail system?

A. Cars

B. Trucks

C. Planes

D. Trains

11. Rockets use which of the following to change directions?

A. Rudder

B. Aileron

C. Nozzle direction

D. All of the above

12. The "camber" of a wheel refers to the:

A. Amount of traction it has

B. Wheels suspension properties

C. Angle is to the road

D. Number of "layers" or "belts" it has

13. How many degrees of freedom does a helicopter have?

A. One

B. Two

C. Three

D. Four

14. Hot air balloons control:

A. Direction by using rudders

B. Speed by propellers

C. Altitude by the amount of hot air in the balloon

D. Altitude and direction through the use of thrusters and ballast

15. Control systems are designed to control a vehicles position in space as well as:

A. Speed and direction

B. Support it in its environment

C. Determine danger

D. Protect passengers from the surrounding environment

16. Drum and disc are two types of:

A. Suspension systems

B. Propulsion systems

C. Transmission systems

D. Guidance systems

17. To increase the speed of different types of vehicles one may:

A. Increase the fuel consumption of the engine

B. Change sail position

C. Change the pitch or speed of the propeller

D. All of the above

18. To steer a boat one must turn the:

A. Elevator

B. Stabilizer

C. Keel

D. Rudder

19. In control systems, the number of changes in direction a vehicle can make is called:

A. Degrees of freedom

B. Directional degrees

C. Mobility

D. Maneuverability

20. On aircraft, the longitudinal axis, "roll" is controlled by the:

A. Fuselage

B. Elevators

C. Rudder

D. Ailerons

21. Which device allows an airplane to change its compass heading?

A. Ailerons

B. Fuselage

C. Rudder

D. Tail

COURSE: Transportation Systems

UNIT D: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles of transportation vehicular sub-systems.

OBJECTIVE: 005.04: Explain the fundamental concepts, principles and applications of transportation

suspension systems.

OBJECTIVE	RESOURCES

A. Purpose: Understanding the fundamental concepts and principles of transportation suspension systems is essential for the intelligent design, development, and evaluation of transportation systems and subsystems.

B. Definition of Transportation Suspension Systems — R1/219-232

Suspension systems are designed to support the vehicle in the environment in which it is designed to operate. This includes enabling it to operate efficiently and to provide comfort and/or freedom from damage to people or things being carried.

C. Types of Transportation Suspension Systems and their uses and theories of operation:

1. Land — R1/219-232
   a. Tires (Pneumatic tires filled with air) — R1/219
   b. Springs
   c. Shock absorbers (Reduce spring oscillation) — R1/224
   d. Stabilizer bars (Prevents excess going around curves) — R1/224
   e. Electromagnetic (MagLev)

2. Water(Hydrodynamic) — R1/227
   a. Water
      1. Hulls
         a - Round (Least stable) — R1/228
         b - Flat
         c - V-hull
         d - Catamaran (One of the most stable)
         e - Tri-hull
         f - Hydrofoils (Rides on "wings" attached to hull) — R1/230

         g - Planing hulls (Skim on water at cruising speed) h - Displacement hull (Designed to carry great weight) R1/228

2. Flotation tanks R1/229
   a. Control the buoyancy of submarines
   b. Air

3. Air R1/141
   a. Wings
      1. All heavier than air vehicles rely on airfoils to provide lift
   b. Envelopes (balloon) R1//139
      1. Blimps rely on helium to provide lift
      2. Hot air balloons rely on hot air to provide lift
   c. Rotor blades R1/142
      1. Helicopters rely on "rotor blades" (Rotating wings) to provide lift
4. Land and water (air cushioned vehicles) R1/230
   a. Float on cushion of air
   b. Plenum chamber
   c. Annular jet

Activity:

Purpose: To reinforce the information learned about suspensions and give students a concrete example of how a suspension system works.

Activity: Springs; What makes them different

Problem: Working in teams of two, make springs out of various diameter wires and of various lengths, then find their load rating and evaluate the effect wire diameter and length have on their performance in a vehicle.

Materials:

8" x 16" x 1/2" plywood (chassis)	1/team
5/8" x 5/8" x 4" wood (axles)	4/team
11/4" x 3/4" x 2" wood (axle block)	1/team
1/8" x 11/2" wood dowel	4/team
1/8" x 1" wood dowel	2/team

3/8" x 12" wood dowel	1/team
3/16" drill bit	2/class
1/8" drill bit	2/class
1/2" drill bit	2/class
9/64" drill bit	2/class
diagonal cutting pliers	1/team
1/8" flat washer	4/team
3/4" x #7 wood screw	2/team
13/4" X #7 wood screw	4/team
0-8 lbs. scale	1/class
11/2" x 5/8" wood dowel (wheels)	4/team
phillips screwdriver	1/team
wire of various diameters	1/team
hot glue gun	2/class

Evaluation:

Followed directions	25 pts.
Workmanship on vehicle	25 pts.
Data Collection	25 pts.
Worked as a Team	25 pts.
Total	100pts.

TEACHER INSTRUCTION:

1. Obtain and prepare materials for the activity
   a. cut board for chassis from 1/2" plywood
   b. Cut axles to size
   c. cut and dado axle blocks
   d. cut a slot in the end of the 3/8" dowel and mark it off every 1/4"
   e. cut 11/2" x 3/4" wood dowel for wheels
   f. cut 2, 12" pieces of each size or kind of wire that you are going to use
2. Go over the following terms and define each:
   Temper
   Spring Rate
   Travel
   High carbon steel
3. Build a straight course consisting of some bumps over which the students can pull their vehicles. Put a load on the vehicle (some bricks), not exceeding the vehicle's spring rate.

STUDENT INSTRUCTION:

Building the vehicle:

1. Get materials from your teacher

2. Drill a 1/8" x 3/4" deep hole in the ends of your 5/8" x 5/8" x 4 axles
3. Insert the 1/8" x 11/2" dowels in the ends of your axles
4. Drill the 1/2" pockets for the springs in your axles and chassis. Check the drawing for the location of these pockets
5. Drill the two 1/8" holes in the 11/4" x 3/4" axle block (see drawing)
6. Drill a 9/64" hole in each axle (see drawing)
7. Drill a 3/16" hole in each axle (see drawing)
8. Drill a 9/64" hole in the center of the 11/2" x 5/8" wood dowel
9. Attach axle block to chassis using 3/4" x #7 wood screws (see drawings)

10. Attach axles to axle block using the 1/8" x 11/2" wood dowel (see drawing)
11. Attach wheels to axles using a washer and a small amount of hot glue

Winding the springs:
1. Using the 3/8" dowel, wind your springs, two for each wire diameter that you have. One should have 5 turns and one should have 10 turns. Be sure each turn matches the marks on the dowel.
2. Slide the spring off the dowel, trim off any ends that are not wound so that you have a ice round spring. Now make four more.
3. Compress your springs all the way so that the coils touch. Your springs are now ready to be tested for load rating and then installed in your vehicle.

Spring Testing:
1. Take one spring made from each size or type of wire to the scales. Put the springs on the scales, one at a time, and press down on the spring until the spring coils just touch. At that point read the scale to determine how much weight that spring will hold.
2. Now measure the length of each spring uncompressed and compressed to determine the travel of each spring.
3. After you have taken these two measurements, you can install each set of springs in your vehicle and see how they preform.

Other Suggested Activities:

-Construct an obstacle course that requires various types of

suspension systems for different terrains and surfaces
-Design hulls for maximum efficiency, speed, load, and stability
-Design and test different wing designs, testing air foils
-Make and test different textures used in hull designs (i.e. rough, waxed, etc.)
-Make a hovercraft (pie plate) using a hair dryer

VoCATS QUESTIONS

FOR

OBJECTIVE 5.04

1. Pneumatic tires are filled with:

A. Oil

B. Air

C. Water

D. Pneumatium

2. A boat that rises above the surface of the water on "wings" that remain in the water is called a/an:

A. Planer

B. Jet-ski

C. Hydrofoil

D. Air-boat

3. Both balloons and boats are kept afloat by the:

A. Gravitational forces acting on them

B. Trust created by their engines

C. Buoyancy of their

D. Lift created by their foils

4. Lift on a helicopter is created by the:

A. Props

B. Elevators

C. Rotor blades

D. Airfoils

5. An aircraft is suspended in air by its wings. This is made possible by the lift which is made by the:

A. Air moving more quickly under its wings

B. Air moving more quickly over the top of the wings

C. Buoyancy of the vehicle in relation to the air around it

D. Coefficient of drag created by the thrust of its engines

6. What is used to give blimps lift?

A. Hot air

B. Hydrogen

C. Oxygen

D. Helium

7. A stabilizer bar prevents:

A. An aircraft from bumps caused by erratic winds

B. Ships from excessive roll

C. Trains from leaving the track at high speeds

D. Cars from leaning out too far when turning

8. Flat, round, catamaran, and hydrofoils are all types of:

A. Boats

B. Wing designs

C. Hull designs

D. Plenum chambers

9. Pneumatic tires provide a cushioning effect because:

A. Air compresses

B. Oil compresses

C. Water compresses

D. Pneumatium compresses

10. All heavier-than-air aircraft rely on:

A. Propellers to provide thrust

B. Rotors to provide lift

C. Wings to fly

D. Airfoils to provide lift

11. Which type of boat hull is designed to skim on the surface of the water once the boat reaches its optimum speed?

A. Displacement

B. Planing

C. Hydrofoil

D. Air cushioned

12. The four forces affecting a plane in flight are the lift, weight(gravity), thrust, and:

A. Propulsion

B. Compression

C. Combustion

D. Drag

13. Land suspension systems are made up of tires, springs, shock absorbers, and:

A. T-props

B. Steering cables

C. Stabilizer bars

D. Centering drivers

14. The buoyancy of submarines are controlled by:

A. Its rudder

B. Speed

C. Inflation tubes

D. Flotation tanks

15. Which of the following hulls is the most stable?

A. Round bottom

B. Flat bottom

C. Semi-Vee bottom

D. Catamarans and tri-hulls

16. The boats which tend to be the LEAST stable have:

A. Round hulls

B. Flat bottom hulls

C. Tri-hulls

D. Semi-Vee bottom hulls

17. A hydrofoil is lifted out of the water by:

A. Thrusters

B. A cushion of air

C. The lift created by its foils

D. Its propellers

18. The main purpose of a shock absorber is to reduce:

A. Damage resulting from a head-on collision

B. Spring oscillation

C. Torque forces of an engine

D. The braking forces of air brakes

19. In marine vessels, the hull designed to carry heavy loads is called a:

A. Displacement hull

B. Planing hull

C. Delta hull

D. Conical hull

20. Trains which have no physical contact with tracks and instead use electromagnetic field are called:

A. Subways

B. L-trains

C. Maglev

D. Turbolifts

21. When electromagnetic fields are used to lift an object the technique is called:

A. Magnetic levitation

B. Tractor beam

C. Matter-Energy convertor

D. Electro-generator

22. Which device relies on hot air to produce lift?

A. Blimp

B. Balloon

C. Dirigible

D. Wing

23. The following vehicles ALL produce lift through the use of an airfoil EXCEPT:

A. Biplane

B. Helicopter

C. Jets

D. Balloons

24. Which of the following vehicles is capable of both land and air travel upon air cushion?

A. Hovercraft

B. ATV

C. Four wheeler

D. Airplane

COURSE: Transportation Systems

UNIT D: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles and applications of transportation propulsion systems.

OBJECTIVE: 005.05: Explain the fundamental concepts, principles and applications of transportation structural systems.

OBJECTIVE	RESOURCES

A. Purpose: To provide mounting places for the systems of propulsion, control, suspension and guidance systems and to provide space for the people and/or cargo being transported.

B. Definition of transportation structural system: Parts of vehicles which hold or carry other vehicular systems and the things being carried.

C. Types of Transportation Structural Systems and their uses and theories of operation R1/233

1. Land

a. Types of Frames

1. Chassis "frame"
2. Uni-body "body-frame combination"

2. Air

a. Monocoque (means one shell) R1/240

1. Provides for more storage space than Truss frame

b. Fuselage
c. Non-rigid and semi-rigid (Hot air balloons and blimps)

3. Water R1/238

a. Bulkheads to support boat R1/242
b. Hulls R1/229
c. Floatation tanks-Hull types

4. Space R1/24
a. Main structural components
1. Fuselage
2. Crew compartment (if manned)
3. Vertical stabilizer

Activity:

A. Activity
Egg Car Crash Test

B. Purpose

In order to better understand forces that occur in a crash of a land transportation vehicle, design and build a safety restraint system to protect an egg in various types of crashes.

C. Problem

Students will use the car base to design and attach a safety restraint system to protect an egg from a head on collision, side impact, 3/4 head on, and rear end collision.

D. Materials and equipment

Crash test car base
Crash test car track
Various materials for students to use in the construction of their safety restraint systems
Eggs (lots!!!)

TEACHER INSTRUCTION:

1. Review different methods of safety restraints-i.e-seatbelts, air bags, crumple zones (places in the frame or body that will crumple and absorb the force of a crash before it gets to the driver), bumpers, roll cages (Formula I Race Cars are designed with a "Capsule" the driver rides in-would this be something you want your students to incorporate?)
2. Provide this information to your students.
3. Pass out the crash test car base to your students.
4. Decide on a way to attach the students S.R.S. to the C.T.C.B.
5. Discuss the way the vehicles will be tested on the ramp.
6. Place the ramp at increasing angles until the passenger fails to survive.
7. Explain the criteria you will use to evaluate the students.
8. Have students present and explain their S.R.S. to the class.

STUDENT INSTRUCTION:

1. Discuss various methods of safety restraint systems that the automotive industry utilize with your teacher and class.
2. Get a crash test car base from your teacher.
3. Come up with a way of attaching the S.R.S. to the C.T.C.B. that is acceptable to everyone.
4. Discuss the way the vehicles will be tested on the ramp.
5. Using material you get from your teacher and come up with

yourself, design and build a S.R.S. that will project a passenger, an egg, from a front, side, rear and 3/4 front impact.

6. Test your vehicles by running them down the ramp at increasing angles until the egg crashes.

Evaluation:

Problem Identification and Definition	5 pts.
Research and Review of Literature	20 pts.
Evaluation of Appropriate Systems	5 pts.
Plan of Work	20 pts.
Expected Outcomes	5 pts.
Evaluation Criteria	5 pts.
Evaluation	20 pts.
Drawing and Bibliography	20 pts.
Overall Design Brief Total:	100pts.

Other Suggested Activities:

-Design and test a model crash car looking at front, rear, and side collisions. Let the passengers be eggs!

-Develop an RC boat hull, include RC controlled rudder and sail system.

-Time the vehicles as they go down the track. Have students calculate the actual speed and scale speed of the vehicles at impact.

-Place restrictions on the S.R.S. Such as the sort of automotive design engineers would be faced with when designing S.R.S. for real cars. Such as headroom, legroom, unobstructed views to the front, back and sides, etc.

-Video tape the crash and play it back in slow motion. Discuss what happens during the crash.

-Come up with a way to simulate the high center of gravity of a sport utility vehicle.

VoCATS QUESTIONS

FOR

OBJECTIVE 5.05

1. The body of an airplane is called a:

A. Chamber

B. Compartment

C. Fuselage

D. Cabin

2. Larger cars generally have conventional frames, tend to be safer, and tend to:

A. Rattle more

B. Handle better

C. Be less fuel efficient

D. Be less expensive because of conventional rather than unibody construction

3. The term monocoque means:

A. Hollow

B. Strong

C. One shell

D. Many chambers

4. The main advantage of monocoque design for plane fuselages

is that this design:

A. Provides considerably more storage space than truss design

B. Is much less expensive to build than truss design

C. Is much less in weight than truss design

D. None of the above

5. One of the major disadvantages of plastics verses steel in car construction, is that plastics:

A. Do not withstand impact as well as steel

B. Tend to weigh more than steel

C. Have a higher coefficient of drag

D. All of the above

6. Unibody, truss system, and monocoque all refer to:

A. Suspension systems

B. Control systems

C. Structural systems

D. Bridge designs

7. Rigid airships are sometimes referred to as:

A. Balloons

B. Blimps

C. Zeppelins

D. Framework

8. Which of the following is NOT a factor in designing space craft?

A. Vehicle's destination

B. Manned or unmanned

C. Tasked to be performed

D. Color of skin

9. What is a longerons?

A. An early aircraft

B. A lifeboat

C. A new style of car

D. Codename for government projects

10. The main parts of an automobile structure are the body and the:

A. Sub-body

B. Chassis

C. Spacers

D. Fiber glass

11. Another name for unibody construction is:

A. Monobody

B. Monoframe

C. Integral frame

D. Unichassis

12. Usually how many columns support the roof on most automobiles?

A. 10

B. 2

C. 7

D. 6

13. Airships with nonrigid or semirigid construction are called:

A. Balloons

B. Blimps

C. Zeppelins

D. Framework

14. Another name for the bag that holds the air in airships is:

A. Hydrogen collector

B. Air bag

C. Envelope

D. Antigravity pouch

15. In modern aircraft common alloys are used to make the skin. Which of the following is NOT one of these alloys?

A. Titanium

B. Magnesium

C. Aluminum

D. Iron oxide

16. Another name for the tail section of an aircraft is:

A. Empennage

B. Rudder

C. Aft

D. Port

17. What force are submarines designed to withstand?

A. Shear

B. Stress

C. Pressure

D. Torque

COURSE: Transportation Systems

UNIT D: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles of transportation vehicular sub-systems.

OBJECTIVE: **005.06: Explain the fundamentals concepts, principles and applications of transportation support systems.**

OBJECTIVE	RESOURCES
A. Purpose: Understanding the fundamental concepts and principles of transportation support systems is essential or preventative maintenance, service and preservation of transportation systems.	
B. Support systems for land vehicles:	R1/247-254
1. Related construction-on which vehicles travel	
a) roads and highways	R1/248
b) railroads	R1/249
c) bridges	R1/249, 250
d) tunnels	R1/250, 251
2. Passenger facilities	R1/251, 252
3. Cargo facilities	R1/252
4. Facilities for vehicle maintenance	R1/253, 254
C. Support systems for water transportation:	R1/254-256
a) harbor and port facilities	R1/254
b) locks	R1/254-256
c) marine vehicle maintenance	R1/256
d) Canals	R1/128, 129
D. Support systems for air transportation:	R1/256-259
a) runways	
b) airport terminals	
c) aircraft maintenance	
E. Support systems for space transportation:	R1/259
1. NASA	

a) maintenance
b) launch
c) recovery
d) space station

Suggested Activities:

-Using A-train simulation software, design and build an efficient transportation system considering environmental, population, and economic impacts

VoCATS QUESTIONS

FOR

OBJECTIVE 5.06

1. The first part of road construction which is the foundation is called the:

A. Paving

B. Roadbed

C. Painting the lines

D. Strip-mining

2. Which of the following is the first layer of a railbed?

A. Ballast

B. Crossties

C. Rails

D. Subballast

3. Waterway locks are used for which of the following:

A. Equalizing water level

B. Equalizing water pressure

C. Stopping water flow

D. Stopping ships from sailing

4. A dry dock does which of the following?

A. Allows cars to drive through the ocean

B. Dries a sunken ship

C. Allows planes to land in the ocean

D. Drain water from around a ship for maintenance

5. Runway lights DO NOT do which of the following?

A. Show location of airfield

B. Flash if the pilot is off course

C. Help determine the width of the runway

D. Help see in bad weather conditions

6. Which U.S. government organization demands thorough inspection of aircraft on a regular basis?

A. CDC

B. OSHA

C. FAA

D. No organization

7. Which U.S. government organization is responsible for space exploration?

A. FEMA

B. OFAC

C. NASA

D. OSHA

8. What are private companies which work for NASA called?

A. Contractors

B. Subcontractors

C. Booster boys

D. Cliques

9. What does TBM stand for in land structure systems?

A. Transportational Barrier Mathematics

B. Theory of Bridge Making

C. Tube-building

D. Tunnel-boring machines

10. Which of the following types of bridges is the oldest?

A. Beam

B. Cantilever

C. Arch

D. Suspension

11. Which of the following is not a passenger facility?

A. Bus station

B. Airport terminals

C. Dry docks

D. Train stations

12. Which technique is used to find micro fissures in a plane's hull?

A. Submersion

B. Magnetic fields

C. Tactile response

D. Broken air current

13. What is the reason why passenger and cargo approach the airport from one side and air traffic from the other?

A. To protect passengers from exhaust fumes

B. To allow passenger to pick up cargo

C. To keep the length of conveyer belts down

D. To provide smooth traffic flow for land and air vehicles

14. As engines are becoming more advanced they are becoming

easier for anyone to fix.

A. True

B. False

15. On arch bridges where can roads be located?

A. Above

B. Below

C. Both A and B

D. Neither A nor B

16. A cross section of a railroad rail would resemble a/an:

A. R-rail

B. Rail tie

C. C-beam

D. I-beam

17. What is the term for removing excess earth from a hill and placing it in a low area?

A. Ditching

B. Cuts and fills

C. Terra forming

D. Erosion

18. What time intervals are used to regulate maintenance schedules?

A. Number of hours

B. Number of flights

C. Number of years

D. Number of light years

19. On a submarine the conning tower is located on the bottom of the submarine.

A. True

B. False

20. Which of the following are not located in the conning tower?

A. Polarization Rods

B. Radio antennas

C. Radar equipment

D. Periscopes

21. Which of the following propulsion systems were used on the Apollo mission?

A. Light drive

B. Separation

C. Staging

D. Warp drive

22. Which of the following is NOT one of the major components of the shuttle orbiter?

A. Impulse Modifier

B. Fuselage

C. Vertical stabilizer

D. Crew Compartment

UNIT E

FABRICATION OF COMPLEX TRANSPORTATION VEHICLES

COURSE: Transportation Systems

UNIT E: Fabrication of Complex Transportation Vehicles

COMPETENCY: 006.00: Design, produce and evaluate a transportation vehicle.

OBJECTIVE: 006.01: Design a transportation vehicle or system.

OBJECTIVE RESOURCES

A. Purpose: Designing a transportation vehicle or system is an excellent strategy for increasing ones understanding of the transportation vehicle or system.

B. Activity

Development of a Design Brief

C. Problem:

Working individually or in small teams, students will identify and define a problem within transportation systems or transportation vehicular systems and then research and design a complex transportation system or vehicular model in an efficient manner. Students are required to use the following design brief.

D. Materials

Design Brief

Research facilities such as a quality library with scientific and technical transportation related information

Access to the Internet

Quality laboratory with equipment and materials necessary for experiments

TEACHER INSTRUCTION:
Determine if students will be working as individuals or teams. Give each student a copy of the design brief outline. Explain precisely how the outline is to be used, and what is expected from each student and/or team. Give students due dates for each step of the design and production process. Review with the students researching strategies and available research resources. Assess the students using the following criteria. Explain the evaluation process to the students.

STUDENT INSTRUCTION:
Working individually or in small teams, as determined by your teacher, identify and define a problem related to transportation systems. This problem can focus on vehicular systems such as the design and development of a radio controlled blimp, or the design and development of complex model transportation systems such as designing a mass transit system for a small city. Your teacher will explain precisely what problems are acceptable.

With your teacher review the design brief outline. Make sure you understand your teacher's instructions, knowing exactly what is expected of you, how much time you will be allotted, and how your design brief will be assessed.

PERFORMANCE ACTIVITY

The purpose of this activity is to help students identify, research, design, and build a complex transportation vehicle model in the most efficient and instructive manner. Give each student the detailed outline of the design brief (see Appendix) found within your curriculum guide. Explain each step and what outcome you expect from each student. Review the assessment criteria Monitor student progress frequently and ensure that their design briefs are complete before they proceed to the actual construction of the vehicle models.

1. Problem Identification and Definition
   This is the first step in developing a design brief. Without a clear idea of what one is trying to accomplish, success is not likely. (Example: To design a model sailing racer, meeting the event criteria listed within the competition

guidelines, which will out perform all other competitors.

2. Research and Review of Literature
This should be thorough and detailed. The more background information the more likely the student will be successful. Flailing about without "doing one's homework" is the least efficient and least productive of problem solving techniques. Check the student's bibliography for the quality and number of resources used. Most importantly, does the design reflect an understanding of the materials the student used for research?

3. Evaluation of Appropriate Systems and Sub-systems (Appropriate focus and conceptual understanding)
The student should focus specifically on those factors which will address the problems(s) he or she has identified. For example, if the student decides to make a RC sailboat to race, he or she would have to address design problems related to hull shape, sail size and weight, weight of vessel, stability and control factors among others. Aesthetical factors while very important in the design of an inland cruising yacht, should not take on the importance of the performance factors in the design of a racing sailboat. Doing this well, not only means that he or she is focused on pertinent issues, but also that he or she understands the problem(s) well enough to design in an intelligent manner. One strategy to help you evaluate the student for this part of the design problem, is to ask "what and why". Ask what has he or she focused on and why have they chosen to focus on those particular areas. If the response is thoughtful, intelligent and appropriate, there's a good chance the student understands what he or she is about.

4. Plan of Work
This will include the step-by-step process the student will use to complete his or her design project. Included in this section will be the tentative dates for completion of each step.

5. Expected Outcome(s)
Explicit outcome(s) are clearly stated and defined.

6. Evaluation Criteria (How will "success" be measured in terms

of the vehicle's performance?)
Clearly stated, well thought out, and comprehensive.

7. Evaluation (Student's Narrative Reflecting Upon the Entire Process)
The student will write several paragraphs, reflecting upon the entire design process. He or she should point out areas of particular difficulty, successes and failures, and things which he or she found particularly enjoyable. He or she should also speak to ways he or she would have done things differently upon reflection. An oral report will be done upon the building and testing of the vehicle.

8. Drawings and Bibliography
Sketches, mechanical drawings, and bibliography are technically correct, accurate and complete.

9. Overall Design Brief
Well organized, and well written and complete. The design brief should be efficient, purposeful, and effective in helping the student execute an intelligent solution to the stated problem.

Evaluation Criteria:	points:
Problem Identification and Definition	5
Research and Review of Literature	15
Identification of Appropriate Systems	5
Plan of Work	15
Expected Outcomes	5
Evaluation Criteria	5
Students Written Evaluation	1 5
Drawings and Bibliography	15
Overall Design Brief Total:	20
Total	100

VoCATS QUESTIONS

FOR

OBJECTIVE 6.01

INSTRUCTIONS TO THE STUDENT: Using a design brief as a planning tool, identify, research, and design a transportation vehicle or system.

Working individually or in small teams, as determined by your teacher, identify and define a problem relate to transportation systems. This problem can focus on vehicular systems such as the design and development of a radio controlled blimp, or the design and development of complex model transportation systems such as designing a mass transit system for a small city. Your teacher will explain precisely what problems are acceptable. With your teacher, review the design brief outline. Make sure you understand your teacher's instructions, knowing exactly what is expected of you, how much time you will be allotted, and how your design brief will be assessed.

TEACHER INSTRUCTIONS: Determine is students will be working as individuals or as teams. Give each student a copy of the design brief outline. Explain precisely how the outline is to be used, and what is expected from each student and/or team. Give students due dates for each step of the design and production process. Review with the students researching strategies and available research resources. Assess the students using the following criteria. Explain the evaluation process to the students.

Evaluation:

Problem identification and definition	5 points
Research and review of literature	15 points
Identification of appropriate transportation systems design criteria	5 points
Plan of work	15 points
Expected outcomes	5 points
Evaluation criteria	5 points
Students written evaluation of the design and production process	15 points
Drawings and bibliography	15 points
Overall design brief	20 points
Total Possible Points	100

COURSE: Transportation Systems

UNIT E: Fabrication of Complex Transportation Vehicles

COMPETENCY: 006.00: Design, produce and evaluate a transportation vehicle.

OBJECTIVE: 006.02: Produce a transportation vehicle or system.

OBJECTIVE	RESOURCES

A. Purpose: Producing a transportation vehicle or system is an excellent strategy for increasing ones understanding of the transportation vehicle or system.

B. Activity

Produce a quality transportation system or sub-system.

C. Problem

Upon completion of the students' design brief's the students are ready to begin the construction of their complex transportation vehicle model. The students may work individually or as team members. Continue to work to ensure that they use their skills, knowledge, and insights gained in previous experimentation and fabrication activities, particularly safety procedures.

Students are expected to follow the design they have made and work toward the outcome(s) they've written including the specific specifications and design criteria they have developed. Evaluate this activity paying close attention to intelligence (economy) and quality of construction. Pay particular attention to how closely the student has come to satisfying their desired final outcomes and criteria as stated in their design brief.

D. Materials: as needed

VoCATS QUESTIONS

FOR

OBJECTIVE 6.02

INSTRUCTIONS TO THE STUDENT: Produce a quality transportation vehicle, system or subsystem. Upon the completion of problem identification, research, and design and the approval of your teacher, build a quality transportation vehicle, system, or subsystem.

Once you have completed your design brief, ask your teacher for approval to go to the fabrication stage of your project. Review all safety procedures related to the tools and machines you will be using to build your project. Monitor your progress regularly. Try to make your deadlines as you've identified them on your plan of work. Notify your teacher if you encounter serious delays.

TEACHER INSTRUCTIONS: Once the student or student teams have completed their design briefs to your satisfaction, permit them to proceed with the development of their project. Review all necessary safety procedures. Monitor their progress regularly. You may evaluate their project using the following evaluation.

Evaluation Criteria:

Aesthetics	0-20 points
Creativity and Ingenuity	0-20 points

Engineering (efficacy) (well designed, does what it is supposed to do)	0-40 points
Artisanship	0-20 points
Total Possible Points	100

COURSE: **Transportation Systems**

UNIT E: **Fabrication of Complex Transportation Vehicles.**

COMPETENCY: **006.00: Design, produce and evaluate a transportation vehicle or system.**

UNIT: **006.03: Evaluate a transportation vehicle or system.**

OBJECTIVE	RESOURCES

A. Purpose: Evaluating a transportation vehicle or system is an excellent strategy for increasing ones understanding of the transportation vehicle or system.

B. Activity

Oral Report

C. Problem

The student is to give an oral report. Pay close attention to the appropriate use of scientific and technical terms and concepts in the oral report. The student's reflection should be well thought out and thorough. Clearly and in detail explain your expectations to the students.

<u>Evaluation of Activity</u>

The oral presentation should be assessed for thoroughness, clarity, intelligence, interest, and the appropriate use of scientific and technical terms and concepts. Also, the presentation should be presented professionally and with the use of appropriate presentation tools.

VoCATS QUESTIONS

FOR

OBJECTIVE 6.03

INSTRUCTIONS TO THE STUDENT: Evaluate your transportation project using the insights you have gained throughout the process. Share your findings with your class by giving a formal presentation.

Once you have completed the design and development stage of your project, present a formal oral report to your class. Use graphics if helpful. Demonstrate your model and explain the problems you encountered and the solutions to your problems. Use appropriate scientific and technical terms. Strive for clarity, thoroughness, intelligence, and interest.

TEACHER INSTRUCTIONS: Once the student(s) has completed the design and development of their project, have him/her present a formal oral report (with appropriate graphics if necessary) to the class. The student should demonstrate their model, address technical problems encountered, and insights gained through the process. Student will be expected to use appropriate scientific and technical terms and concepts as well as deliver a thorough, clear, intelligent and interesting report. Evaluate the report by using the following criteria:

Evaluation:

Oral Report:

Clear and well organized	20 points
Thoroughness	20 points
Intelligent and thoughtful	20 points
Technically and scientifically correct	20 points
Interesting	20 points
Total Possible Points	100

APPENDIX A

BIBLIOGRAPHY/REFERENCES

Appendix A
Bibliography

REFERENCES:

R-1a*	Johnson, S., Farrar-Hunter, P. Exploring Transportation. South Holland Ill: Goodheart-Wilcox, 1993.
R-1b	Instructors Manual-Exploring Transportation
R-1c	Student Activity Manual-Exploring Transportation
R-2a	Schwaller, A.E. Transportation, Energy and Power Technology. Albany, NY: Delmar, 1989.
R-2b	Instructors Guide-Transportation, Energy and Power Technology
R-3a	Bohn, C.B. and MacDonald, A.J. Energy Technology, Power and Transportation. Peoria, Ill.: Glenco, 1992.
R-3b	Instructor's Resource Guide-Energy Technology, Power and Transportation
R-3c	Student Workbook-Energy Technology, Power and Transportation
R-4	Pratt, Douglas R. Basics of Model Rocketry, Waukesha, WI: Kalmback Books, 1993.
SR-1**	Williams, Trevor I. History of Invention. New York, NY: Facts On File Publications, 1987.
SR-2	DeLuca, W. and Haynie, J. Safety System Design for Technology Education. Raleigh, NC: NCDPI, 1990.
SR-3	1998-2000 Curricular Resources Guide. Reston, VA: Technology Student Association, 1998.

R* Primary References-All test-item questions are taken from primary references **or** former references. Each test-item gives the specific reference text and page used for writing the item. Within the Transportation Test-item Bank under the "attribute" section of each test-item, will be found the exact text and page number of the information used to write the test-item.

SR** Secondary-References-These are materials which provide additional and/or in depth information regarding the content in question. While no test-items are derived from this material it is never-the-less strongly recommended that this media be purchased to provide both the teacher and the student additional resource information.

APPENDIX B

VENDOR'S ADDRESS FOR TEXTS, LITERATURE, SOFTWARE AND FILMS

Appendix B
Technology Education
Vendor's Addresses for Texts, Literature, Film, and Software

Amazon.com Inc. (Book resource)
www.amazon.com

Creative Learning Systems
16510 ViaEsprillo
San Diego, CA 92127
(800) 458-2880

Delmar Publishing Inc.
Computer Drive West
Albany, NY 12212
(800) 824-5179
Rep: Patrick Delaney
(704) 536-9180

Glenco/McGraw Hill
3305 Donner Trail
Wake Forest, NC 27587
Rep: Laurie Merlo
(919) 556-8453

Goodheart-Wilcox Co., Inc.
123 West Taft Drive
South Holland, IL 60473
(800) 323-0440

Pitsco
1004 East Adams
P.O. Box 1328
Pittsburgh, KS 66762
(800) 835-0686

San Diego Technical
Books, Inc.
4698 Convoy Street
San Diego, CA 92111
Rep: Amy
(800) 346-0071
www.sdtb.com

Tower Hobbies
P.O. Box 9078
Champaign, IL 61826-9078
(800) 637-4989
www.towerhobbies.com

TSA
(Technology Student Assoc.)
1914 Association Drive
Reston, VA 22091
(703) 860-9000
www.tsawww.org

NC Dept. of Public Instruction
Division of Instructional and Accountability Services
Education Building
301 North Wilmington Street
Raleigh, NC 27601-1714

APPENDIX C

EQUIPMENT AND SUPPLY LIST

Technology Education
Fundamentals of Technology
Equipment List

Courses taught within the facility:		
	Fundamentals of Technology	**(FT)**
	Communication Systems	**(CS)**
	Manufacturing Systems	**(MS)**
	Structural Systems	**(SS)**
	Transportation Systems	**(TS)**

Equipment	FT	CS	MS	SS	TS
Air compressor (min. 10 cfm)	1 F		1 F		1 F
Air brush	1 F	1 F			1 F
Altitude finder					3F
Audio tape recorder	5 F	5 F			5 F
Band saw (bench)	1 F		1 F	1 F	2 F
Battery charger	1 F		1 F		1 F
Boat hull design tank					1 F
Cabinet (material and supply storage)	2 F	2 F	2 F	2 F	2 F
Cabinet (flammable liquid storage)	1 F	1 F	1 F	1 F	1 F
Cabinet (fire blanket)	1 F	1 F	1 F	1 F	1 F
Calipers / micrometer sets (inside and out / metric and standard)	2 F	2 F	2 F	2 F	2 F
Camcorder	1 F	2 F	1 F	1 F	1 F
Clamps (C-type various sizes/ bar or pipe / adjustable hand-screw / quick grip)	12 F		12 F	12 F	12 F
Computer (see "Specifications")	1:2 S	1:2 S	1:2 S	1:2 S	1:2 S
Computer cart	1 F	1 F	1 F	1 F	1 F
Computer control technology	1:2 S	1:2 S	1:2 S	1:2 S	1:2 S
Dial indicator set			1 F		1 F
Digital camera	1 F	1:4 S	1 F	1 F	1 F
Digital scale	2 F		2 F	2 F	2 F
Drafting tool set	1 S	1 S	1 S	1 S	1 S

Quantities are listed per: F = Facility C = Center S = Student

Technology Education - Fundamentals of Technology, continued

Courses taught within the facility: Fundamentals of Technology, Communication Systems, Manufacturing Systems, Structural Systems, Transportation Systems

Equipment	FT	CS	MS	SS	TS
Drafting/ design table	1 S	1 S	1 S	1 S	1 S
Drill bit sets (twist, spade, forstner, machine spur, counter-sink set)	1 F		1 F	1 F	1 F
Drill press (bench/pedestal)	1 F		2 F	1 F	2 F
Drill (electric hand, 3/8' variable, reversible, cordless)	2 F		2 F	2 F	2 F
Electronic lab kit	1:2 S	1:2 S	1:2 S	1:2 S	1:2 S
Electronic tool kit	2 F	2 F	2 F	2 F	2 F
Electronic communication kit		1:2 S			
Engine, small - four cycle trainer					1 F
Experimental breadboard			1:4 S		
Extension cords (25' & 50')	3 F	3 F	3 F	3 F	3 F
Eyewash station	1 F	1 F	1 F	1 F	1 F
Face shields	5 F		5 F	5 F	5 F
Fiber optic kit	1:4 S	1:4 S			
Fire extinguisher (all purpose)	2 F	2 F	2 F	2 F	2 F
First aid cabinet	1 F	1 F	1 F	1 F	1 F
Flatbed scanner	1 F	1F			
Gear / lever / pulley kit	1:4 S		1:4 S		1:4 S
Global positioning system					1 F
Grinder	1 F		1 F	1 F	1 F
Handscrew sets (six clamps)	1 F		1 F		1 F
Helium tank (25-30 cfm)					1 F
Hot air balloon launcher					1 F
Hydraulic / pneumatic trainer	1 F		1 F		1 F
Injection molder	1 F		1 F		1 F
Kiln (bench)	1 F		1 F		

Quantities are listed per: F = Facility C = Center S = Student

Technology Education - Fundamentals of Technology, continued

Courses taught within the facility: Fundamentals of Technology, Communication Systems, Manufacturing Systems, Structural Systems, Transportation Systems

Equipment	FT	CS	MS	SS	TS
Radio control blimps					2 F
Robotic arm (programmable; 5 axis, 18" reach minimum, teach pendent, and computer interface)	1 F	1 F	1 F	1 F	1 F
Rocket launcher					2 F
Router bit set	1 F		1 F	1 F	1 F
Router (1-1/2 hp)	2 F		2 F	2 F	2 F
Rules (steel, metric & English)	1 S	1 S	1 S	1 S	1 S
Safety Glasses/goggles in sanitizing cabinet	1 S	1 S	1 S	1 S	1 S
Sander , electric, hand	2 F				2 F
Sanders (belt/disk)	2 F		2 F	2 F	2 F
Satellite communication system	1 F	1 F			
Scale (triple beam platform balance)	2 F		2 F	2 F	2 F
Scanner	1 F	1 F	1 F	1 F	1 F
Scroll saw (bench)	2 F		2 F	2 F	2 F
Shop vac (25 gal.)	1F		1 F	1 F	1 F
Smoke generator (for wind tunnel)					1 F
Socket sets (standard and metric)	1 F		1 F	1 F	1 F
Solar energy kit	1:4 S				1:2 S
Solar collector	1 F				1 F
Soldering iron (temperature controlled)			1:4 S		1:4 S
Steam engine kit					1 F
Stirling engine					1 F
Stop watch (digital)	4 F		4 F		4 F
Styrofoam cutter	1 F		1 F	1 F	1 F
Super conducting kit (with supplies)					2 F
Table saw (bench)	1 F		1 F	1 F	1 F

Quantities are listed per: F = Facility C = Center S = Student

Technology Education - Fundamentals of Technology, continued

Courses taught within the facility: Fundamentals of Technology, Communication Systems, Manufacturing Systems, Structural Systems, Transportation Systems

Equipment	FT	CS	MS	SS	TS
Television monitor	1 F	1 F	1 F	1 F	1 F
Thermal Imager		1 F			
Tin snip set (straight and circular)	2 F		2 F		2 F
Track (CO2 cars)					1 F
Vacuum former	1 F		1 F		
Vacuum cleaner	1 F		1 F	1 F	1 F
VCR	1 F	1 F	1 F	1 F	1 F
Video editing equipment	1 F	3 F			
Vises (machinist & woodworking)	20 F		20 F	20 F	20 F
Wind tunnel (computer interface / measures lift and drag)					1 F
Wire striper	2 F	2 F	2 F	2 F	2 F
Workbench (33"H x 36" W x 60" L with storage)	1:4 S	1:4 S	1:4 S	1:4 S	1:4 S
Wrench sets (standard and metric)	4 F		4 F	4 F	4 F

Quantities are listed per: F = Facility C = Center S = Student

APPENDIX D

DESIGN BRIEF

Appendix D
DESIGN BRIEF

I. Problem Identification and Definition

This is your first step in developing a design brief. Without a clear idea of what you are trying to accomplish, your success is not likely. An example of statement of the problem and definition is as follows:

> Design a model sailing racer which will meet all NC-TSA design criteria which will surpass the performance of all past sailing racers entered at the NC-TSA Spring Conference (specifically 60 seconds per/lap 10 meters per minute as well as tack, jibe, and point 35-45 degrees into the wind).

II. Research and Review of Literature

This should be thorough and detailed. The more pertinent information you study, the more likely that your project will be successful and the less time it will take you to accomplish your goals. Flailing about without "doing one's homework" is the lease efficient and least productive of problem solving techniques. Use sufficient number and quality of reference materials. Remember that the Internet has many excellent resources directly related to transportation systems, but don't forget that traditional sources such as your library is still one of the best sources of information. Your teacher will expect your design to reflect an understanding of the concepts and principles you are applying.

III. Identification of Appropriate Transportation Systems Design Criteria

You should focus specifically on those factors which will address the problem(s) you have identified. For example, if you want to make a model racing sailboat, you would focus on design criteria directly related to speed, stability, and maneuverability. Specifically, hull and sail shape, weight and size, and boat stability and control factors. Aesthetically factors (sleeping and leisure activities and general attractiveness) while very important in the design of an inland cruising yacht, should not take on the importance of the performance factors in the design of a racing sailboat. Selecting the most appropriate design factors not only means that you have focused on the pertinent design issues, but that you understand the underlying principles needed to design in an intelligent manner. You should be able to explain to your teacher why your hull is designed the way you designed it. Your responses should be thoughtful, intelligent, and appropriate.

IV. Plan of Work

You will develop a plan of work. This is a written step-by step process you will go through from the problem statement, research, design, and completion of the product. Included in this time-line will be precisely what is done and when it will be completed.

V. Expected Outcome(s)

This is a simple statement of what it is you are trying to accomplish. Using the example of the racing model sailboat from above, the statement could read:

> I (we) will design a model sailing racer which will meet all NC-TSA design criteria which will surpass the performance of all past sailing racers entered at the NC-TSA Spring Conference (specifically 60 seconds per/lap 10 meters per minute as well as tack, jib, and point 35-45 degrees into the wind).

VI. Evaluation Criteria (A statement of how "success" will be measured).

Your evaluation criteria must be clearly stated, well thought out, and comprehensive. Use numerical data whenever possible. Again, using the above example:

> Success will be measured by the following criteria:
>
> The number of seconds below 60 (per lap) the sailboat travels the required course.
> How well the sailboat tacks, jibes (turns down wind), and points (sails into the wind).
> How stable the sailboat is in all racing situations.
> How quickly the sailboat is able to tack, or jibe, and change direction.
> Sailboat must be all required specifications (list these).

VII. Students Written Evaluation of the Design and Production Process

This will be your brief narrative of no more than several paragraphs reflecting upon the entire design and development process. You should point out areas of particular difficulty, successes and failures as well as things you found particularly enjoyable. You should note things you would do differently if you were to go through this process again.

VIII. Drawings and Bibliography

Your bibliography will be appendix A of your Design Brief (done in APA "American Psychological Association" style or one approved by your school's English department.
Your sketches and drawings will be appendix B of your Design Brief. Your drawings will meet ANSI standards.

Overall Design Brief:

Your design brief should be well organized, well written, and complete. The design brief should be efficient, purposeful, and effective in helping you execute an intelligent solution to your identified problem.

Evaluation:

You will be evaluated using the following criteria:

Problem Identification and Definition	5 pts.
Research and Review of Literature	15 pts.
Identification of Appropriate Transportation Systems Design Criteria	5 pts.
Plan of Work	15 pts.
Expected Outcomes	5 pts.
Evaluation Criteria	5 pts.
Students Written Evaluation of the Design and Production Process	15 pts.
Drawings and Bibliography	15 pts.
Overall Design Brief	20 pts.
Total Possible Score	100 pts.

APPENDIX E

CURRICULUM PRODUCTS EVALUATION FORM

Appendix E

Transportation Systems Curriculum Products Evaluation Form

Your suggestions and insights are needed to improve our curriculum products (curriculum guides, blueprints, test-items, equipment lists, and recommended media. Please review all the Transportation Systems materials carefully. After teaching one full course cycle, please take 15 minutes to fill out and return this evaluation form. Note that the more specific and clear your suggestions are, the more useful and influential they will be. You may wish to have an industry representative evaluate the products. Thank you for helping us serve you and your students better.

Rate the following statements from 1-5, with 1 being poor, and 5 being excellent. When responding to specific curriculum content found within the curriculum guide or blueprint, please give competency and objective numbers.

Teacher's Name: ______________________________

School Name: ______________________________

	Don't Know	Poor	Fair	Good	Very Good	Excellent
1) Blueprint is well structured and focuses on essential concepts and skills. It does not contain superfluous content. Comments:	Unsure	1	2	3	4	5
2) Curriculum Guide clearly specifies the content needed to achieve program mastery. It is easy to use and is technically correct. Comments:	Unsure	1	2	3	4	5
3) Curriculum incorporates appropriate math, science, technical concepts, and processes. Content is not too complex or too simple for students. It is technically correct. Comments:	Unsure	1	2	3	4	5
4) Curriculum reflects the use of state-of-the-art technology. Equipment list reflects state-of-the-art technology and meets minimum standards. Comments:	Unsure	1	2	3	4	5
5) Program completers are well prepared for entry level position in industry and/or post-secondary studies. Comments:	Unsure	1	2	3	4	5

Return To:

Tom Shown
NC Department of Public Instruction
301 North Wilmington Street
Raleigh, NC 27607-2825

APPENDIX F

TRANSPARENCIES