INHERITANCE

Inheritance

Science 7

15-16

Objectives for Unit 1 - Part 1: Reproduction

You will UNDERSTAND the following concepts…

Underlined terms are required vocabulary words.

- Organisms have different methods for reproducing & creating offspring.
- Unicellular & multicellular organisms differ in their reproductive strategies.
- Sexual & asexual reproduction have advantages and disadvantages.
- Patterns of growth & development vary among living things.
- The term **genetic** refers to the "instructions" in the nucleus of all cells that controls the traits (appearance, behavior, structure) of that organism.

You will KNOW the following ideas and concepts…

- **Asexual Reproduction**
  - All **genetic** material (genes, DNA, chromosomes) come from the same parent.
  - Offspring are genetically **identical** to the parent.
  - There is just ONE parent involved.
  - **Most** asexual reproduction occurs in **unicellular** or very simple organisms.
  - Asexual reproduction allows a population to increase quickly.

- **Cell Division**
  - The purpose of **cell division** in single celled organisms is for reproduction.
  - The purpose of cell division in multi-cellular organisms is for growth, , repair, and replacement.
  - The most common type of cell division creates body cells (**daughter cells**) that are genetically identical to the original cell.
  - There is a special type of cell division that creates **sex cells**.

Continues on the next page!

- **Sexual Reproduction**
  - The female sex cell is the **egg**. The male sex cell is the **sperm.**
  - Sex cells have half the number of chromosomes (DNA, genes) as body cells.
  - **Fertilization** is the joining of egg and sperm to create a **fertilized egg** (**zygote**).
  - ½ the genes (DNA, chromosomes) in an offspring come from each parent.
  - The cells resulting from sexual reproduction have a combination of genetic material from both parents.
  - Offspring are not genetically identical to either parent in sexual reproduction.
  - Fertilized eggs undergo numerous cell divisions, which results in a multicellular organism.
  - A **body cell** is every cell in an organism EXCEPT **egg and/or sperm.**
  - A **sex cell** is a cell needed for sexual reproduction and has ½ the number of chromosomes as a body cell.
  - In plants, **pollen** is the sperm, and a **seed** is a **zygote**.
  - One advantage of sexual reproduction is genetic **diversity** (variety), which increases the chance that a species will be able to respond to changes in their environment.

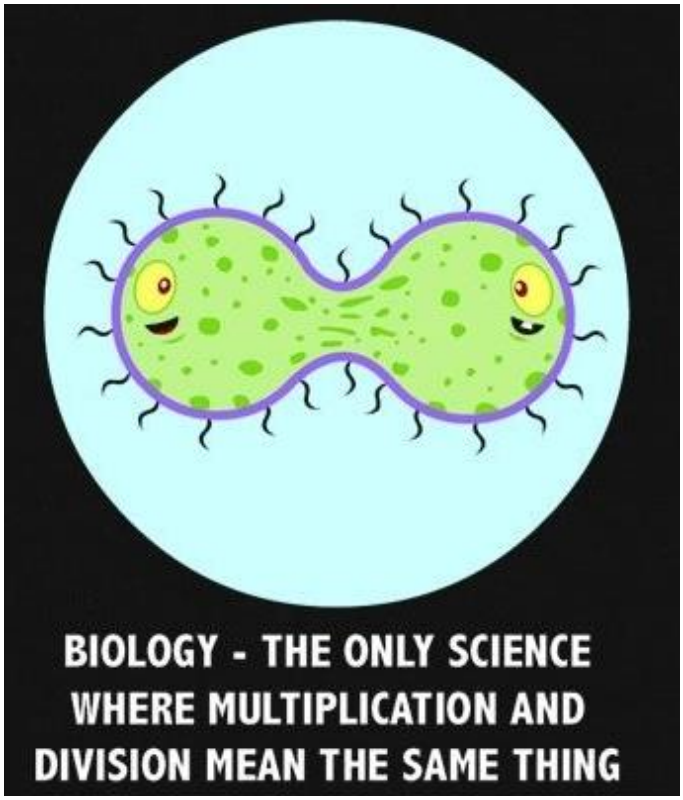
Continues on the next page!

- **Life Cycles**
  - All living things have a life cycle in which growth, development, & reproduction occur.
  - In some species, the young resemble the adult.
  - In some species, the young is very different in structure & activity from the adult. This type of growth is known as metamorphosis.
  -
- Some organisms reproduce asexually. Others reproduce sexually. Some can reproduce both sexually and asexually, such as plants.
- In multicellular organisms, complex changes occur during development; eventually tissues, organs and organ systems develop.

- A **species** is a group of very similar organisms that can reproduce to create offspring, and their offspring can repeat this process to keep the species going.

You will BE ABLE TO DO the following activities…

- Compare and contrast asexual & sexual reproduction.
- Describe the advantages and disadvantages of asexual and sexual reproduction.
- Describe how cell division is involved in all reproduction & growth.
- Construct an explanation with evidence that accounts for differing amounts of genetic diversity among species.
- Develop an argument with evidence to support a claim about advantages of different methods of reproduction.
- Explain how sex cells differ genetically from body cells.
- Interpret a diagram showing fertilization and the development of an embryo.
- Describe how a fertilized egg develops into a multicellular organism.
- Compare/contrast the life cycles of various living things.



Learning Target: *I can compare and contrast the 2 different types of reproduction and explain the advantages and disadvantages of each. I can also explain the role of cell division in reproduction and growth of organisms.*

Strategies for Producing Offspring

- All **organisms** (living things) must **reproduce.** When an organism reproduces it creates **offspring** (babies, kids, children, etc.)
- Today you will collect evidence about 6 different organisms and their reproduction methods. You will use that evidence to compare and contrast **asexual** and **sexual** reproduction.

PART A: Below are a list of organisms and their methods of reproduction. After reading about each organism on the info sheets, circle the best choice in each box.

Organism & Method of Reproduction	**Grizzly Bear** ***Sexual Reproduction***	**Amoeba** ***Asexual Reproduction***
Number of Parents	1 **or** 2	1 **or** 2
Reproductive Mechanism	Uses egg & sperm **or** No egg & sperm needed	Uses egg & sperm **or** No egg & sperm needed
Genetic Variation	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent
Complexity of the organism	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*

Organism & Method of Reproduction	**Sand Scorpion** *Sexual Reproduction*	**Hydra** *Asexual Reproduction*
Number of Parents	1 **or** 2	1 **or** 2
Reproductive Mechanism	Uses egg & sperm **or** No egg & sperm needed	Uses egg & sperm **or** No egg & sperm needed
Genetic Variation	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent
Complexity of the organism	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*

Organism & Method of Reproduction	**Sunflower** *Sexual Reproduction*	**Salmonella Bacteria** *Asexual Reproduction*
Number of Parents	1 **or** 2	1 **or** 2
Reproductive Mechanism	Uses egg & sperm **or** No egg & sperm needed	Uses egg & sperm **or** No egg & sperm needed
Genetic Variation	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent	Offspring are genetically identical to parent (same) **or** Offspring are genetically different from parent
Complexity of the organism	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*	Simple organism *(unicellular or very small)* **or** Complex organism *(multicellular & larger)*

Part B:

1. Review the evidence collected from the charts on part one.

2. Record facts about organisms that reproduce **sexually**.

(Example) There must be 2 parents

_____

_____

_____

_____

3. Record facts about organism that reproduce **asexually**

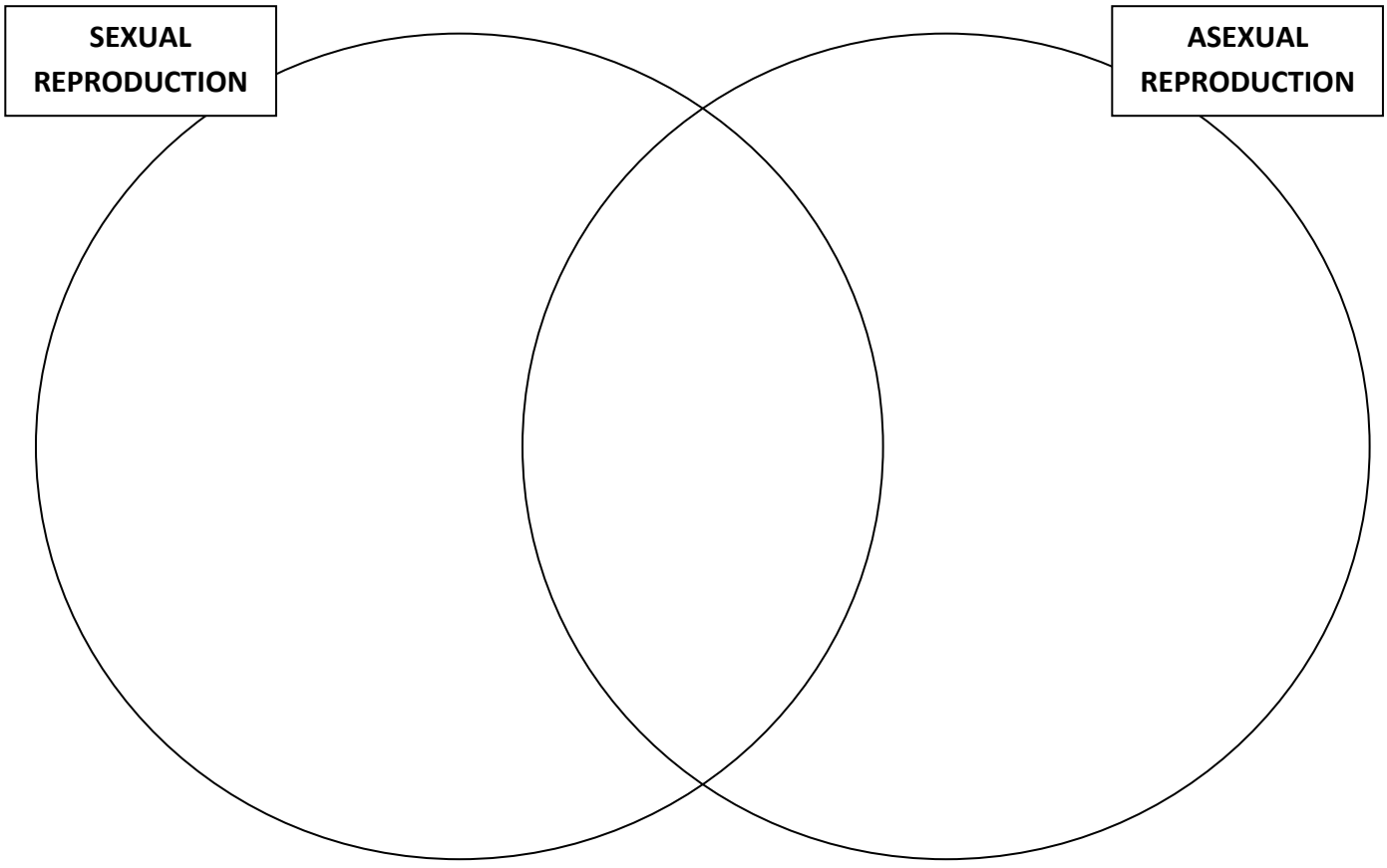
_____

_____

_____

_____

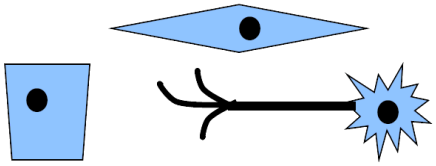
4. Complete the Venn diagram to compare & contrast sexual and asexual reproduction.



Part C: Complete this chart as your teacher shows the slides.

	ASEXUAL	SEXUAL
Advantages *(the pros)*		
Disadvantages *(the cons)*		

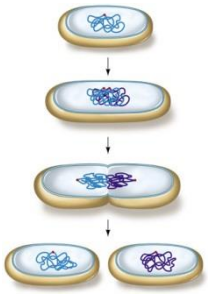
Part D: The 2 Categories of Cells in Multicellular Organisms *(Like You!)*

	Sex Cells	Body Cells
Examples		
Where are they found?		
What's in the nucleus?		
Amazing Fact!	Every sperm or egg is totally _____! Each has a unique ½ of dad or mom's DNA *(genetic material)*	Every single body cell in your body has the exact same _____ *(genetic material in the nucleus)*

Part E: Watch the Brainpop on Asexual Reproduction and then complete these notes with the class.

Cell Division in Living Things

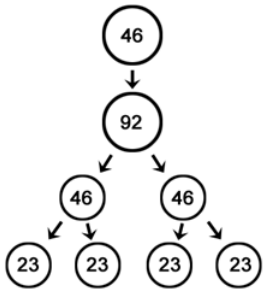
Cell Division for _____ Reproduction



- Used by _____-cellular organisms to _____ _____
- The offspring are genetically _____ to the parent
- Used by _____-cellular organisms to _____ and repair themselves

Cell Division for _____ Reproduction

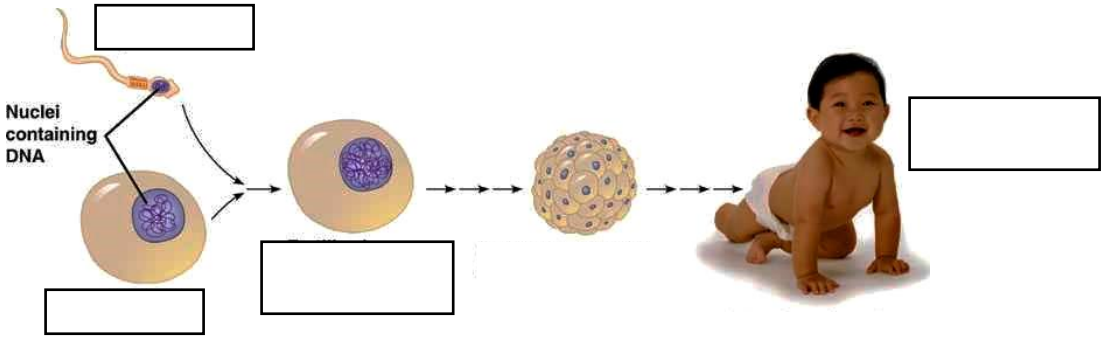
- Special cell division creates _____ cells
- _____ = male sex cell _____ = female sex cell
- _____ = merging (_____) of egg & sperm to create a fertilized egg (_____)



This special cell division makes sex cells (4 eggs or 4 sperm at a time)

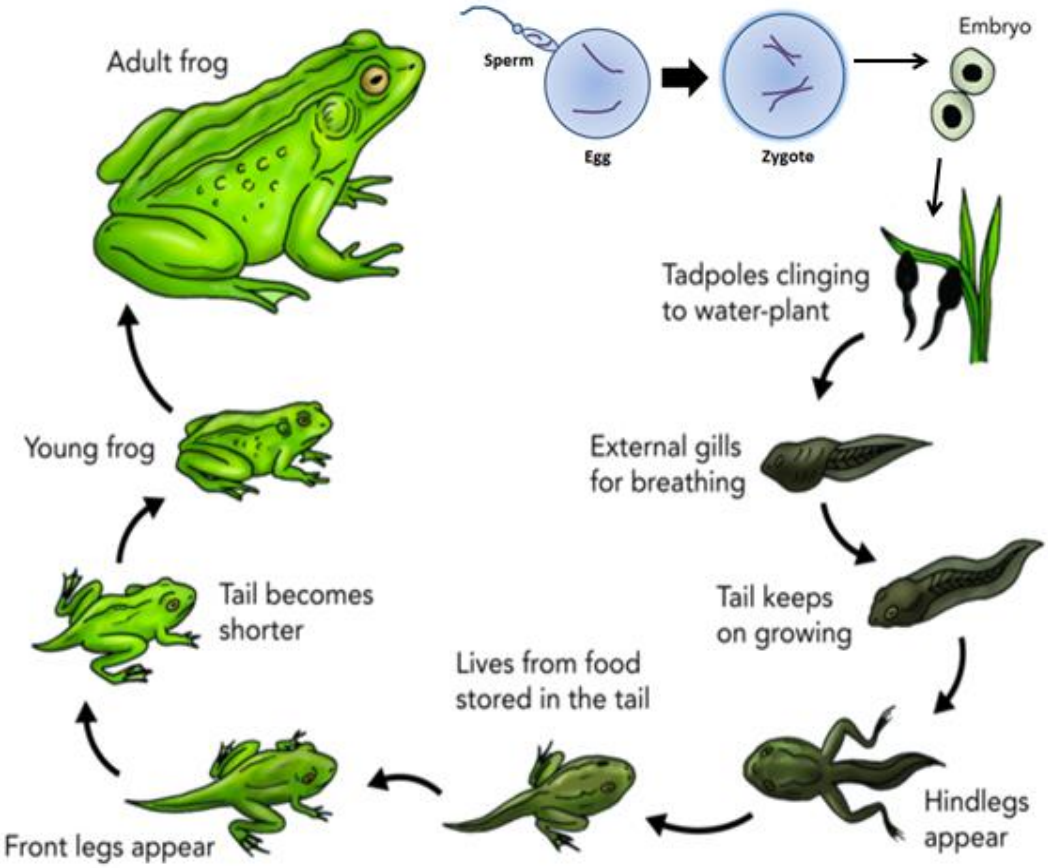
Cell Division for _____&_____&_____

- **GROWTH:** lots of _____ _____ allows a _____ (just one cell) to become an _____ and then a baby
- **GROWTH:** a baby grows into an adult by lots more _____ _____ of all the _____ cells (*a body cell is any cell other than the _____ cells*)



- **REPAIR:** when you get a _____ or break a _____ your body makes new cells to _____ the damage!
- **REGENERATION:** some organisms (like _____ or _____) can grow a whole new _____ or _____ by cell division

Part F: Apply what you have learned:



Defend the following statements with evidence from the diagram above:

a) **Statement:** Frogs are organisms that reproduce sexually.

Evidence: _____

_____

_____

b) **Statement:** Frogs also rely on cell division (asexual reproduction) as part of their life cycle.
Evidence: _____

_____

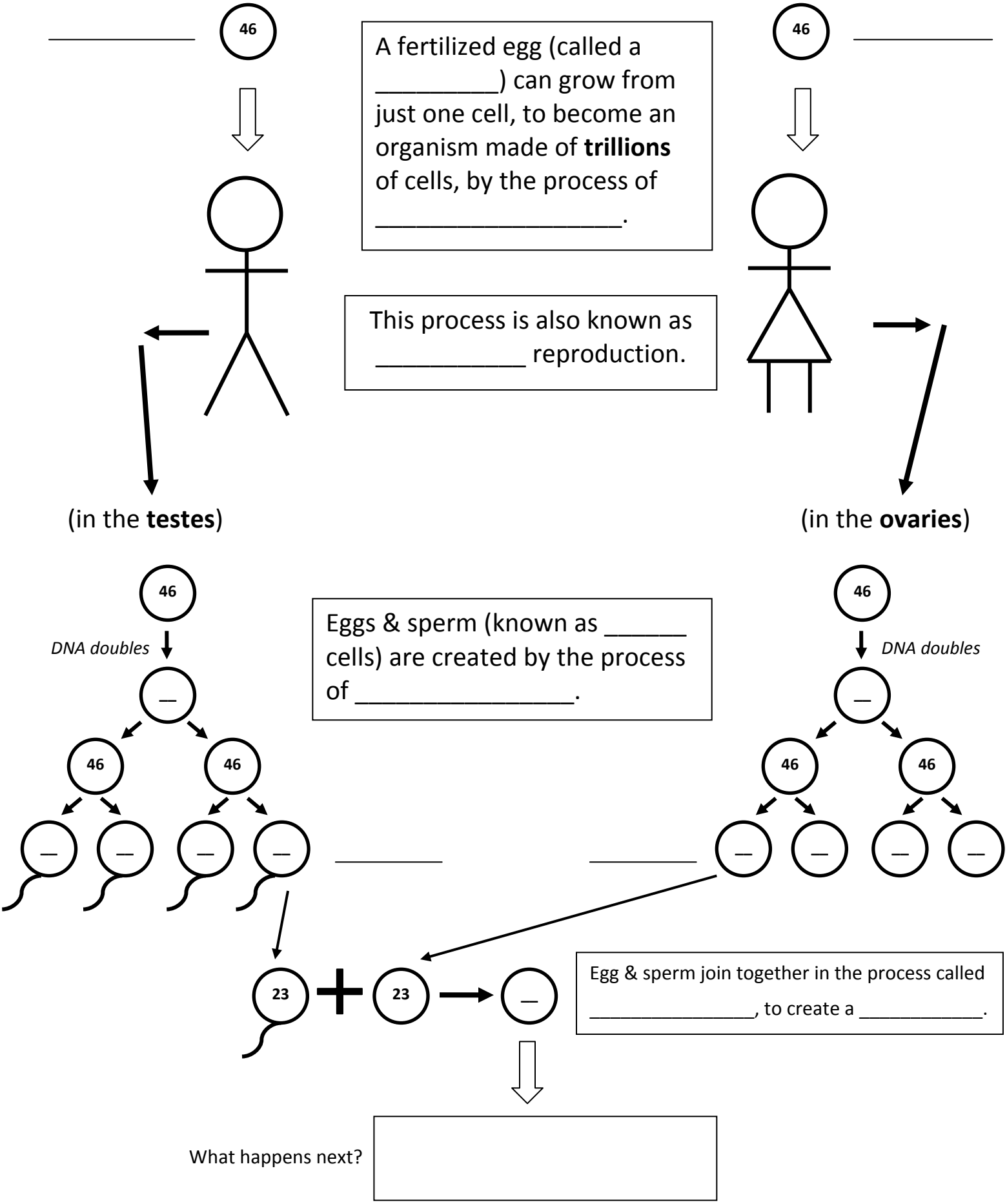
_____

_____

c) One advantage of sexual reproduction is **variety** in the offspring. **List some variations (differences)** that might allow some young frogs to escape from predators (like a snake) while other young frogs get caught & eaten:

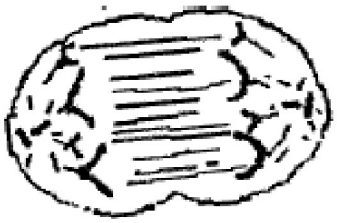
_____

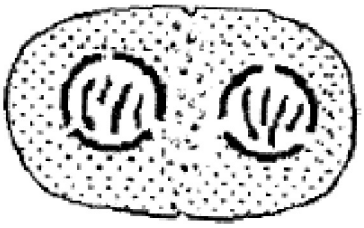
<u>Mitosis</u> & <u>Meiosis</u> in multicellular organisms – The Big Picture

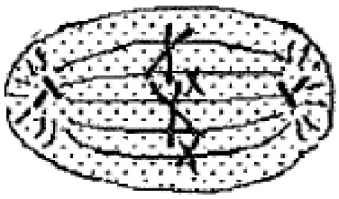


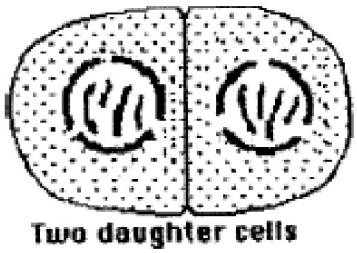
Phases of Mitosis

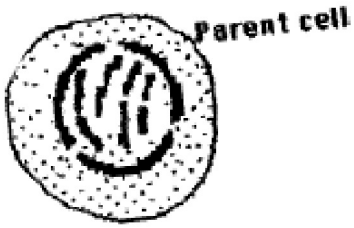
Cut out the six pictures below. These will be pasted next to the description of each phase.

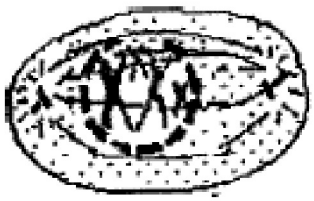












Directions: Complete the paragraph below using the word bank.

Word Bank	
single	zygote
produce	growth
two	mitosis
genetically	repair
asexual	identical

Cell division, also referred to as _____ is a process whereby _____ new cells are produced. These cells are _____ _____ to the original cell. Organisms use mitosis for several reasons. _____-celled organisms use mitosis as a form of _____ reproduction thus creating new organisms. Multicellular organisms use mitosis for _____ and _____. A person may receive an injury to his arm. The process of cell division can _____ new cells to patch the injury. A _____ grows by the process of cell division.

Objectives for Unit 1 - Part 2: DNA, Genes, & Chromosomes

You will UNDERSTAND the following concepts…

- Most cells have genetic information that determines traits.
- Organisms inherit genetic information in a variety of ways that result in variations/similarities in organisms.
- Models of genetic inheritance can be used to show the probability of traits being expressed.
- Genes can be modified through mutation or human intervention.
- Genetic traits are passed from parents to offspring.

Underlined terms are required vocabulary words.

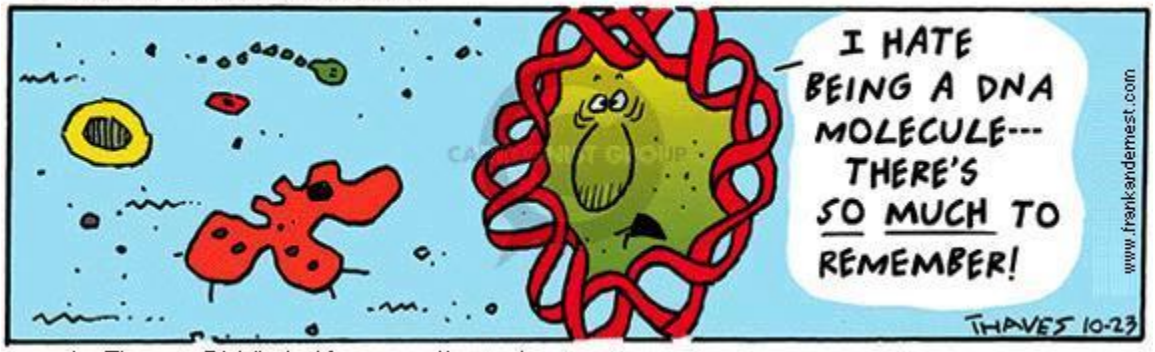
You will KNOW the following ideas and concepts…

- A single celled (**unicellular**)organism has one cell; a **multi**-**cellular** organism is made of many cells.
- Some organisms are single-celled and others are multi-cellular, including humans.
- DNA
    - **DNA** is the genetic material that contains the traits of any organism.
    - DNA is found inside the **nucleus** of most organisms.
    - A random change in an organism's DNA is called a **mutation.** A mutation can be helpful, harmful, or neutral.
    - New **traits** develop due to changes in an organisms DNA.
- Genes
    - A **gene** is a segment of DNA.
    - A human cell contains many thousands of genes. Each human cell contains a copy of all the genes needed to produce a human being.
    - Each gene sequence results in a trait.
    - The environment may affect the expression of genes. In other words, two organisms may be genetically identical, but not look exactly the same.
- Chromosomes
    - **Chromosomes** are coiled up DNA.
    - All organisms have a characteristic number of chromosomes in their body cells and their sex cells have ½ that normal number.
    - In a human body cell, there are 46 chromosomes. A human sex cell has 23.
    - Each body cell in a multi-cellular organism has the exact same DNA as every other cell even though each cell does a different job!
- Cell division
    - The purpose of **cell division** in single celled organisms is for reproduction.
    - The purpose of cell division in multi-cellular organisms is for growth, maintenance, repair, and replacement.
    - **Cancers** are a result of abnormal cell division.
    - The most common type of cell division creates body cells (**daughter cells**) that are genetically identical to the original cell.
    - There is a special type of cell division that creates sex cells.

You will BE ABLE TO DO the following activities…

- Create a model to represent DNA, genes, and chromosomes. (DNA Dog)
- Interpret/analyze data/graphs and draw conclusions.
- Complete the DNA, Chromosomes, and Genes webquest.

Frank and Ernest



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Introduction to Genetics Notes

What is genetics?

- The study of how _____ are inherited through the interactions of _____

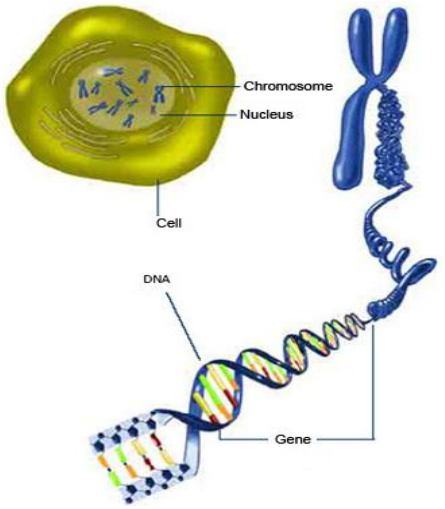
DNA

- Contains _____ for the _____
- Made of two strands _____ together in a _____ _____
- _____% of your DNA is identical to everyone else's

– The remaining _____ % controls our differences (hair color, eye color, height, etc.)

Genes

- Short segments of _____
- one _____ molecule contains many _____
- Each _____ has instructions for a _____ in an organism



Chromosomes

- Packets of _____-up _____
- Humans have_____ chromosomes in our _____ cells (_____ in our sex cells)
- _____ parent contributes _____ of his/her chromosomes to its _____

Heredity

- The _____ of _____ from _____ to _____

Traits

- _____ or features
- Genetic traits are passed from parents to offspring (by genes)
- Traits can be _____ by the _____
    - Ex: your **hair color** may become lighter after being in the sun for long periods of time
    - Ex. **height** can be reduced by malnutrition when you are young

Traits & Reproduction

ASEXUAL	• The offspring have the _____ _____ traits as parents (same _____) • Very little _____ from generation to generation.
SEXUAL	• Offspring get a random _____ of _____ from each parent. • More _____! (New combinations of _____ with each new generation.)

A DNA, Genes, and Chromosome Model

1. Sketch the model in the space below. Label the parts.

2. What are some things about this model that are accurate representations of real DNA?

3. What are some things that are not accurate when comparing this model to real DNA?

4. What other models can you think of that would represent our topic? Describe, draw and label in the space below.

DNA, Genes, and Chromosomes Reading Guide

Name _____ Class _____

Select True or False for each statement BEFORE reading the article	Statement	Determine if the statement is True or False based on the article
	DNA is found in cells and determines your traits.	
	Chromosomes are rod shaped and made of coiled up DNA.	
	Sex cells (egg and sperm) have ½ the chromosomes of other cells in the body (body cells).	
	Both mitosis and meiosis are types of cell division.	
	A zygote is a single cell that is formed by fertilization.	

Part II: For each set of terms below, write a couple of sentences to explain how the terms **relate to each other**. Use each word in your explanation. You may need to go back to the reading to make sure you completely understand the terms.

DNA and Chromosomes

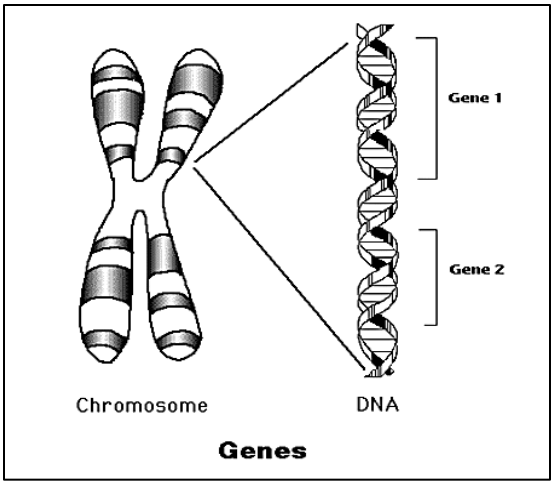
Sex Cells and Meiosis

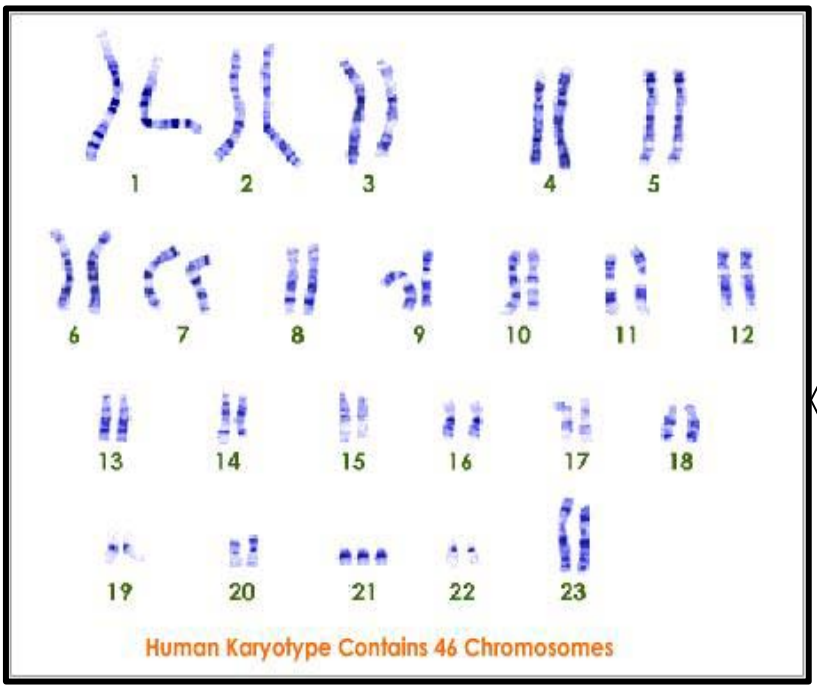
Body Cells and Mitosis

Fertilization and Sex Cells

DNA, Genes, and Chromosomes

DNA (deoxyribonucleic acid) is found in the nucleus of every cell in your body. It contains genetic information, in the form of **genes,** which are passed on from one generation to the next. Your DNA determines all of your traits. The DNA model is referred to as a **double helix.** What this really means is that it looks like a ladder that is twisted - like a spiral staircase.





DNA is arranged into **chromosomes** when the cell gets ready to divide. Think of a chromosome as a long thread of DNA coiled up into a rod. Chromosomes vary in size and shape and almost always occur in pairs.

Humans generally have 46 chromosomes. How many chromosomes does this person have? ____

What does this indicate? _____

_____

Each species has a characteristic number of chromosomes in its body cells. In the sex cells, there is half that number. This makes sense because you receive half of your genes from your mother and the other half from your father and these genes are carried in the **sex cells (the egg and sperm).** The egg and the sperm are produced by another type of cell division called **meiosis. Meiosis** produces cells with one-half the number of chromosomes as the parent cell. **Mitosis** produces cells with the same number of chromosomes as the parent cell which in turn become body cells. For example, humans have 46 chromosomes in their body cells and 23 chromosomes in their sex cells. When the egg (23) and the sperm (23) meet, fertilization occurs and the resulting cell, **the zygote,** will have the appropriate number of chromosomes.

Species Number of Chromosomes

Species	Chromosome Number
fruit fly	8
housefly	12
onion	16
cabbage	18
corn	20
toad	22
tobacco	24
frog	26
McIntosh apple	34
human	46
wheat	48
lizard	140
gray kangaroo	16
cat	38
hermit crab	254
goldfish	104
Indian fern	1260

Critical Thinking

1 What is the major difference between mitosis and meiosis?

2 What types of cells are produced by meiosis and by mitosis?

3 What is the name of the process whereby egg and sperm unite to form a new individual (zygote)?

4 Each body cell in a mouse contains 40 chromosomes. How many chromosomes did the mouse receive from each of its parents? Explain.

5 How many chromosomes are present in the mouse's sex cells? How do you know this?

6 Give an example of when a mouse might need the process of mitosis?

DNA, Chromosomes, and Genes

Directions: Using the website http://learn.genetics.utah.edu/units/basics/tour/ complete the following questions.

What is DNA?

How is DNA like a blueprint?

Draw a DNA double helix. Be sure to include the letters

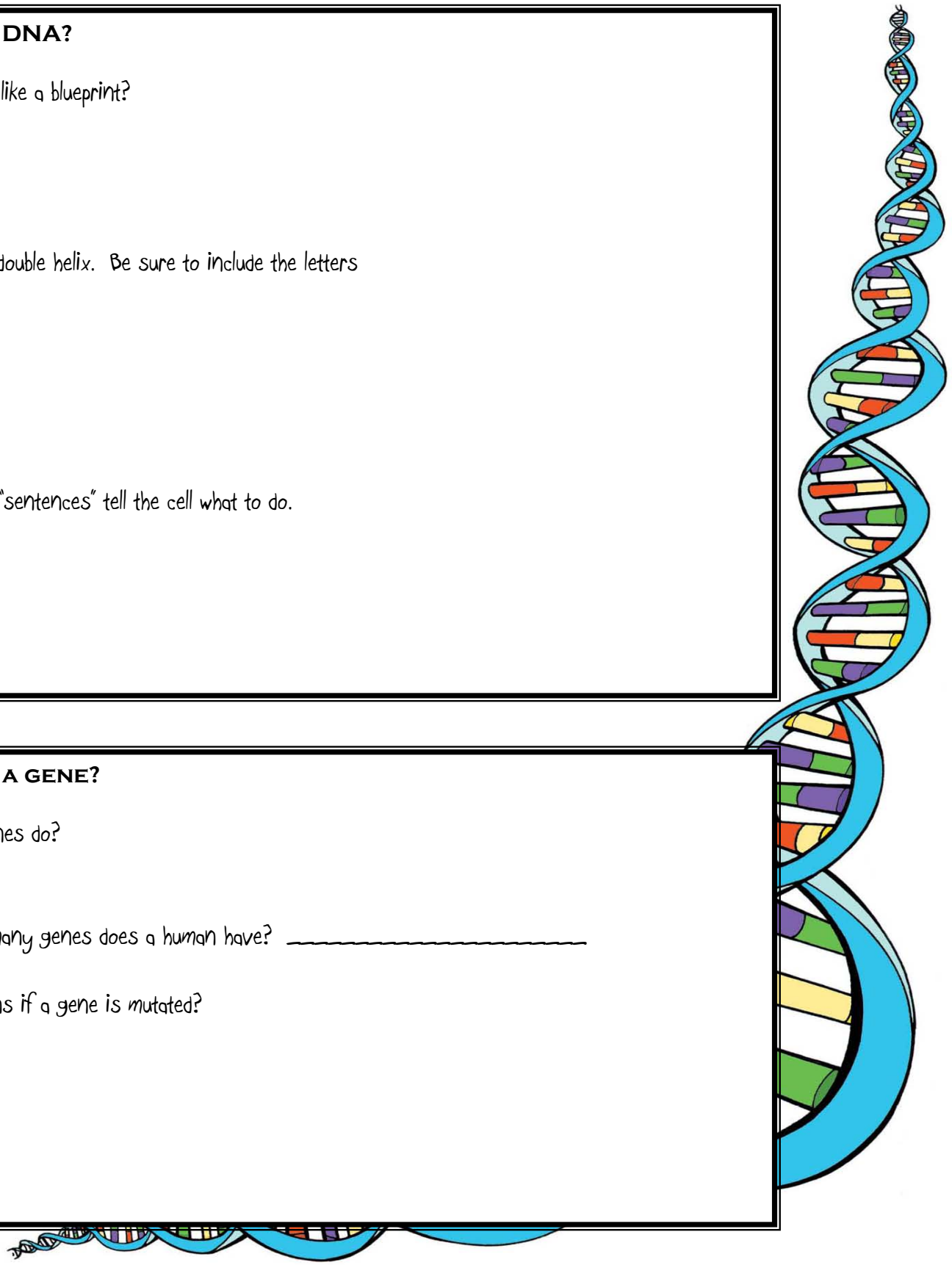
Explain how "sentences" tell the cell what to do.

What is a gene?

What do genes do?

About how many genes does a human have? _____

What happens if a gene is mutated?



What is a Chromosome?

How does all of the DNA fit into one cell?

How many chromosomes does each human cell contain? _____

Which code determines whether an offspring is male or female? XX _____ XY _____

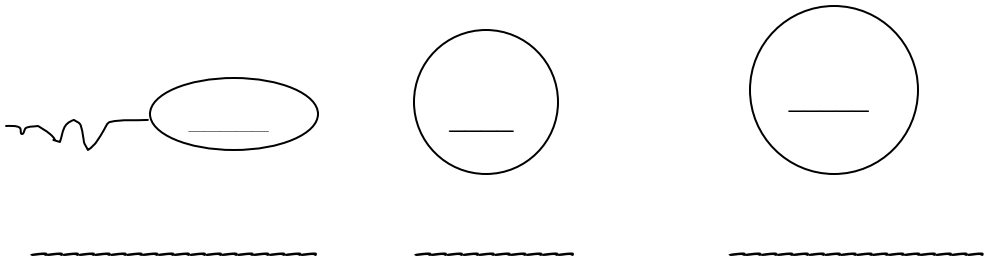
How many chromosomes does each of the following organisms have?

Mosquito _____ Onion _____ Carp _____

What is Heredity?

How are traits passed from parents to offspring?

Label each reproductive cell (zygote, egg, or sperm) and <u>write the number of chromosomes inside each cell</u>.



_____ _____ _____

How is it that each sibling (brother and sister) can be so different from each other even though they have the same parents?

What is a trait?

What is a trait? Give two examples.

How does the environment influence your traits? Give an example.

What is Cancer?

By Tim Brainpop

Name:

Cancer is a condition where cells divide uncontrollably inside someone's body. A **tumor** is a mass of cancer cells that can interfere with the surrounding normal cells and prevent them from doing their job. This growth can damage surrounding tissues or organs, which can be very dangerous and often deadly. Tumors, or clumps of cancer cells, aren't contagious – so you can't catch cancer from a person who has cancer.

What is the scientific term for **cell division**? (such as a skin cell dividing to become 2 skin cells)

_____

Cancer is caused when there is a **mutation** in the **DNA** of cells in the body. A mutation is a random change to the DNA of a cell. It is not always known why a mutation occurs. Some mutations are caused by exposure to **carcinogens** in the environment such as chemicals, cigarette smoke, or too much radiation from the sun. Other mutations can be passed down to you from your parents. Certain people may have a higher chance of developing cancer because of their inherited DNA. Someone who has an **increased chance** of developing cancer, due to their inherited DNA, is said to have a **genetic predisposition** to cancer.

TRUE or FALSE

A carcinogen is something harmful or dangerous to cells.

DNA is the **genetic material** in the nucleus of almost every cell in your body. DNA provides instructions for how cells should behave and do their jobs. Genetic material (DNA) gets damaged in cancer cells, and causes them to divide repeatedly without stopping.

Using information from the previous paragraph, what is the scientific term for DNA that is changed?

_____

There is currently no overall cure for cancer, but there are lots of successful treatments that help people that have cancer, including surgery, radiation treatments, and chemotherapy.

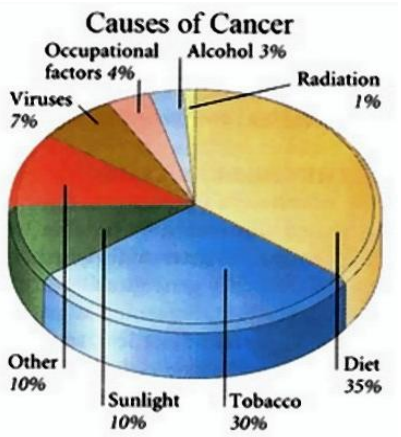
	Statement	T/F	Evidence (line numbers)
1	Cancer cells have normal DNA.		
2	Cancer can be caused by carcinogens in a person's environment.		
3	Both the environment and your genetic predisposition can influence your chances of getting cancer.		
4	Cancer can be transmitted from one person to another like the flu.		

Name: _____ **Class:** _____

Mutations Slideshow & Notes

1. A mutation is a _____ _____ in an organism's DNA.

- Can be _____ – passed down from a parent. *(And passed down to their* _____ *)*
- Can be caused by _____ (cancer causing agents in the environment)



2. According to the pie chart, what are the three leading causes of cancer?

- #1 _____
- #2 _____
- #3 _____

3. What ingredient in tobacco is a carcinogen?

_____

4. Mutations that occur in **[sex cells / body cells / any cell]** *(circle one)* can be passed down to offspring.

5. **TRUE or FALSE?** A mutation may be POSITIVE, NEUTRAL, or NEGATIVE depending on its environment.
6. **POSITIVE OR NEUTRAL OR NEGATIVE?** A desert rat is born with a mutation which results in extra fur.
7. **POSITIVE OR NEUTRAL OR NEGATIVE?** An artic fox is born with a mutation which results in extra fur.
8. **POSITIVE OR NEUTRAL OR NEGATIVE?** A fish is born with a mutation which results in extreme camouflage with the corals.
9. **POSITIVE OR NEUTRAL OR NEGATIVE?** A child is born with a mutation which results in brown eyes instead of green eyes.

What's to come… *Mutations can lead to **changes in a species**! How? Read on…*

- **Some** mutations cause useful **traits**, and those traits may give an organism a **survival advantage**.
- Organisms with the useful traits have a higher chance of reproducing & passing the trait to offspring.
- The offspring with the useful traits are "better adapted" to their environment (to survive and live on and have more offspring).
- After a **long** period of time, most members of the species will have this new useful trait that started out as a random mutation! The species has now changed!

Name: _____ Class _____

What Causes Cancer?

Active Reading Strategy: *As you read, collect evidence -* ***<u>one textual support and one paraphrase</u>*** *- and record in the graphic organizer below.*

Thesis: Cancer is a disease that is caused by several factors including a person's **genetic predisposition** as well as the **environment** that a person is exposed to.

	Genetic Predisposition	**Environment**
Article Title: Cancer Cluster	Textual Support: Paraphrase:	Textual Support: Paraphrase:
Article Title: Fortune Teller	Textual Support: Paraphrase:	Textual Support: Paraphrase:

Name: _____ Class _____

By Derek Nichols

CANCER CLUSTER

Why have so many children from Fallon, Nev., developed cancer?

On September 1, 2001, Stephanie Sands lost a two-year battle with cancer. Sands, 21, died of *acute lymphocytic leukemia*, a cancer of the blood and bone marrow.

Sands was living in Pennsylvania when she fell ill but had spent much of her childhood in the city of Fallon, Nev. That location is significant because Sands was one of 17 children from Fallon to develop leukemia between 1997 and 2004.

Fallon is the site of a *cancer cluster*, a greater-than-expected number of cancer cases in a geographic area over a period of time. Now Fallon residents are demanding answers. "I am admittedly obsessed with Fallon and leukemia," Stephanie Sands's father, Floyd Sands, told the *Las Vegas Review-Journal*. Is some mysterious *carcinogen* (cancer-causing agent) lurking in Fallon, or has the city just been hit by random bad luck?

Students walk near a pipeline that transports jet fuel in Fallon, Nev. Some residents suspect that the fuel is responsible for the cluster of cancer cases in the city.

COUNTLESS CAUSES

One in three Americans will develop some form of cancer. The causes of cancer are many, from genes to personal habits (smoking, poor diet) to environmental agents (radiation, viruses, chemicals).

Identifying a single cause of any given cancer is difficult, if not impossible. When a cancer cluster arises, though, *epidemiologists* look for something in the environment that could be involved in every case. Epidemiologists study the occurrence and distribution of diseases in a population.

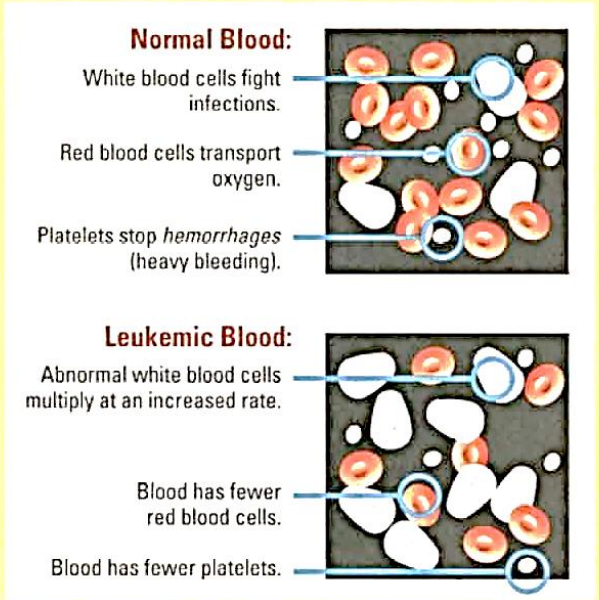
Many researchers are skeptical of cancer clusters. Why? People tend to interpret random events as though they are *not* random. That type of false impression is called a *clustering illusion*. If a friend tosses a coin four times and gets four heads in a row, you might suspect him of cheating. However, four heads in a row isn't statistically unusual. In 20 flips, your friend has a 50 percent chance of getting four heads in a row. Similarly, cancer rates are naturally higher in some places and lower in others.

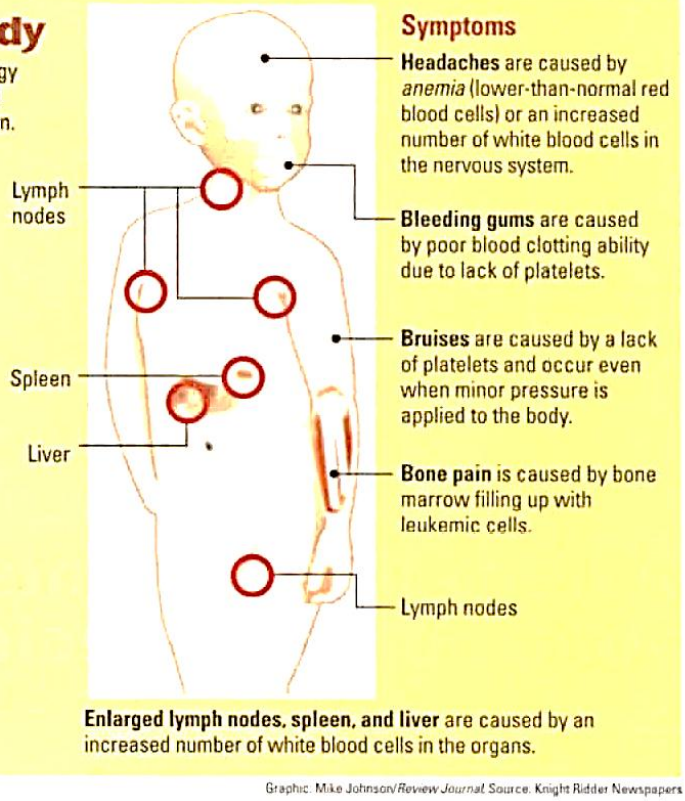
Joseph Wiemels, an epidemiologist at the University of California, San Francisco, believes most cancer clusters are just chance events. He says, though, "Fallon is a little different." Based on national averages, he explains, Fallon should expect about one case of childhood leukemia every three or four years. However, the small town experienced 17 cases in just a few years. "It's just too remarkable a cluster to be by chance," he says.

Background image: Dr. Gopal Murti/Photo Researchers, Inc.; Inset: Christine Wetzel

How Leukemia Attacks the Body

Leukemia is a cancer that occurs when *bone marrow*—the soft, spongy tissue that fills the cavities in bones—produces too many white blood cells. Acute lymphocytic leukemia is the most common form in children.





Graphic: Mike Johnson/*Review Journal* Source: Knight Ridder Newspapers

FAMILIES TAKE ACTION

In the summer of 2001, Adam Jernee, 10, became the first Fallon cluster patient to die of leukemia. By then, more than a dozen cases of the disease had been diagnosed in the town. Soon after, the U.S. Centers for Disease Control and Prevention (CDC) launched an investigation. In 2003, the agency announced that it was unable to identify an environmental cause for the cluster.

The CDC might have given up, but Fallon residents weren't about to. Many united to form Families in Search of Truth. With help from Sen. Harry Reid (D-Nev.), the group secured almost $700,000 from Congress to keep funding researchers, including Wiemels and Mark Witten, of the University of Arizona College of Medicine.

Fallon is home to a number of cancer suspects, says Wiemels. "It's a hard-hit community as far as environmental issues go," he says. For starters, the town's water supply contains high levels of *arsenic*, a naturally occurring but poisonous element that has been linked to bladder and skin cancers, though not to leukemia.

The town also houses a U.S. Navy base with an aging jet-fuel pipeline. The fuel's chemical formula was changed in the mid-1990s, Wiemels notes, right before Fallon's kids started falling ill.

Now a third suspect has emerged. Fallon is the site of a metal refinery that processes tungsten. In its report, the CDC noted very high levels of tungsten in Fallon's drinking water. The health effects of tungsten haven't been well studied, though it has been linked to *rhabdomyosarcoma* (RAB-doh-migh-uh-sar-KOH-muh), a rare cancer of *connective tissue* (cartilage, ligaments, muscles, and tendons).

Fallon resident Jeremy Braccini was diagnosed with leukemia at age 3. He survived but was found to have sky-high levels of arsenic and tungsten in his body. "How does a 3-year-old child get this much toxicity in his body?" his father, Jeff Braccini, asked in the University of Nevada magazine.

DIGGING FOR CLUES

Witten is digging into the tungsten mystery. He has investigated a leukemia cluster in Sierra Vista, Ariz., and found high tungsten levels there too. Now he is researching the metal's effects on the body and plans to publish his results soon.

Tungsten may not be the only cause, though. Wiemels suspects that multiple factors have combined in Fallon to create a toxic environment that weakens the *immune* (disease-fighting) system.

Though teasing out the truth of the Fallon cancer cluster won't be easy, Witten is optimistic that scientists will eventually discover the cause. "I think, hopefully, we'll get to the bottom of this," he says. If he and the others can identify the true culprit, perhaps they can find a way to limit the harm it causes—not just in Fallon but everywhere. "We need to make sure our environment is as clean as we can make it so we have kids that grow up healthy," he says. **CS**

HEALTH

Fortune Telling

Would you take a genetic test to see what's in store for your health?

By Kirsten Weir

Claudia Gilmore is used to tough exams. She's a student at Georgetown University. But one of the hardest exams she's ever taken was a simple blood test.

After her grandmother died of ovarian cancer, Gilmore, 21, learned that a *gene* called BRCA1 ran in her family. Genes are segments of DNA that determine a person's inherited characteristics. Women with the BRCA1 gene have a 40 percent chance of developing ovarian cancer during their lifetime and an 85 percent chance of developing breast cancer. The odds were 50-50 that Gilmore had inherited the gene. She decided to get tested. "I wanted to just know, instead of wondering if this was going to be part of my life," she says.

Like Gilmore, more and more people are making the choice to undergo genetic testing. For some people, the test result is a black-and-white picture of their future. For others, it's more like the cloudy view through a crystal ball. Would you want to know what your genes hold in store for you?

GRAY ANATOMY

The human *genome*—the entire collection of genes in the human body—contains between 20,000 and 25,000 genes, explains David Margulies, a doctor and president of the genetic testing company Correlagen Diagnostics. Everyone is unique, and individual genes vary a bit from person to person. Most variations, or *mutations*, are harmless. Sometimes, though, a mutation can cause a disease.

"Approximately 2,000 [genes] have been associated with some human disorder," Margulies says, "and a gene test is [available] for approximately 1,500 of them." Every week, he adds, about two new tests hit the market.

Who benefits from genetic testing? Pregnant women may be tested to find out whether their unborn babies are at risk of inheriting certain diseases. Children or adults with suspected genetic disorders can be tested to confirm the diagnoses. Even seemingly healthy people can undergo genetic testing to determine their risk of developing certain conditions sometime in the future.

Using genetic tests to predict future diseases has its limitations, however. Some diseases, such as cystic fibrosis, arise only because of certain genetic mutations. If you have a cystic fibrosis mutation, you'll get the disease; if you don't have one of the mutations, you won't. For many other diseases, though, genetic

Getting Personal

Ever wonder what's written in your DNA? You might consider *personal genomics*, in which a private company decodes your genome for around $400. Take the results with a grain of salt, though, says David Margulies.

Personal genomics is different from the genetic testing that doctors do to identify the risk of specific diseases. That type of testing looks for genes strongly linked to specific diseases. A positive test typically means that there's a 75 percent to 100 percent chance the patient has or will develop the disease.

Personal genomics doesn't look for disease genes. Instead, a genome is scanned for broad changes that might indicate a slightly increased risk of developing a common condition, such as diabetes or heart disease. However, the test results aren't always meaningful. Personal genomics might tell you you're at increased risk of diabetes, for instance, when in fact the risk is just 2 percent or 3 percent greater than average. For now, Margulies says, the results of personal genomics tests are mostly for entertainment.

Claudia Gilmore: Courtesy Claudia Gilmore. Crystal ball: Jose Luis Pelaez/Getty Images; DNA: Shutterstock (2)

testing falls into a gray area. For diseases such as cancer, many different genes may be involved. Environmental factors play a role too. Genetic tests for such conditions—like the BRCA1 test that Gilmore took—can't say with certainty that a person will or will not contract a certain disease. Rather, the tests indicate whether a person has a higher-than-normal risk of developing the condition.

THE AWFUL TRUTH

Financial and emotional costs are also involved in testing. A single test might cost hundreds or thousands of dollars. And learning that you might contract a genetic disease can be traumatic—especially if no cure exists. Would you want to know that you will develop a life-threatening, incurable disease? Could you handle the truth?

For now, Margulies says, testing everyone for rare conditions doesn't make sense. Genetic testing is best for people who have a family history of disease. If you know a family member who has suffered from an inherited condition, he asks, why wouldn't you get tested for it? A positive test result, says Margulies, might enable doctors to start treating you early, even before symptoms appear.

In some cases, "a genetic test can be critical in telling a person whether or not to use a specific medicine," Margulies says. For instance, a small number of people who have *leukemia* (cancer of the blood and bone marrow) share an unusual mutation. For them, the standard leukemia treatment doesn't work. If a leukemia patient tests positive for that mutation, doctors will know to use an alternative treatment.

KNOWLEDGE IS POWER

Two weeks after giving a sample of blood, Gilmore learned that she tested positive for BRCA1. "When the nurse said I had the mutation," she says, "my heart stopped for a minute."

Though the result was a shock, Gilmore now feels lucky to know her status. She is careful to eat right and exercise and has regular screenings for early signs of cancer. "I've always been taught that knowledge is power," she says. "I will be a 'pre-vivor' rather than a survivor." **CS**

GUESS GENES? Do the terms *genes*, *DNA*, and *chromosomes* confuse you? Learn how they differ by checking out a short animated film at **www.weeklyreader.com/genetics**.

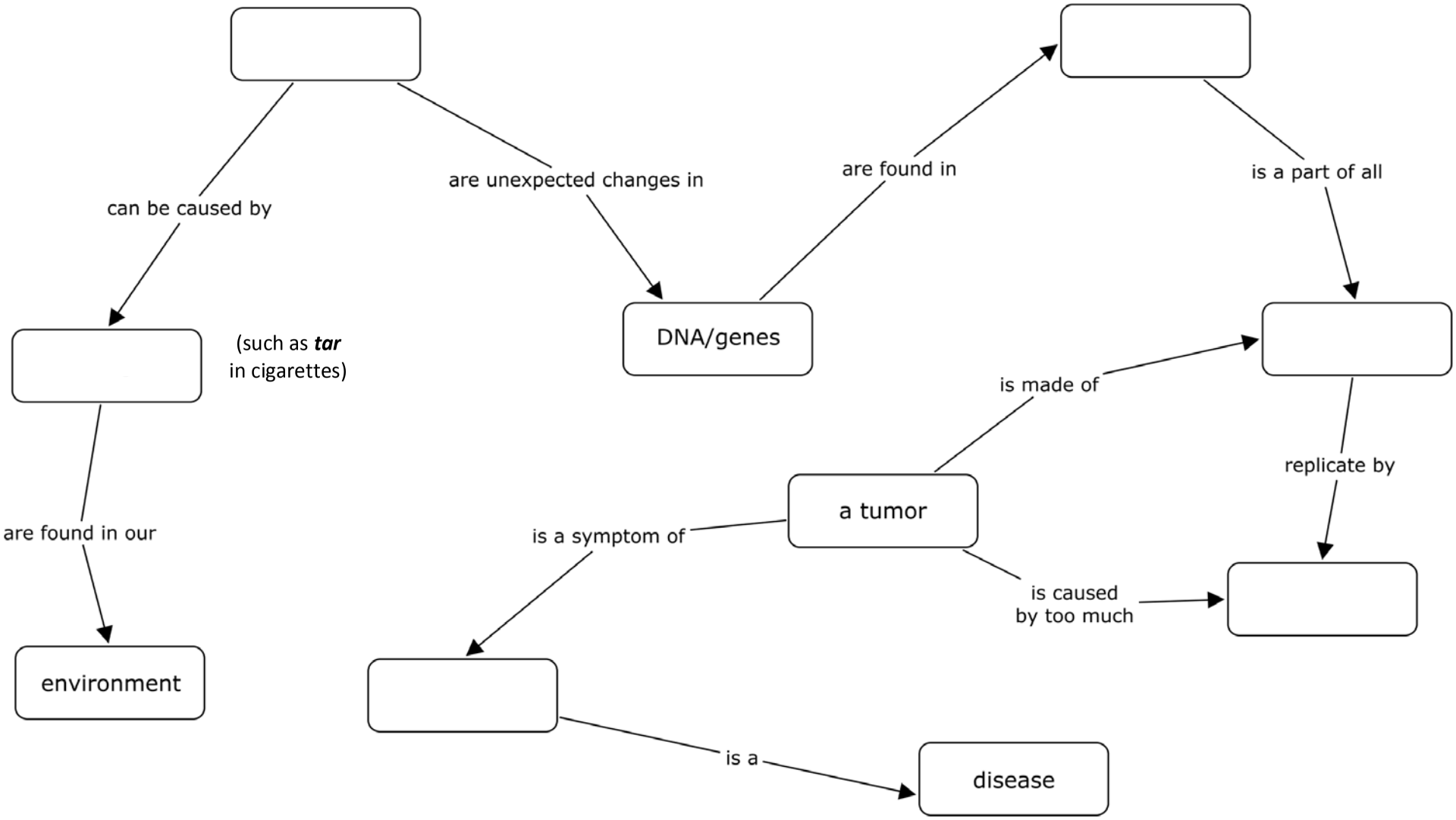
Name: Class:

Bellwork:

For each quote below, check the appropriate column to indicate whether the quote provides evidence for GENETIC PREDISPOSITION or ENVIRONMENT as a cause of cancer.

		Genetic Predisposition	Environment
1	"…the town's water supply contains high levels of arsenic, a naturally occurring but poisonous element that has been linked to bladder and skin cancers." (Nichols)		
2	" Women with the BRCA1 gene have a 40% chance of developing ovarian cancer during their lifetime." (Weir)		
3	"After her Grandmother died of ovarian cancer, Claudia Gilmore learned that a gene called BRCA1 ran in her family."		
4	"Mark Witten has investigated a leukemia cluster in Arizona and found high tungsten levels there." (Nichols)		
5	"Genetic testing is best for people who have a family history of disease." (Weir)		
6	"Fallon, Nevada is the site of a cancer cluster, a greater than expected number of cancer cases in a geographic area over a period of time."		

Cancer Word Web – Use all the remaining vocabulary words to fill in this word web. Remember – you must follow an arrow from one box to another to make a sentence with those two words.



Vocabulary Bank

cancer mutations carcinogens mitosis ~~DNA/genes~~ cells the nucleus ~~environment~~ ~~disease~~ ~~a tumor~~

Name _____

Date _____

A Recipe for Traits

A set of instructions called DNA makes a ''recipe'' for traits in all organisms. Information in a DNA strand is grouped into small segments. Each segment is made of even smaller units (like recipes are made of words, and words are made of letters). Differences in the DNA ''alphabet'' are what make differences in traits (just like a different sequence of letters makes different words, and a different recipe).

Follow the directions below to create a DNA recipe for a dog. Using the Dog Traits Key, read your DNA recipe and make a drawing of your dog showing all of its traits.

Directions:

1. Make sure you have an envelope containing "Dog DNA".
2. Determine the first trait of your dog (body shape) by randomly picking a piece of dog DNA out of the envelope.
3. Look at the symbols on the DNA strip you have chosen. Match the pattern to one you see on the Dog Traits Key for body shape.
4. Circle the picture for body shape that matches the DNA piece that you picked.
5. Set the piece of DNA aside and repeat steps 1-4 for the next trait on the key.
6. After circling the matching picture, tape the second piece of DNA to the first to make one long strand. This will become the DNA recipe for your entire dog.
7. Repeat these steps for each of the traits listed on the Dog Traits Key.
8. When you have finished, draw your dog with all of its traits (the traits you have circled on the Dog Traits Key) on a separate piece of paper.
9. As instructed by your teacher, hang up the picture of your dog along with its DNA recipe (the DNA pieces you chose attached in a long strand).

Is your dog different or the same as others in the class?

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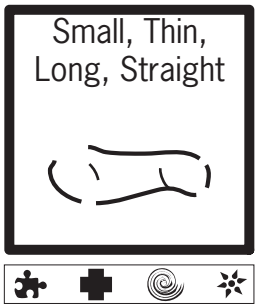
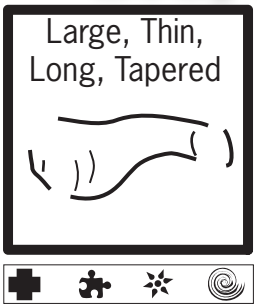
Name _____

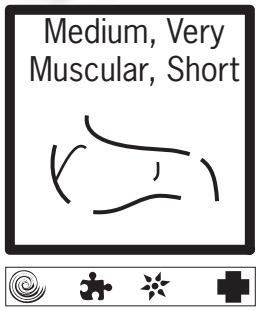
Date _____

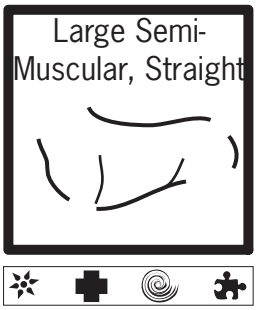
Dog Traits Key

Body Shape

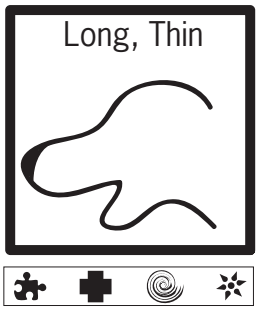


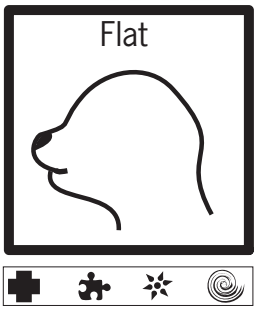


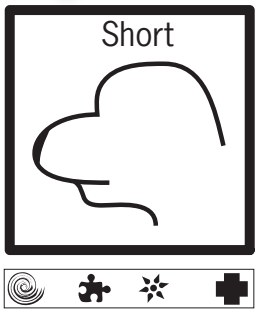


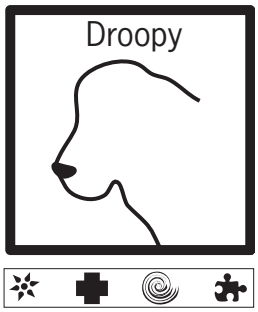


Head Shape

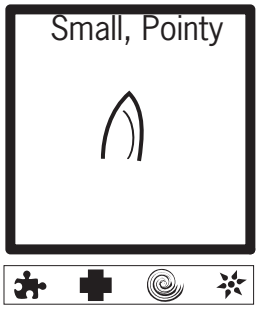


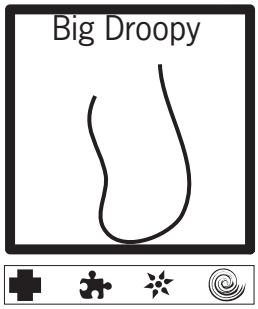


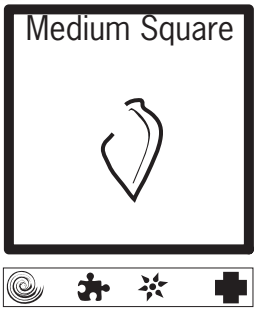


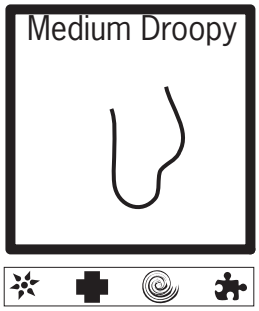


Ears

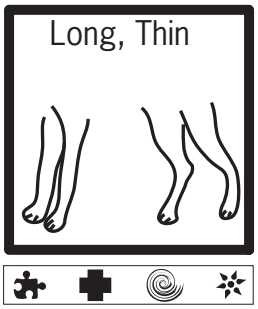


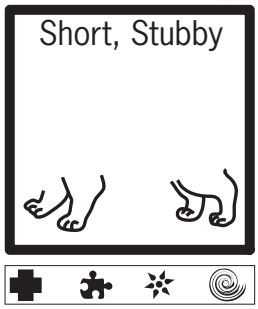


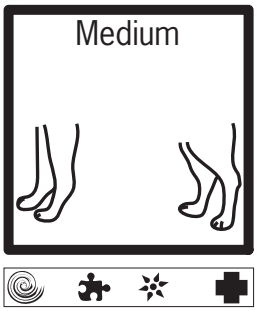


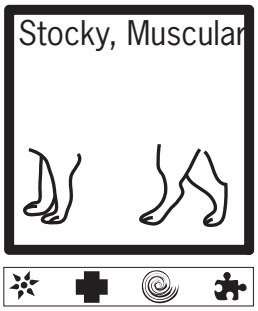


Legs









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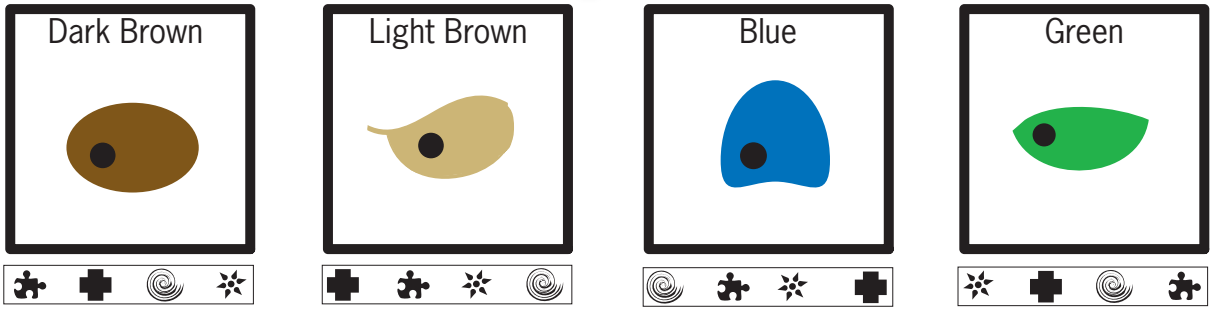
S-2

Name _____

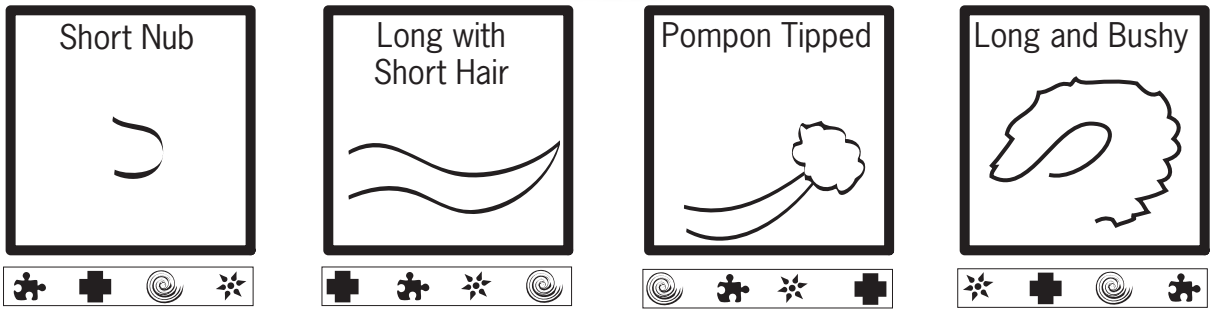
Date _____

Dog Traits Key

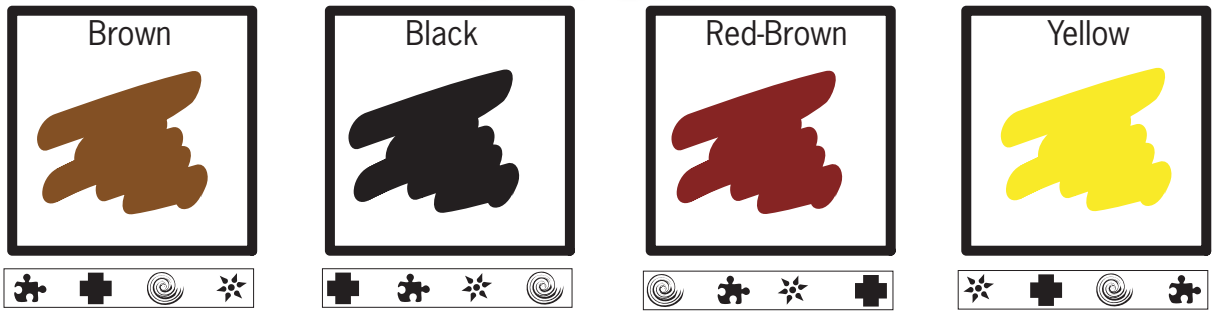
Eyes



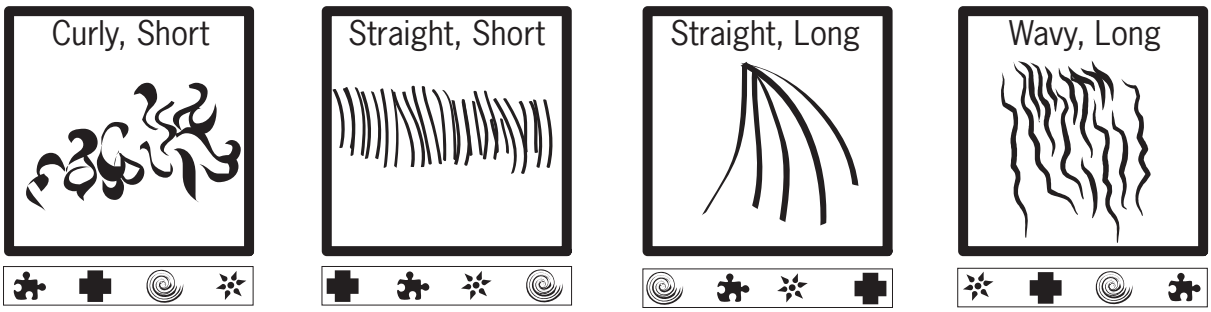
Tail



Coat Color



Hair



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S-3

Name: _____

Class: _____

A Recipe For Traits

Follow Up Questions

1. What does the entire strip of colored paper represent?

2. What does each small section represent?

3. How many traits did you determine for your dog?

4. Why are most of the dogs different from each other?

_____

_____

_____

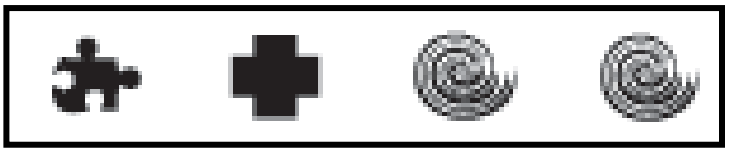
_____

_____

_____

_____

5. Look at your dog's DNA strip. The genes that determined your dog's traits came from your dog's mom and dad. What would happen if your dog received the following traits for body shape?



_____

_____

_____

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_____

_____

6. What do we call these random changes in the DNA?

7. Which body shape is most likely to happen due to the DNA mistake (circle your choice)? Why do you think so?

A larger, more muscular body; an **advantage** for the dog.

A smaller and weaker body shape; a **disadvantage** for the dog.

_____

_____

_____

_____

_____

DNA: Instruction manual

DNA is like an instruction manual for life. Every cell contains DNA molecules, and these molecules include genes. **Genes** are small pieces of DNA that control many aspects of an animal's looks and behavior.

Scientists have analyzed the DNA of Tasha, a female boxer.

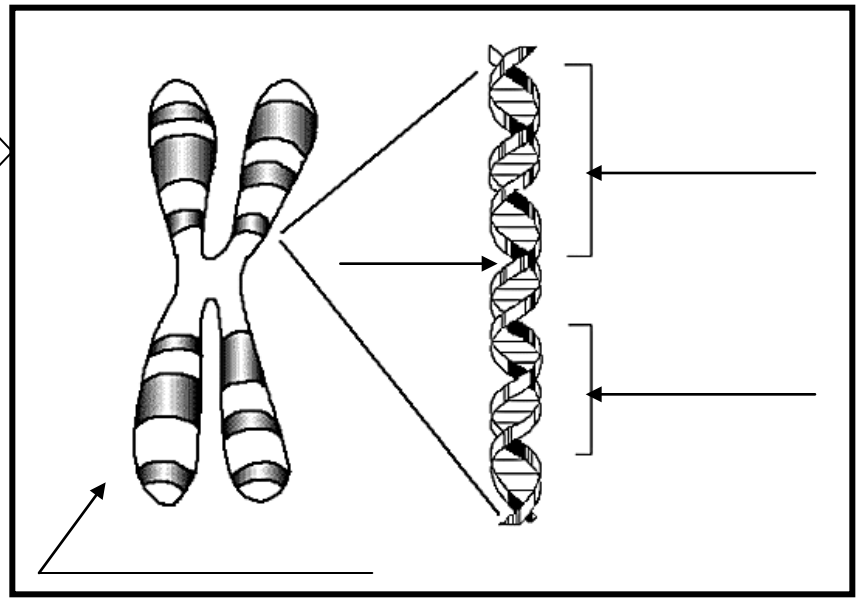
A wealth of important information lies within the genes of dogs. Pinpointing which genes do what may help breeders create calmer, cuter, or healthier dogs.

Dogs may be helpful for studying a variety of human diseases. A simple blood test or saliva sample is enough for researchers to extract DNA for analysis. Dogs and people suffer from about 400 of the same diseases, including heart disease and epilepsy.

Cancer is the number one killer of dogs after age 10. By understanding cancer in dogs, perhaps we can find a window into understanding cancer in humans.

Vocabulary Alert

Cancer: The uncontrolled growth of mutated (abnormal) cells that can lead to tumors.



Using your knowledge of cells, why is it that researchers can do a DNA analysis on a drop of blood or a saliva sample?

Dog diversity

Belonging to as many as 400 different breeds, dogs are one of the most diverse species of animal on Earth. They're also one of the most vulnerable to diseases and sickness, having more genetic problems than nearly any other animal.

To create a new type of dog, a breeder mates dogs that share a particular trait, such as snout length or running speed. When puppies are born, the breeder selects the ones that have the longest snouts or run the fastest to mate in the next round. This goes on for generations, until a new breed of long-snouted or super-fast dogs is created.

By choosing dogs that look or act a certain way, the breeder is also choosing **genes** that control those traits. At the same time, though, genes that cause diseases can build up in the population. The more closely related two animals are, the higher the chance that their offspring will suffer genetic diseases or other problems.

Different breeds tend to have different problems. Greyhounds' very light bones make them fast, but a greyhound can break its legs just by running. Dalmatians often go deaf. Heart disease is common in boxers. Labradors have hip problems.

Border collies, known for their intelligence and working ability, were bred to herd sheep.

The article says dogs are a **diverse** species. What does this mean?

Use one word to define **offspring**?

Why do disease genes build up?

Solving problems

New information about dog genetics is helping scientists find ways to rid dogs of certain undesirable types of behavior.

Burmese mountain dogs are one example. The muscular dogs used to be extremely aggressive. Through a careful study of heredity, scientists tracked down a **gene** responsible for this aggression and bred dogs that don't have it.

Burmese Mountain Dogs are bred to be friendly, obedient servants. They are very easy to train and want to please as much as possible.

How can scientists "track down" a gene?

_____

_____

_____

_____

_____

_____

Curriculum PREVIEW!
There is a special name for this process of selecting organisms with desirable traits with the hope that the offspring has these traits. We will learn more about this is our next section. The process is known as…

_____

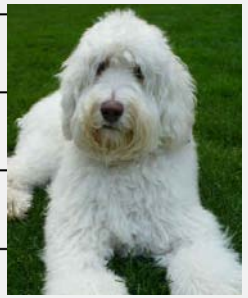
The labradoodle is a good example. What two breeds were used and what were the qualities that were desired?

_____

_____

_____

_____



Dog DNA Recording Sheet

1. What is cancer?

2. What is it called when breeders purposely select specific dogs to mate to get desirable characteristics in the offspring?

3. What are the common health problems in these breeds?
    a. Greyhound –

    b. Dalmation –

    c. Boxer –

    d. Labrador retriever –

4. How did breeders select and change the traits of some dog breeds, like the Burmese Mountain dog?

Bill Nye: Genes

Where do genes come from?

How does Bill define "gene?"

Mom tells Richie: Genes are the set of _____ _____ that get passed down from _____ to child. In the process, of course, the genetic material is _____ in new ways which is why some people bear resemblance to their _____ and _____ without looking like any one relative in particular.

What two organisms were combined to create the message to Bill in the petri dish?

How many genes do humans have?

What analogy does Bill use to describe the human set of chromosomes?

In Bill's analogy, what does each chapter represent?

How many chromosomes do most species have?

Objectives for Unit 1 - Part 3: Mendel, Punnett Squares & Pedigrees

You will UNDERSTAND the following concepts…

- Most cells have genetic information that determines traits.
- Organisms inherit genetic information in a variety of ways that result in variations/similarities in organisms.
- Models of genetic inheritance can be used to show the probability of traits being expressed.
- Genes can be modified through mutation or human intervention.
- Genetic traits are passed from parents to offspring.

Underlined terms are required vocabulary words.

You will KNOW the following ideas and concepts…

- Pure genes are a result of each parent contributing the same type of gene – either a **dominant** or a **recessive** (RR or rr).
- **Hybrid** genes result from each parent contributing a different type of gene (Rr).
- Some genes are dominant and some genes are recessive. Dominant genes mask the appearance of recessive genes which means even though an organism is hybrid, it will show the dominant trait.
- Hybrids can pass the recessive gene or the dominant gene on to their offspring (50% chance.)
- A **Punnett Square** is a tool that can be used to predict the **probability** of different traits in **each** offspring.
- A **cross** refers to fertilization of egg and sperm.
- Even if a Punnett Square shows a 25% chance of a trait, the offspring of these same parents could ALL show that trait, although unlikely.
- An offspring is an organism created by reproduction.
- **A pedigree** is a chart used to track ONE specific trait through many generations.

You will BE ABLE TO DO the following activities…

- Complete a Punnett Square to predict the traits of the potential offspring.
- Determine the type of genes an organism has given its physical appearance and vice versa.
- Convert a word problem into a Punnett square.
- Calculate the probability (percent/fraction) of gene combinations resulting in traits.
- Read and interpret pedigree charts and symbols (circles=female, squares=males).
- Create an Alien family applying Laws of Genetics.

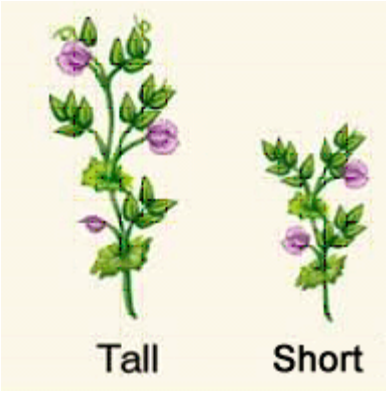
The Father of Genetics: Gregor Mendel

Hi! My name is ***Gregor Mendel***. I was a monk and a science teacher at an abbey in the Czech Republic in the 1800s.

I was REALLY into gardening – in fact I was so into gardening that I grew 29,000 pea plants in just 8 years! And I didn't just do it because I like pea soup – I grew all those pea plants for a series of scientific experiments.

You see – I noticed that pea plants have certain characteristics or ***traits*** that are easy to see and to keep track of – in the parent pea plants and in their offspring (baby peas).

For example – certain pea plants were tall, and produced seeds that always grew into tall plants. And other pea plants were short, and they produced seeds that always grew into short plants. These were ***pure*** lines – the offspring always had the same trait as their parents.



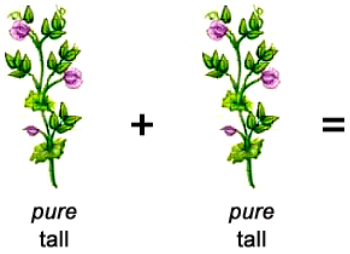
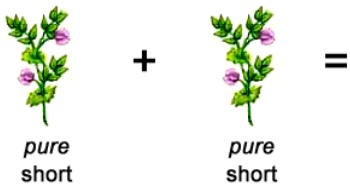
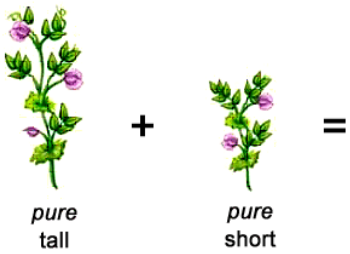
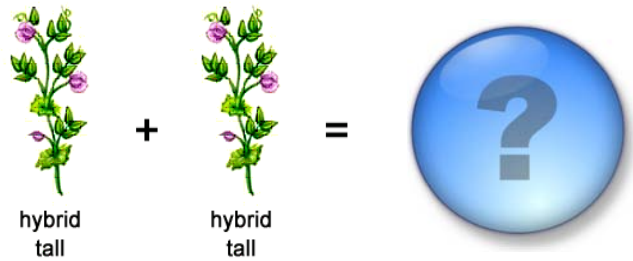
I assumed that if I bred a pure tall plant with a pure short plant, that I would get something in between – a medium-height plant.

BUT – that's when things started to get weird…

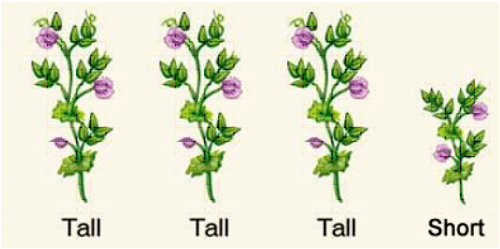
I found that a pure tall crossed with a pure short only gave me more tall pea plants! Somehow the short trait seemed to be lost!

I called these new tall plants ***hybrids***. And when I crossed 2 hybrids, things got even weirder…

Let's summarize what Mendel found so far…

I did this experiment over and over until I was sure of my results. Eventually I found out that **when I crossed two hybrid tall parents,** I **always** got ¼ short plants in the offspring.



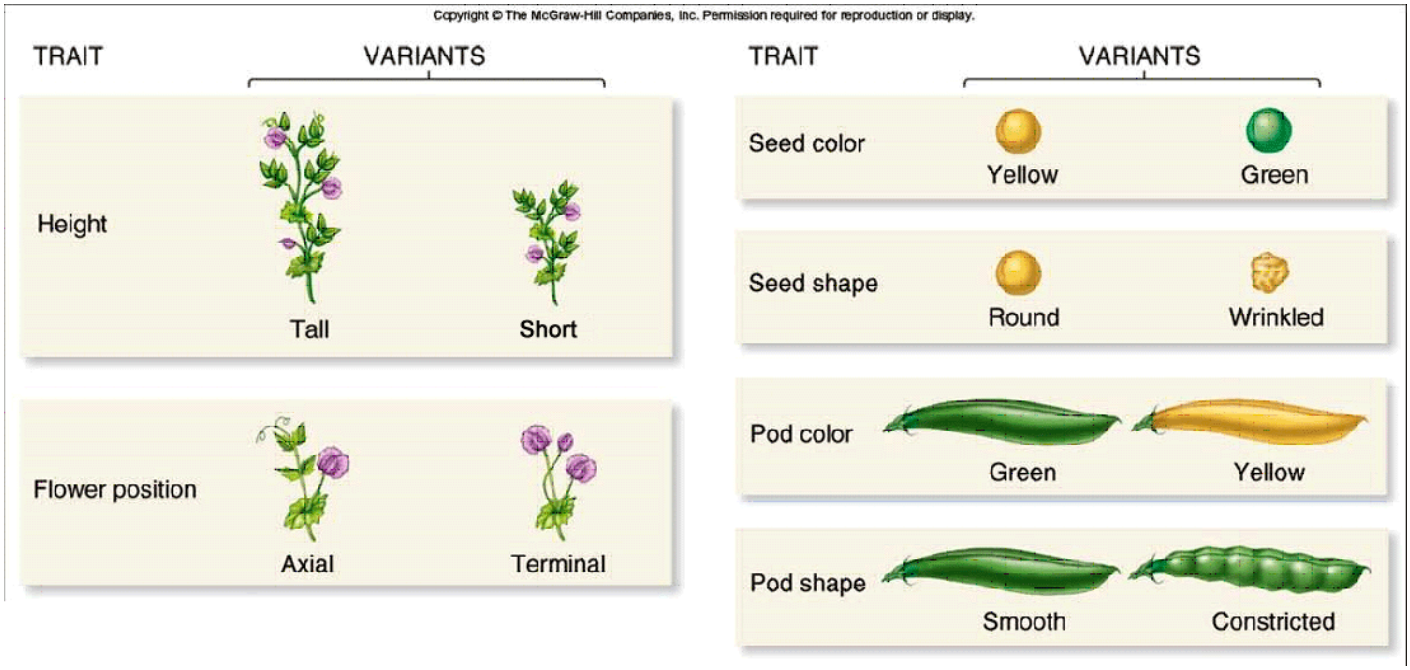
I came up with a ***hypothesis*** that there must be 2 ***factors*** controlling pea plant height – one factor that produced tall plants, and one factor that produced short plants.

And the short factor could be hidden or ***masked*** by the tall factor – **but it did not just disappear** when tall plants were crossed with short plants.

I called the tall factor the ***dominant*** factor, and the short factor was the ***recessive*** factor. I kept experimenting, and I found ***seven different traits*** that seemed to have both a dominant factor and a recessive factor!

These were traits like seed color, flower color, seed shape (smooth or wrinkled), and more. And all these traits seemed to follow similar rules or patterns!

Here is a chart showing some of the traits that Mendel studied:



Sadly, even though I published papers about my results, no one paid much attention to my research when I was alive.

But years later a guy named R. C. ***Punnett*** repeated my experiments, and he verified my results. Even cooler, he figured out how to ***mathematically*** represent and predict the offspring that would result when crossing different ***pure*** and ***hybrid*** plants.

He invented the ***Punnett square***, which you are going to be able to make and use – with pea plant factors and traits, and even with some of vour own factors and traits!

Summary of Mendel's findings…

Characteristic	Dominant factor	Letter	Recessive Factor	Letter
Plant Height	Tall	T	Short	t
Flower Position	At side of stem	F	At end of stem	f
Seed Shape	Smooth (Round)	A	Wrinkled	a
Seed Color	Yellow	B	Green	b
Seed Coat	Colored	D	White	d
Pod Shape	Inflated	I	Narrowed	i
Pod Color	Green	G	Yellow	g

Matching with Mendel

(Accompanies Mendel Pages in Inheritance Unit Pack)

After reading about Gregor Mendel, use the terms from the word bank to fill in the chart of definitions.

WORD BANK

mask pure hybrid Gregor Mendel recessive R. C. Punnett dominant

cross factor Punnett square predict traits offspring hypothesis

	A monk and science teacher from the Czech Republic, who is now thought of as the Father of Genetics.
	A notable feature or quality of an organism that can be passed from generation to generation.
	A new organism produced by one or more parents.
	Breeding situation where the offspring always have the same traits as the parents.
	An offspring that results from the breeding of two plants (or organisms) with **differing** traits, that **only** shows the trait of **one** of the parents.
	To breed (or mate) one organism with another organism.
	A statement that is intended to explain facts of observations about the natural world.
	A **version** of a trait, such as tall plant vs. short plant.
	To hide or conceal.
	A trait factor that can never be hidden when it is present in an organism – it masks a recessive factor.
	A trait factor that may be **masked or concealed** by a dominant factor.
	A scientist who was able to mathematically represent the results of Gregor Mendel's pea experiments, many years later.
	To be able to tell something in advance.
	A mathematical tool for predicting the offspring of parents with various traits.

Practicing the new "code" you just learned!

New terms:

a. **Phenotype** – starts with "**ph**" to help your remember _____

b. **Genotype** – starts with **"g"** to help you remember _____

c. Examples of "**pure**" genotypes: _____

d. Examples of "**hybrid**" genotypes: _____

e. Which gene factor always shows (even if there's only 1)? ***dominant*** *or* ***recessive***

f. Which gene factor can be hidden by the other? ***dominant*** *or* ***recessive***

g. Which gene factor can **ONLY** show when it is **pure**? ***dominant*** *or* ***recessive***

h. Which gene factor always shows in a **hybrid**? ***dominant*** *or* ***recessive***

i. **Geno- & Pheno- Practice:** Use the **chart for pea plant traits** *(back on page _____)*

genotype	phenotype
Tt	
	narrow pod
	smooth seed
gg	
Ff	
	yellow seed
tt	
	flower at end

j) Write some pea genotype examples that are **pure recessive**:

k) Write some pea genotype examples that are **pure dominant**:

l) Write some pea genotype examples that are **hybrids**:

Hybrid vs. Pure Review

GENETICS HINT: Every gene has 2 factors (parts). If there is at least one dominant, then dominant will show. Recessive **only** shows if both factors are recessive. ***Dominant always wins – even if there is just one factor!***

You have been given several **genotypes** below. For each, identify it as **hybrid**, **pure recessive**, or **pure dominant**. *(circle the correct answer)* – then state **which gene factor** will show in the organism.

1. **TT** hybrid pure recessive (pure dominant) *Which gene factor will show?* ***T***
2. **bb** hybrid pure recessive pure dominant *Which gene factor will show?* _____
3. **Mm** hybrid pure recessive pure dominant *Which gene factor will show?* _____
4. **BB** hybrid pure recessive pure dominant *Which gene factor will show?* _____
5. **Aa** hybrid pure recessive pure dominant *Which gene factor will show?* _____
6. **Gg** hybrid pure recessive pure dominant *Which gene factor will show?* _____
7. **hh** hybrid pure recessive pure dominant *Which gene factor will show?* _____

What's the Cross? Review

Write out the **parent cross** using genotypes for each description. Use the dog traits in the chart.

trait	dominant	recessive
ear length	long **E**	short **e**
tail type	straight **A**	curly **a**
eye color	brown **B**	blue **b**
spots or not	spots **H**	no spots **h**

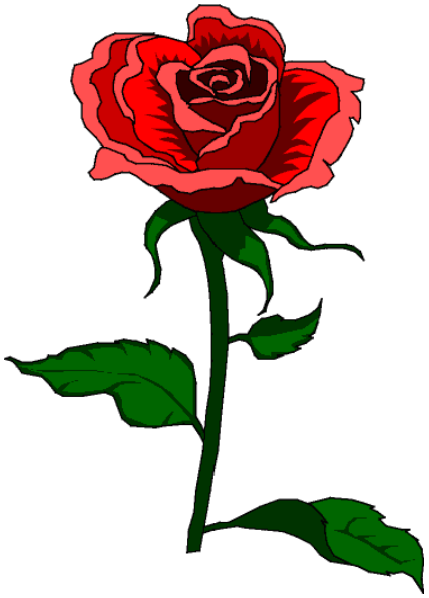
1. A hybrid long ear dog is **crossed** with a pure long ear dog ***Ee*** **x** _____
2. A dog with the pure dominant tail trait is **crossed** with one showing the recessive tail trait _____ **x** _____
3. A hybrid brown eyed dog is **crossed** with a blue eyed dog _____ **x** _____
4. Two dogs that are hybrid for spots are **crossed** _____ **x** _____
5. A short eared dog is **crossed** with a pure long eared dog _____ **x** _____
6. Two no-spot dogs are **crossed** _____ **x** _____
7. A dog that shows the recessive eye trait is **crossed** with one that is hybrid for the eye trait _____ **x** _____
8. Two straight tail dogs are crossed, but only one is pure dominant _____ **x** _____

Genotype and Phenotype Questions to Ponder...

1. Why does a genotype contain two letters?

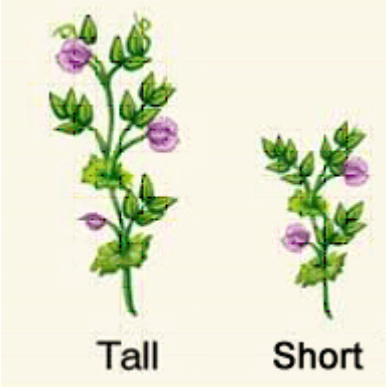
2. Write genotypes for the following...

- a hybrid yellow seeded plant _____
- a wrinkled seeded plant _____
- a pure inflated pod _____
- a pure smooth seeded plant _____



Mendel's Experiments Punnett Style

For example – certain pea plants were tall, and produced seeds that always grew into tall plants. And other pea plants were short, and they produced seeds that always grew into short plants. These were ***pure*** lines – the offspring always had the same trait as their parents.



Cross	Punnett Square	Offspring Phenotypes:
pure X pure tall tall **X**		Offspring Genotypes:

Cross	Punnett Square	Offspring Phenotypes:
pure X pure short short **X**		Offspring Genotypes:

I assumed that if I bred a pure tall plant with a pure short plant, that I would get something in between – a medium-height plant.

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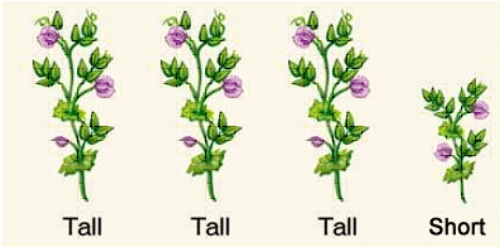
Cross	Punnett Square	Offspring Phenotypes:
pure X pure tall short **X**		Offspring Genotypes:

I did this experiment over and over until I was sure of my results. Eventually I found out that **when I crossed two hybrid tall parents,** I **always** got ¼ short plants in the offspring.



Cross	Punnett Square	Offspring Phenotypes:
hybrid X hybrid **X**		Offspring Genotypes:

Using Punnett Square to Solve Genetics Problems

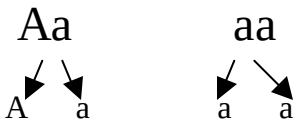
The Problem: Round peas are dominant over wrinkled peas. Predict the genotypes and phenotypes of a cross between a hybrid round-seeded pea plant and a wrinkled pea plant.

1. **Choose a letter to represent the genes in the cross.**
   Use a letter whose capital form does not look similar to its lower case form.

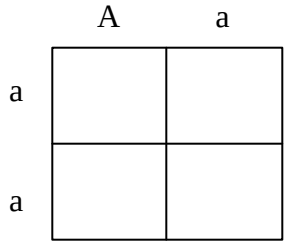
2. **Write the genotypes of the parents.**
   This is written as an abbreviation of the cross being studied. The "x" is read as "being crossed with."

   Aa x aa

3. **Determine the possible genes each parent can produce.**



4. **Write the possible genes at the top and side of the Punnett square.**
   Place one parent's genes across the top and the other down the side.



5. **Complete the Punnett square.**
   Write the gene combinations in the appropriate box. These combinations represent the possible offspring of this cross.

	A	a
a	Aa	aa
a	Aa	aa

6. **Record the genotypes and phenotypes of the offspring.**
   The genotype is the actual genes. The phenotype is the physical appearance.

   Genotypes of offspring - 2 Aa : 2 aa, **Phenotypes** of offspring – 2 round : 2 wrinkled

When in doubt,

More practice with Punnett Squares.

For each of the crosses below, indicate the genotypes and phenotypes of the offspring.

1. A hybrid yellow seeded pea with a pure yellow seeded pea.

Cross	Punnett Square	Offspring Phenotypes:
x	Offspring Genotypes:	

2. A pure tall pea with a hybrid pea.

Cross	Punnett Square	Offspring Phenotypes:
x	Offspring Genotypes:	

3. A pure inflated pod with a narrow pod.

Cross	Punnett Square	Offspring Phenotypes:
x	Offspring Genotypes:	

4. A wrinkled seed with a hybrid smooth seed.

Cross	Punnett Square	Offspring Phenotypes:
x	Offspring Genotypes:	

5. A hybrid colored seed coat with a pure colored seed coat.

Cross	Punnett Square	Offspring Phenotypes:
x	Offspring Genotypes:	

Name: _____ Class: _____

Oompa Loompa Punnett Squares

Oompa Loompas usually have orange faces because orange faces are dominant (D). Blue faces are recessive (d), which means Oompa Loompas only have blue faces if they receive a recessive gene from each parent.

Directions: Using this information, complete the following punnett square practice problems.

1. A pure orange faced Oompa Loompa (DD) has children with a hybrid orange faced Oompa Loompa (Dd).

	D	**D**
D	**DD**	**DD**
d	**Dd**	**Dd**

What **percentage** of offspring will have orange faces? _____ %

2. A pure blue faced Oompa Loompa female (dd) has children with a hybrid orange faced Oompa Loompa male (Dd). Complete the punnett square below.

	d	**d**
D		
d		

What **percentage** of the offspring will have blue faces like their mother? _____ %

3. Two **hybrid** Oompa Loompas have children. Complete the Punnett Square below.

Parents: _____ x _____

What are the **genotypes** of the offspring? _____

What are the **phenotypes** of the offspring (include percentages)?

_____

Bikini Bottom Genetics

PANTS Dominant = Round Recessive = Square	Genotype	Phenotype
	BB	
	Bb	
	bb	

Body Color Dominant = Yellow Recessive = Blue	Genotype	Phenotype
	AA	
	Aa	
	aa	

Eye Shape Dominant = Oval Recessive = Round	Genotype	Phenotype
	EE	
	Ee	
	ee	

Nose Style Dominant = Long Recessive = Stubby	Genotype	Phenotype
	NN	
	Nn	
	nn	

1. SpongBob Squarepants is engaged to SpongeSusie Roundpants. If SpongeSusie is a hybrid for Round shape what are the possible genotypes and phenotypes for the offspring?

Cross	Punnett Square		Phenotype
X			Genotype

2. SpongeBob's mom is a lovely shade of blue and his dad is hybrid yellow. Perform the cross of Spongebob's parents to see if it is possible to have a blue sponge baby.

Cross	Punnett Square		Phenotype
X			Genotype

3. SpongeBob's parents **both** have hybrid oval eyes while SpongeBob has round eyes. Perform the cross to show what the chances were for this to happen.

Cross	Punnett Square		Phenotype
X			Genotype

Punnet Practice – *with Cute Baby Animals!* **Name** _____

1. Otters can have long tails (dominant, G) or short tails (recessive, g). Write out the **genotypes** (2 letter gene code) that goes with each description:
   a. otter with a short tail: _____
   b. otter with a long tail: _____
   c. otter that is a hybrid: _____

There may be more than one correct answer!

2. **QUESTION: If two hybrid otters have a litter, can they have any short tailed pups?**
   *(Don't write **yes** or **no** until you work it out and prove your answer with a Punnett square!)*

parents

_____**x** _____

offspring

Offspring Phenotypes:

Offspring Genotypes:

3. Normal number of stripes is dominant in tigers (**N**), while having extra stripes is recessive (**n**). This baby tiger has normal stripes. He has a dad who is pure dominant, and a mom who has extra stripes.
   a. What is dad's genotype? _____
   b. What is mom's genotype? _____

4. **QUESTION: Is it possible for this tiger to have siblings that look just like their mom?**
   (You must prove your answer with a Punnett square!)

parents

_____**x** _____

offspring

Offspring Phenotypes:

Offspring Genotypes:

5. Aardvarks ears can be long (**dominant, E**) or short (**recessive, e**). This baby Aardvark is a <u>hybrid</u>. <u>His mom and dad both have long ears</u>, <u>but only mom has a pure genotype</u>.

   a. How much of mom's genes did she give to the baby? _____
   b. How much of dad's genes did he give to the baby? _____
   c. Complete the genotype chart below to show where the baby got each half of his ear gene:

dad ____ ____

mom ____ ____

baby ____ ____

← ***To complete the chart…*** *Circle the ½ gene (one letter in the genotype) that each parent gave the baby. Then draw an arrow from each circle (going from parent to baby) to show where the baby got each letter in his 2 letter genotype.*

<u>CHECK your answer to #5c with your teacher before you go on to question 6</u>…

6. This baby elephant has **<u>smooth</u>** ears, but his parents both have **<u>wrinkled</u>** ears. **<u>Use Punnett squares to explain how this is possible.</u>** *(Use R and r for the genotypes – you determine what is dominant or recessive! See question 1 for a hint if you are struggling with this one.)*

My evidence…

_____ x _____

offspring genotypes

offspring phenotypes

Explanation in words…

Practice Makes Perfect

1. What are the genotypes and phenotypes the offspring produced in crosses between hybrid tall pea plants and pure tall pea plants?

Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

2. What genotypic and phenotypic ratios can be expected in the offspring of a cross between hybrid tall pea plants and short pea plants?

Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

3. Mendel found that pure wrinkled-seeded plants crossed with pure smooth- seeded plants resulted in 100% smooth-seeded plants. Using the letter R, complete a Punnett to show this.

Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

4. Black coat color is **dominant** over white coat in guinea pigs. A cross between two black guinea pigs resulted in *four* offspring, all of which were black. *Could* both parents be hybrid? Explain. (The results of mating black guinea pig parents can be represented by three possibilities. Draw Punnetts for all three to help you answer this question.)

Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

5. Do hybrids show the dominant or recessive trait? Explain.

6. If a carnation is hybrid red, what color is dominant? Explain.

7. A green seed is crossed with a hybrid yellow seed. Determine the genotypes and phenotypes of the offspring.

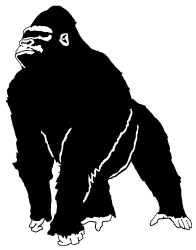
Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

8. Black fur is dominant in guinea pigs. Could a black guinea pig and a white guinea pig have offspring that all have whit fur? Prove it.

Cross	Punnett Square	Offspring Phenotypes:
x		Offspring Genotypes:

Name

How are traits passed on from parents to offspring?



Directions: Please complete the Punnet square for the following traits. Please answer the questions based on your Punnet square.

Eyes

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Ears

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Nose

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Mouth

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Fur

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Feet

Cross	Punnett Square		Offspring Phenotype
x			Offspring Genotypes

Questions:

Please restate the question and answer in complete sentences!

1. What is the difference between a genotype and a phenotype?

2. In pea plants, purple flower color (P) is the dominant allele, while white flower color (p) is a recessive allele. If a pea plant has a genotype Pp, what is the phenotype? Explain your answer.

Are you the **dominant** or **recessive** type?

Tongue rolling is dominant. If Francis **can** roll his tongue, then Francis must carry at least one dominant factor. His genotype is either RR or Rr. If Juanita **can not** roll her tongue, her genotype must be rr.

Traits				
Dominant	Recessive	Your Phenotype	Letter	Your Possible Genotypes
tongue roller	non-roller		R	
free ear lobes	attached lobes		E	
widow's peak	straight hairline		A	
non-red hair	red hair		D	
dimples	no dimples		I	
curly hair	straight hair		N	
long eyelashes	short eyelashes		G	

Challenge:

Francis **can** roll his tongue. We decided, since tongue rolling is dominant, that Francis's genotype must be RR or Rr. How could we figure out if Francis is pure (RR) or hybrid (Rr)? Hint: Where did Francis get his genes from?

Possible Answers:

Mom + Dad Gene Inventory

Directions: Go home and ask your mom and dad about their phenotypes. Find out if they can roll their tongue, have a widow's peak, or free earlobes. These facts about them will help you to determine which genotypes that you have and can potentially pass down also. Circle which phenotype he or she shows... Please do not just circle anything - ask them and really find out because then you can find out more about yourself. If, for some reason, you do not know, then you can make it up.

Mom

Dominant	Or	Recessive
Tongue roller RR / Rr	Or	Non-Roller rr
Free earlobes EE / Ee	Or	Attached lobes ee
Widow's peak AA / Aa	Or	Straight hairline aa
Non-red hair DD / Dd	Or	Red hair dd
Dimples II / Ii	Or	No dimples ii
Curly hair NN / Nn	Or	Straight hair nn
Long eyelashes GG / Gg	Or	Short eyelashes gg

Dad

Dominant	Or	Recessive
Tongue roller RR / Rr	Or	Non-Roller rr
Free earlobes EE / Ee	Or	Attached lobes ee
Widow's peak AA / Aa	Or	Straight hairline aa
Non-red hair DD / Dd	Or	Red hair dd
Dimples II / Ii	Or	No dimples ii
Curly hair NN / Nn	Or	Straight hair nn
Long eyelashes GG / Gg	Or	Short eyelashes gg

Now it's time to see what your genes are for the given traits. From the front, include your parents possible genotype and then try to narrow yours down to one (sometimes this cannot be done).

Here is an example: Mr. Babcock cannot roll his tongue. Mrs. Babcock and their daughter can both roll their tongues. Since Mr. B. can only give his daughter a recessive gene, she must have received the dominant gene from her mom and her genotype must be hybrid! This is what it looks like in pictures.

Mr. B. cannot roll his tongue

rr

+

Mrs. B. can roll her tongue

RR or Rr

Their daughter can roll her tongue

Rr

Now it's your turn…

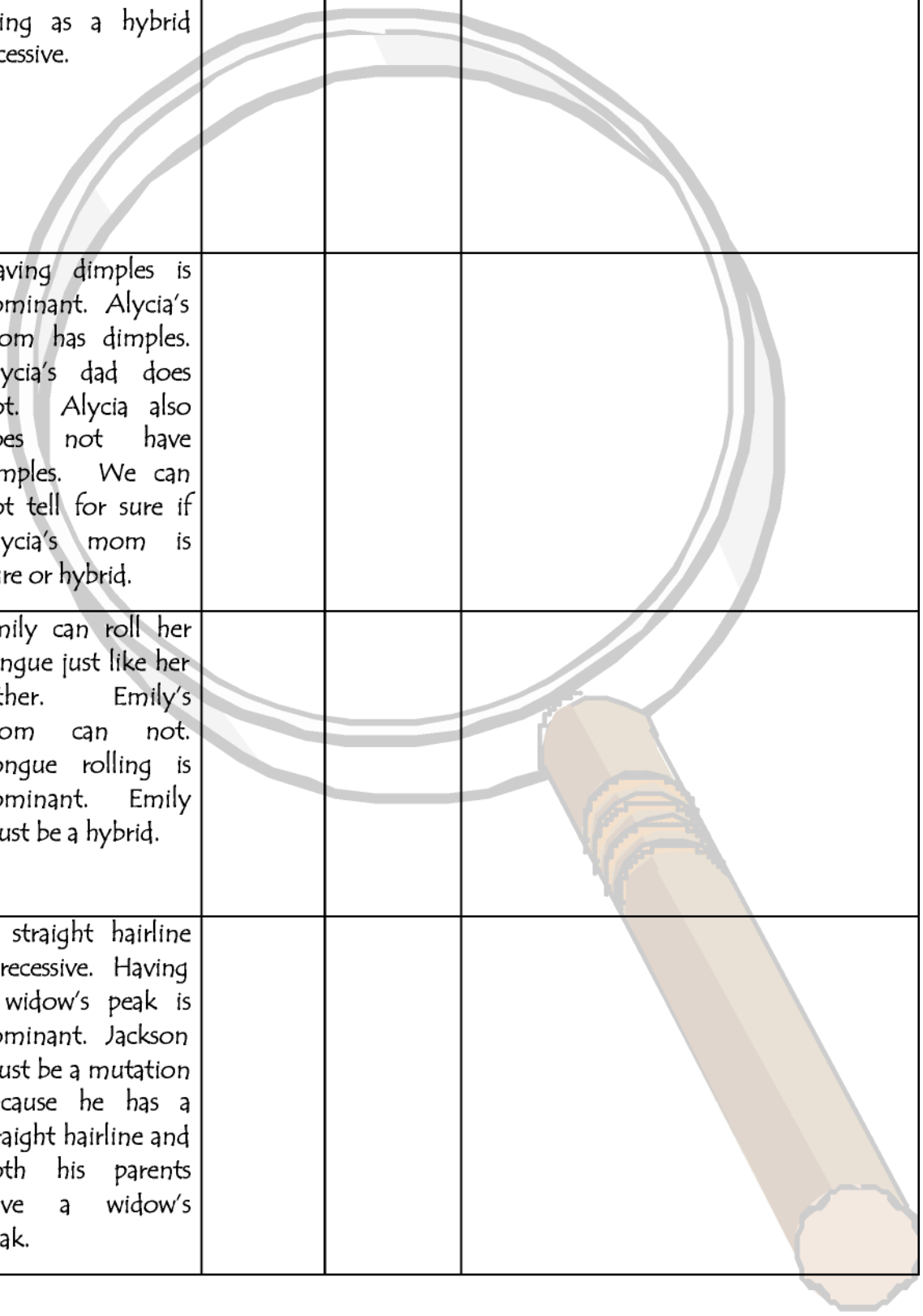
Trait	Your Dad's genotype	Your Mom's genotype	Your genotype
Tongue roller (R) or non-roller (r)			
Free earlobes (E) or attached (e)			
Widow's Peak (A) or straight hairline (a)			
Dimples (D) or no dimples (d)			
Curly (N) or Straight hair (n)			
Long eyelashes (G) or short eyelashes (e)			

Genotype Challenge Challenger Question

How were you able to use your parents' phenotypes and genotypes to help you determine your genotype? Cite one example, from the chart on the previous page, where you were actually able to determine your genotype based on the information from your parents. If the information from your parents was not helpful in any case, indicate why.

Take a closer look…

Question	Agree	Disagree	Proof
There is no such a thing as a hybrid recessive.			
Having dimples is dominant. Alycia's mom has dimples. Alycia's dad does not. Alycia also does not have dimples. We can not tell for sure if Alycia's mom is pure or hybrid.			
Emily can roll her tongue just like her father. Emily's mom can not. Tongue rolling is dominant. Emily must be a hybrid.			
A straight hairline is recessive. Having a widow's peak is dominant. Jackson must be a mutation because he has a straight hairline and both his parents have a widow's peak.			



Welcome to...

The Punnett Square Game

Traits		
Dominant	Recessive	Letter
Tongue roller	Non-roller	R
Widows peak	Straight hairline	H
Non-red hair	Red hair	A
Dimples	No dimples	B
Curly hair	Straight hair	Q
Long eyelashes	Short eyelashes	L
Free Ear lobes	Attached lobes	E

1. Lisa, a pure tongue roller, and her non-roller husband, Jeff, are pregnant. What are the possible genotypic and phenotypic ratios of this cross?
2. Molly has brown hair. Her mother has red hair. Molly's husband has red hair. What is the probability that they will have a red-headed child?
3. Two hybrids for eyelash length have one child. What is the probability that their child has short eyelashes?
4. Chad has dimples, but his wife does not. They have a daughter that does not have dimples. Make a -punned square that proves this possible.
5. Will and Donna both have attached ear lobes. What are the genotypic and phenotypic ratios of their offspring?
6. Kelly and Ian both have curly hair. They have one curly-haired son and three daughters with straight hair. Show the punned square to represent this family.
7. Melvin and his Dad both have a straight hairline. His mom has **a** widow's peak. Draw the punned square to represent this family.
8. Bruce has brown hair and Kelly has black hair. Bruce's parents and Kelly's parents both have dark hair as well. All of the grandparents in the family have brown hair. Bruce and Kelly have one daughter, Maxine. Maxine has light brown hair. Make a punned square that most likely shows how Maxine got her hair color.

Cross	Punnett Square		Phenotype
X			Genotype

Cross	Punnett Square		Phenotype
X			Genotype

Cross	Punnett Square		Phenotype
X			Genotype

Cross	Punnett Square		Phenotype
X			Genotype

Cross	Punnett Square		Phenotype
X			Genotype

Name: ______________________________ **Class:** ______________

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Name: ______________________________ **Class:** ______________

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

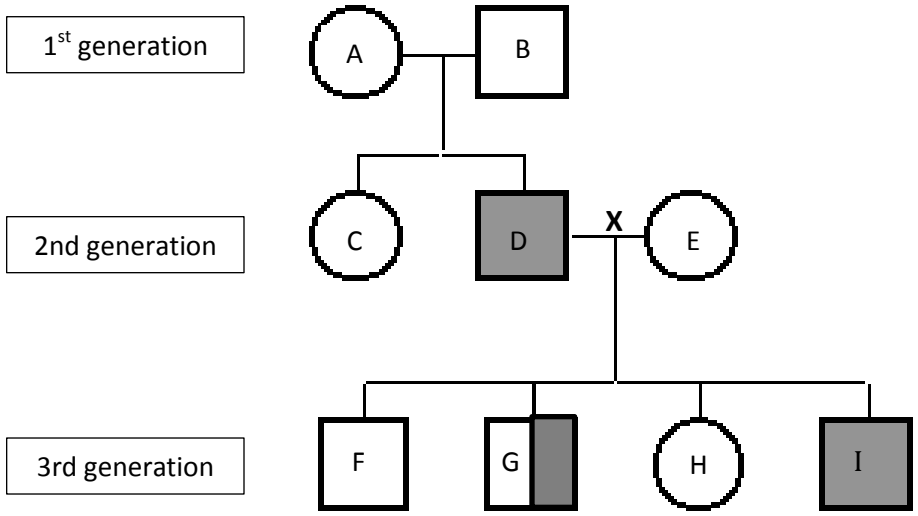
Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Cross	Punnett Square		Offspring Genotypes
X	1	2	Offspring Phenotypes
	3	4	

Name: _____ Class: _____

Pedigrees: Introduction

A pedigree is a diagram of family relationships that uses symbols to represent people and lines to represent genetic relationships. These diagrams make it easier to visualize relationships within families, particularly large extended families. Pedigrees are often used to determine the mode of inheritance (dominant, recessive, etc.) of genetic diseases. A sample pedigree is below.



In a pedigree, squares represent males and circles represent females. Horizontal lines connecting a male and female represent mating. Vertical lines extending downward from a couple represent their children. Subsequent generations are therefore written underneath the parental generations and the oldest individuals are found at the top of the pedigree.

If the purpose of a pedigree is to analyze the pattern of inheritance of a particular trait, it is customary to shade in the symbol of all individuals that possess this trait.

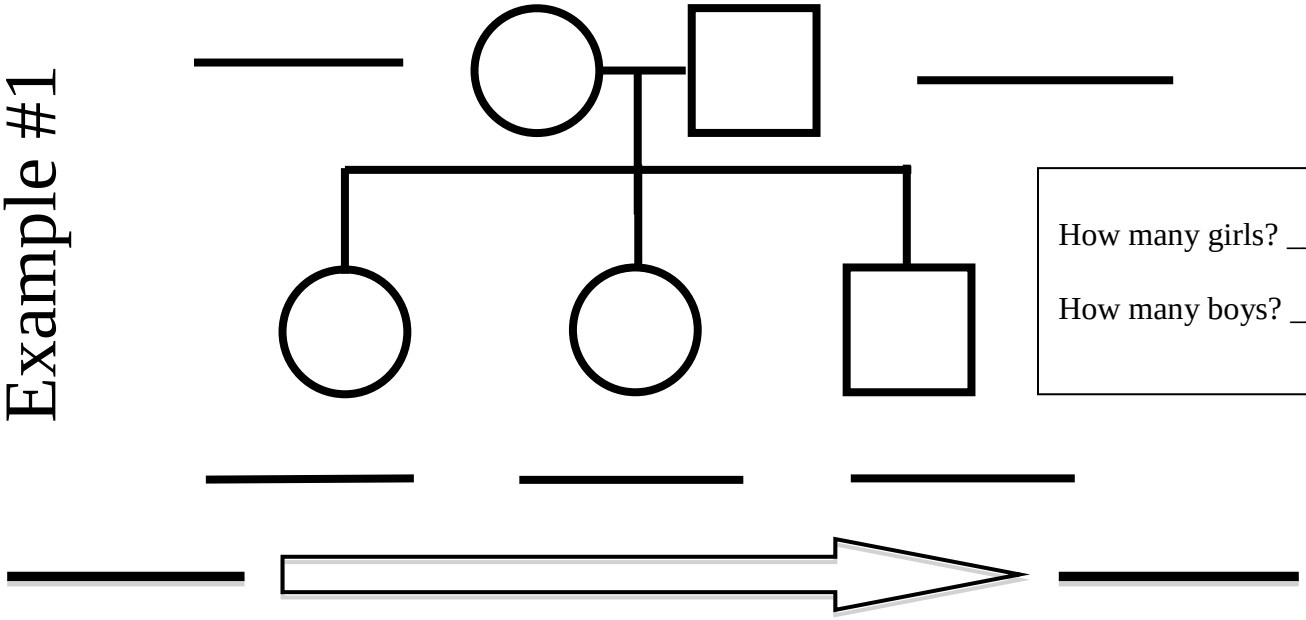
In the pedigree above, the grandparents had two children, a son and a daughter. The son had the trait in question. One of his four children also had the trait.

1. How many females are shown in this family? _____
2. What does a shaded symbol represent? _____
3. What does the line at X tell you? _____
4. How many offspring did the second generation have? _____
5. Describe three characteristics of individual G.
    a. _____
    b. _____
    c. _____
    d. _____

Pedigree Notes **Name: _____**

1. **Pedigree:** a diagram that traces _____ _____ through several generations of a family.

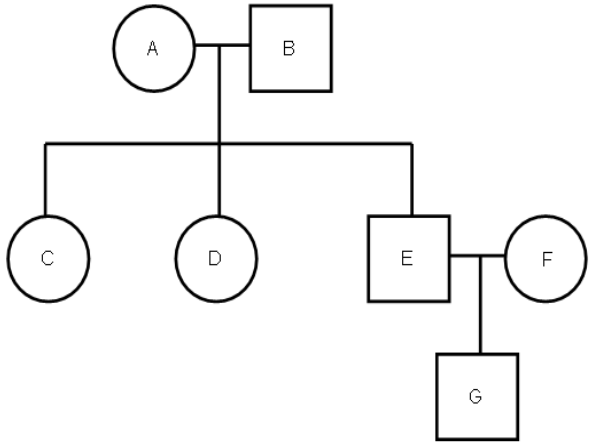
Example #1



How many girls? _____

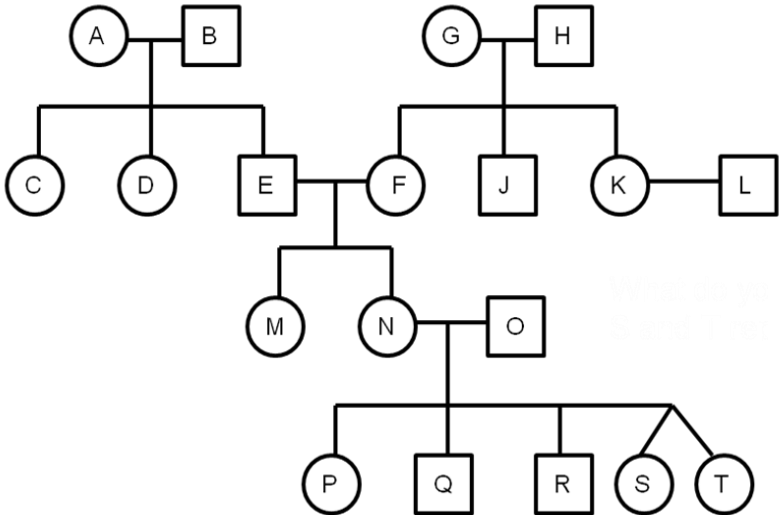
How many boys? _____

2. A horizontal line connecting two shapes represents a _____/_____.
3. How many crosses/marriages in the pedigree below? _____
4. A _____ line extending down from a marriage/cross represents that the couple _____ _____.
5. **A** and **B** are _____.
6. **E** and **F** are _____.
7. **A** and **B** have ____ kids, while **E** and **F** have ____ kid(s).
8. What is **F** to **D**? _____.
9. What is **B** to **G**? _____.



Example #2

Example #3

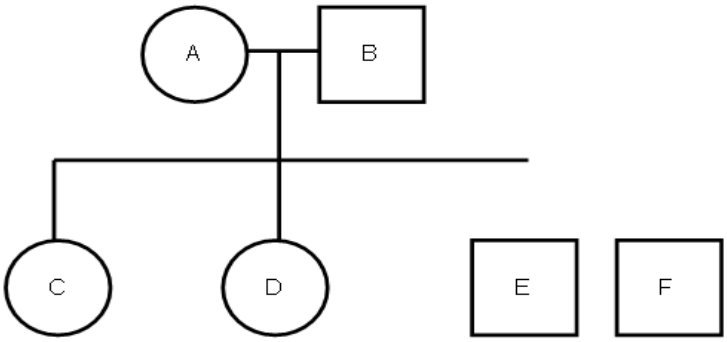


10. How many couples have children?

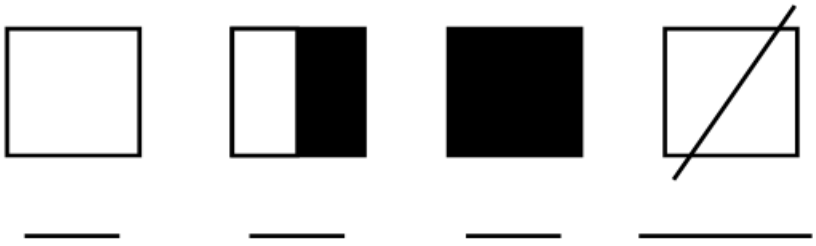
11. What do you think S and T represent?

_____

12. How do you show twins?

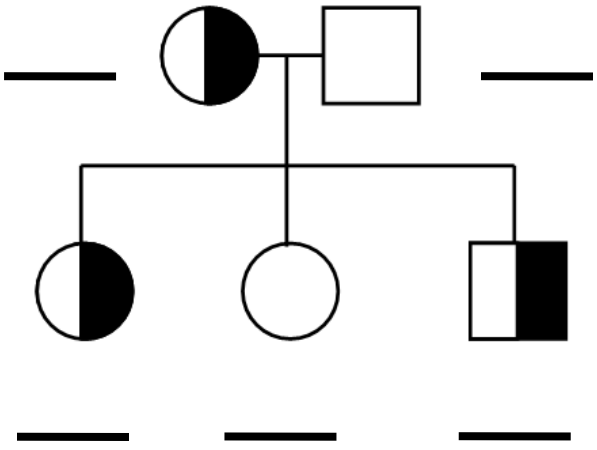


13. How do you show traits? _____ (_____ = _____)



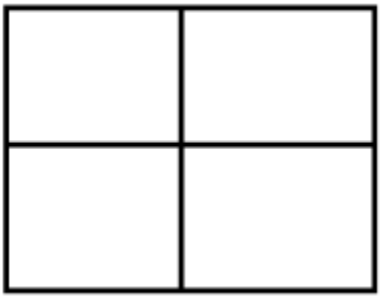
_____ _____ _____ _____

14. A pedigree chart follows _____ _____.

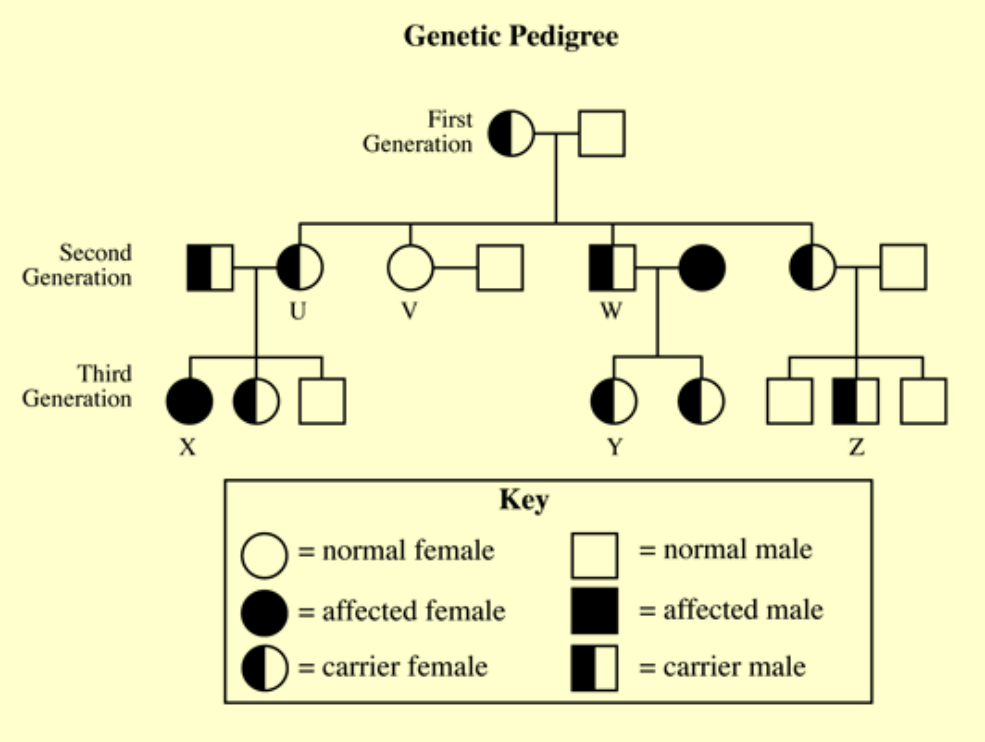


R = _____

r = _____



Name: _____ Class: _____



Questions:

1. How many children did the first generation have? _____
2. How many girls did the first generation have? _____
3. Describe individual Y. _____
4. Describe individual Z. _____
5. How many children and grandchildren have the disease? _____
6. What is the genotype of X? Use the letter R/r. _____
7. What is the genotype of Y? Use the letter R/r. _____
8. How many children and grandchildren are carriers for the disease? _____
9. What is a carrier?

   _____

   _____
10. How many kids did W and his wife have? _____
11. Who is older, U or V? _____ How do you know?

    _____

    _____

Meet the Charltons

The Charltons are a family of five. In addition to mom and dad, there is a son named Tyler, and two daughters named Terry and Anna. Terry is the oldest of the children and Anna is the youngest. Mr. and Mrs. Charlton have black hair. Terry and Tyler have red hair and Anna has black hair like her parents. Mrs. Charlton's mother has black hair and knows that her genotype is pure dominant. Both of Mr. Charlton's parents are hybrids.

Make a pedigree below to represent all of the members of the Charlton family. Add a name label for each person

Questions:

1. How many generations are in your pedigree?

2. What is the genotype and phenotype of Mrs. Charlton's father? How do you know?

3. If Mr. and Mrs. Charlton had a forth child, what are the possible genotypes and phenotypes for that child?

4. If Anna marries a red-head, what is the probability that her first born will have red hair? How do you know this?

Name _____

Inheritance Questions

Draw a pedigree to represent the following family. Include the name and genotype of each person in the family. Use the letter R. Curly hair is dominant.

Joe and Sarah are married. They have three children. David is the oldest and Ben is the youngest. Their daughter is named Cayla. Cayla's husband is Mike. They have one son named Jon. Joe has curly hair, but Sarah is pure recessive. David and Mike have curly hair. Ben and Cayla have straight hair.

1. How many generations are present?

2. What is Joe's genotype? How do you know?

3. What is/are Jon's possible genotype? How do you know?

4. ***Could*** two parents with curly hair have four straight haired sons? Prove your answer by completing a punnett square followed by a written explanation.

Objectives for Unit 1 - Part 4: <u>Cloning, Genetic Engineering, & Selective Breeding</u>

You will <u>UNDERSTAND</u> the following concepts…

- Most cells have genetic information that determines traits.
- Organisms inherit genetic information in a variety of ways that result in variations/similarities in organisms.
- Models of genetic inheritance can be used to show the probability of traits being expressed.
- Genes can be modified through mutation or human intervention.
- Genetic traits are passed from parents to offspring.

<u>Underlined</u> terms are required vocabulary words.

You will <u>KNOW</u> the following ideas and concepts…

- Each human cell contains a copy of all the genes needed to produce a human being.
- **<u>Cloning</u>** is the production of cells/organisms with identical genes.
- **<u>Identical twins</u>** are natural **<u>clones</u>**.
- A **<u>clone</u>** made from a living organism will be genetically identical to that organism, but will be younger.
- The environment may affect the expression of genes. In other words, two organisms may be genetically identical, but no t look exactly the same.
- **<u>Selective breeding</u>** is the mating of two organisms in an attempt to combine the best traits of each in the offspring.
- Selective breeding has been practiced for thousands of years and requires no special equipment.
- **<u>Genetic engineering</u>** is when humans modify/replace/exchange genes to change the DNA of an organism.
- Genetic engineering can combine genes from two different species.

You will <u>BE ABLE TO DO</u> the following activities…

- Identify the advantages and disadvantages of GE and SB.
- Create a virtual clone (Mimi).

Twins! What do you know about twins?

Watch the brainpop on twins and complete the quiz. Pick **one** question to answer. Use COMPLETE sentences! Circle your choice!

1. Are twins clones? Why or why not? (Hint: think about the types of twins.)
2. How are fraternal and identical twins made?

TWINS

Date:_____

Name:_____

Class:_____

1  **Identical twins share the exact same:**

A Genes

B Personalities

C Interests

D Identities

2  **What can you infer about the following set of twins?**

A They are identical twins

B They are fraternal twins

C They are conjoined twins

D They are mixed twins

3 **What is the key difference between fraternal twins and identical twins?**

A Fraternal twins are born several hours apart; identical twins are usually born at the same time

B Identical twins are born at the same time; fraternal twins are usually born several hours apart

C Identical twins develop from two separate eggs; fraternal twins develop from one fertilized egg

D Identical twins develop from one fertilized egg; fraternal twins develop from two separate eggs

4 **Place the following events in sequence: A) A fertilized egg splits; B) Identical twins develop; C) A sperm and egg cell unite**

A A, C, B

B B, A, C

C C, A, B

D C, B, A

5 **In the phrase, "Twins develop during the prenatal stage of life," what does "prenatal" mean?**

A After birth

B Before birth

C Before conception

D During birth

6 **What must happen for fraternal twins to develop?**

A A fertilized egg must divide twice as rapidly as it ordinarily does

B A sperm cell must split in half

C An egg cell must split within the uterus

D A woman must release two egg cells at the same time

7 **Which term best describes the genetic makeup of fraternal twins?**

A Indistinguishable

B Similar

C Opposite

D Generic

8  **How are conjoined twins formed?**

A When two sperm fertilize one egg

B When two separate eggs fuse together

C When one fraternal twin begins to consume the other in the womb

D When identical twins start to form but don't split completely

9 **What can you conclude from the fact that doctors usually try to surgically separate conjoined twins?**

A Conjoined twins often face dangerous health risks

B Conjoined twins can never lead fulfilling lives

C Conjoined twins will die immediately if they're not separated

D Conjoined twins are not legally allowed to live

10 **Which term best describes the occurrence of conjoined twins?**

A Frequent

B Uncommon

C Typical

D Impossible

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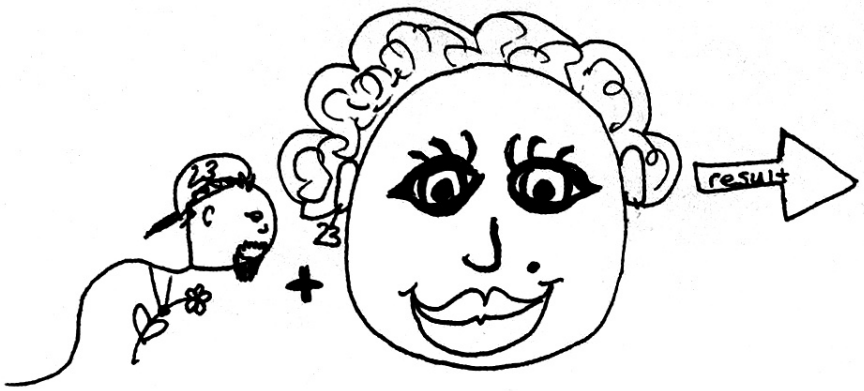
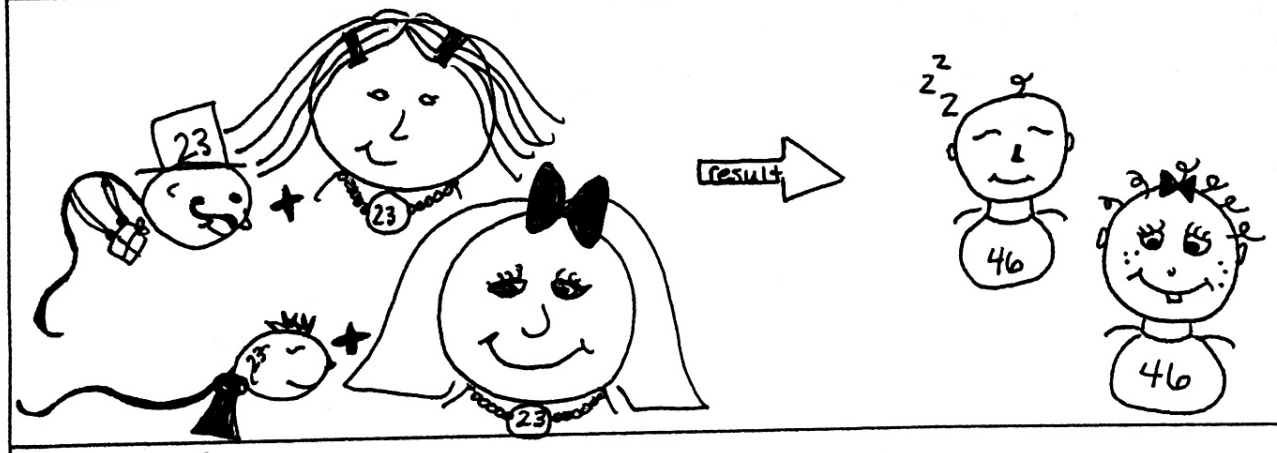
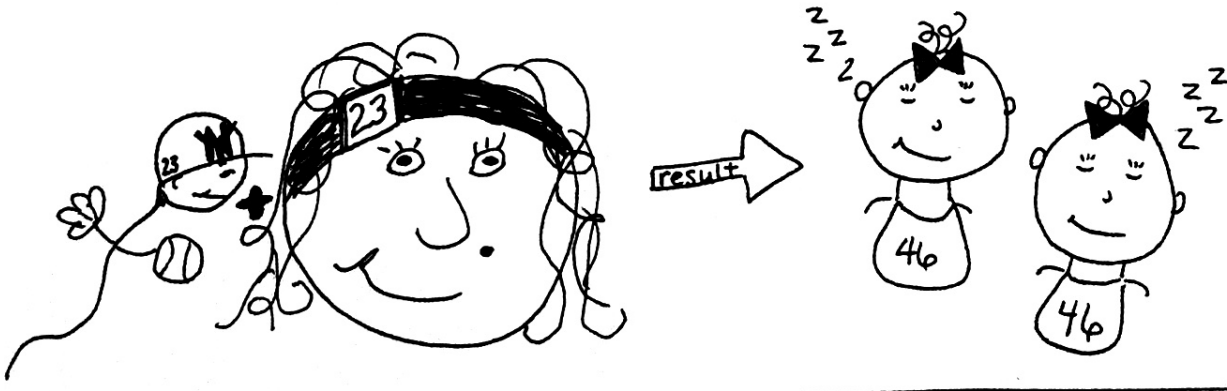
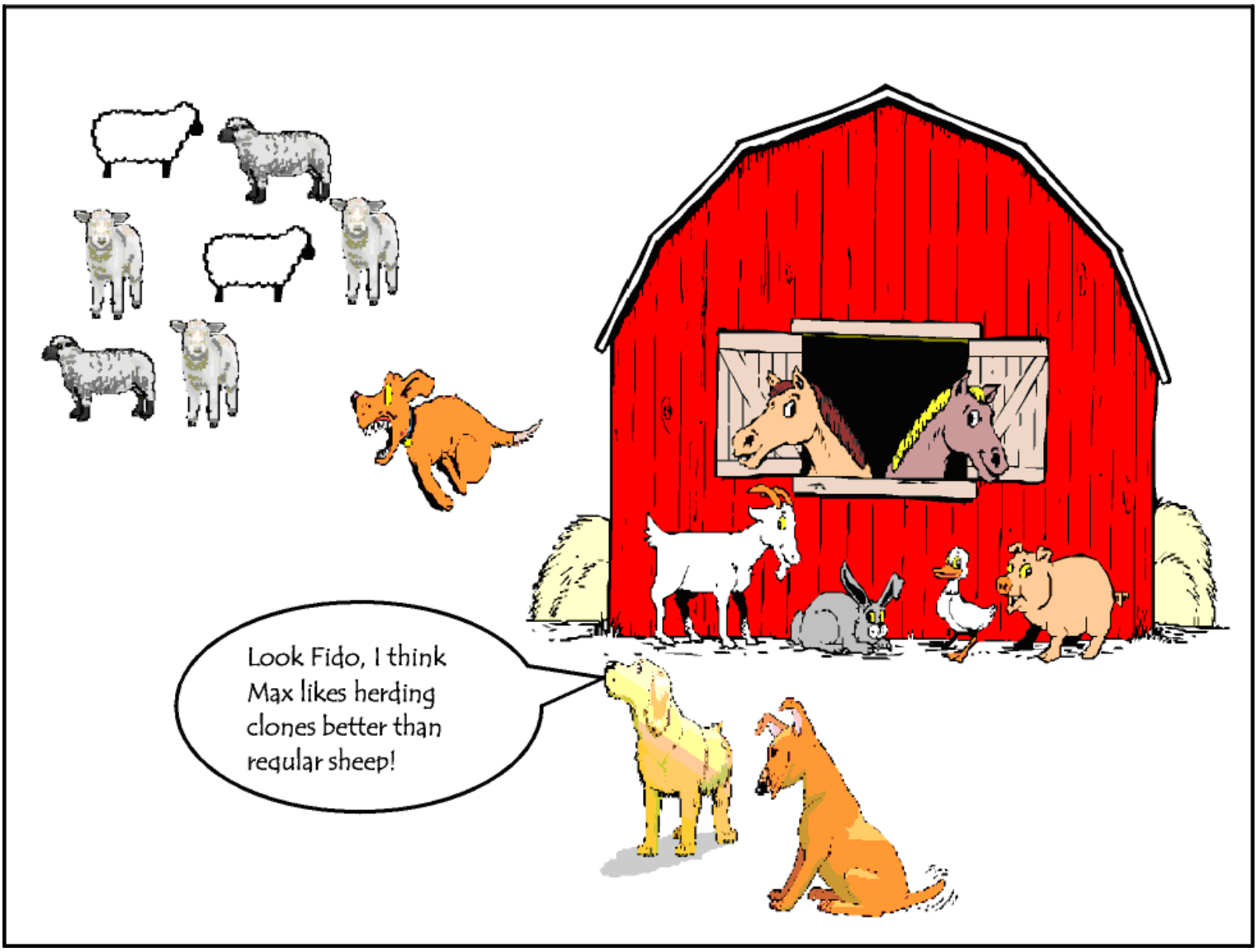
TWINS!

Notes









1. What is cloning?

2. What type of reproduction is cloning? Why?

3. What are some ethical issues regarding cloning?

Let's Clone a Mouse, Mouse, Mouse…..

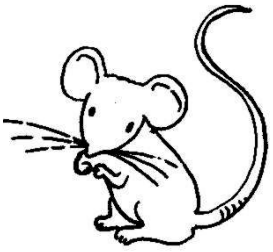
Name _____

BACKGROUND INFORMATION

In 1996, Dolly the sheep became the first mammal to be cloned by transferring the nucleus from an adult body cell into an **enucleated** egg cell.

To confirm that Dolly was truly a clone, researchers at the University of Hawaii used a similar process in 1998 and ultimately cloned 50 mice.

In this activity you will simulate their steps of **somatic cell nuclear transfer** to produce an exact clone, or genetic copy, of a mouse.



enucleated means _____

Your task: check off each step in the activity as you complete it. You must wait to get your **teacher's initials** at certain spots in the activity before you can move forward.

☐ **1.** Go to the 7th grade science website, to the Cloning page under the Inheritance section. Follow the link entitled **"The Cloning Activity".** Then click on **"What is Cloning?"** on that new page.

☐ **2.** Read the first few paragraphs of the **"What is Cloning?"** article and answer the following questions…

a. What is cloning? _____

_____

b. Do human clones exist? _____ **Defend your answer:** _____

_____

☐ **STOP!** You must get your teacher's initials in the box before you can continue.

☐ **3.** Further down in the **"What is Cloning?"** article read about **artificial embryo twinning** and **somatic cell transfer**.

☐ **4.** Watch both **"Compare and Contrast"** animations *(one looks like a 2 cartoon pictures of a cell, the other has drawings of sheep).* **Each has 2 play buttons – be sure to watch all the parts!!**

☐ **5.** Watch both **"See the Real Thing"** videos *(bottom right of the page – they look like microscope pics)*.

☐ **6.** Use what you learned in steps 3-5 to answer the following:

somatic cell = body cell
nuclear = nucleus
transfer = moving an object from one place to another

Using these definitions, what does ***somatic cell nuclear transfer*** mean? _____

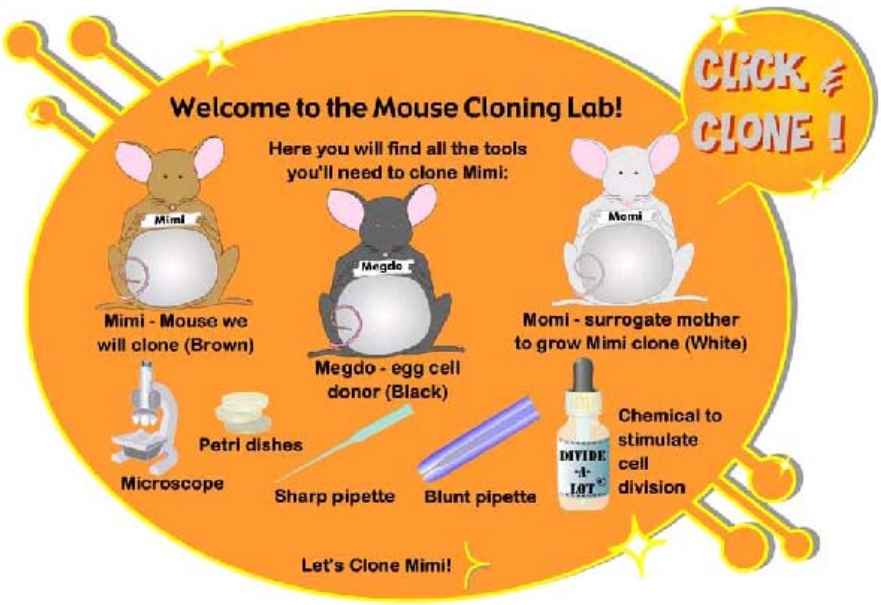
_____

_____

☐ **STOP!** You must get your teacher's initials in the box before you can continue.

☐ **7.** Click the back button, and go to the **"Click and Clone"** activity on the website. *(Find the orange bar with the cartoon mice on it.)*

☐ **8.** Go through all the steps to clone Mimi the mouse. (click on ***"Let's Clone Mimi!"*** to start)



☐ **9.** Answer the following questions…

a. Why isn't the baby white like Momi the surrogate mother? _____

_____

b. What do you think about cloning? Could it be useful to humans? Do you see any possible problems that could be caused by making clones?

_____

_____

_____

c. If you could clone any one person; who would you clone? _____

Why would you clone that person? _____

_____

STOP! You must get your teacher's initials in the box before you can continue.

☐ **10.** Choose one of the following: *(circle your choice)*

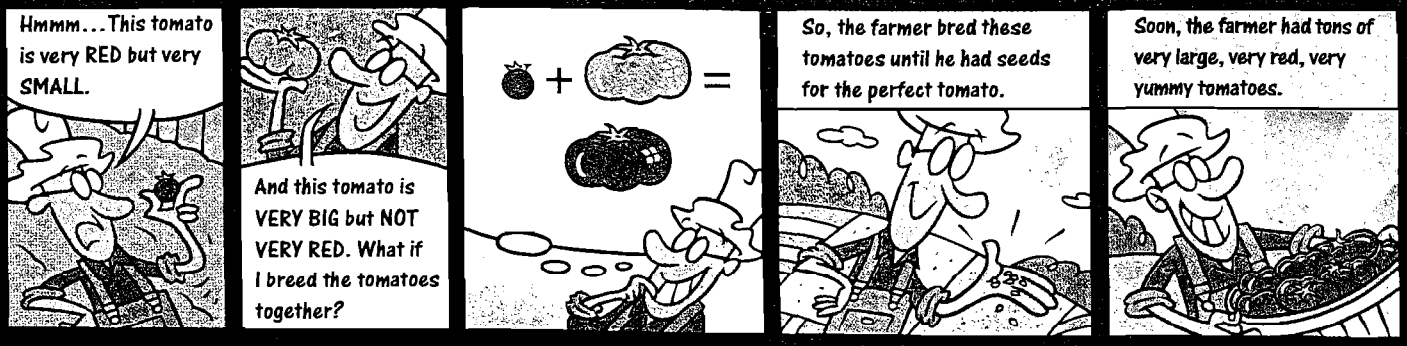
(A) **Cloning Card Sort** to start getting ready for your upcoming quiz

(B) **"Going Further…" writing activity** from the other side of this page (for EXTRA CREDIT)

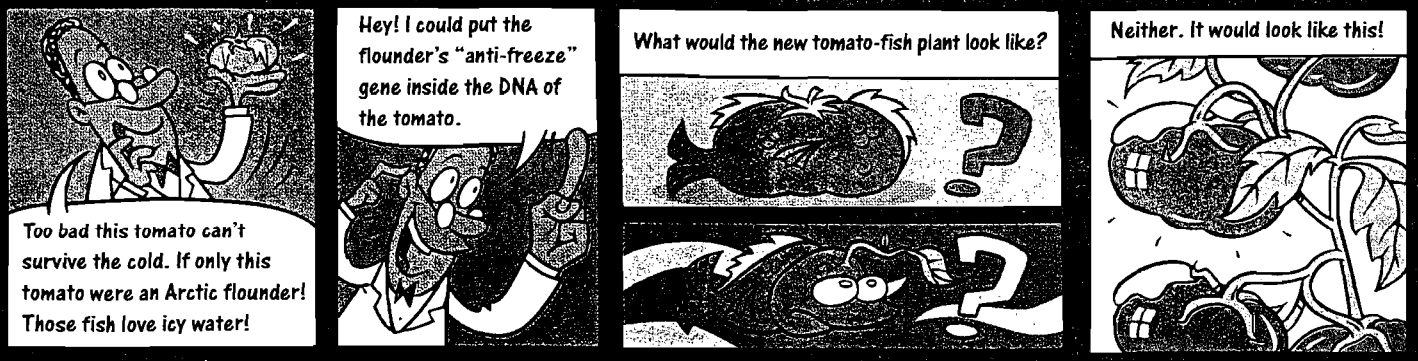
☐ **11.** Be ready for an **Exit Ticket** about cloning!

The Quest for the PERFECT TOMATO

For centuries, farmers have used a method called breeding to grow the most desirable crops. With tomatoes, they have combined different kinds to produce larger, redder, and tastier varieties.



You can make bigger and better tomatoes, but no tomato can withstand chilly weather. What can? Fish in the Arctic! But you can't breed a fish and a tomato. Guess what? Scientists have figured out a way to take genes from one species and put them into another. This is called genetic modification.



Looks aren't everything! If we could genetically modify a tomato using the fish "anti-freeze" gene, it would look like a normal one. But it would surely act differently. It would be able to grow in the cold.

FOOD FOR THOUGHT

Do you think these genetically modified foods are a good idea?

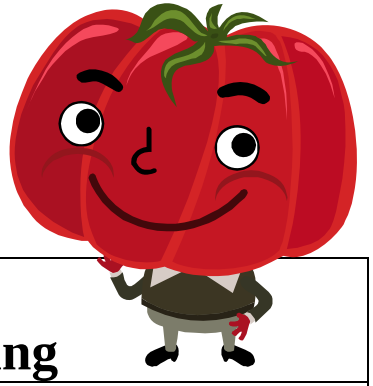
Corn Farmers Are All Ears

Pests can ruin farmers' corn crops. So scientists developed genetically modified corn that resists these bugs. The good news is that the farmers can now produce more corn. The bad news is that some scientists think that the pollen from the corn could be killing harmless insects.

An A-Peeling Vaccine

Each year, thousands of people in poorer countries die of cholera. There is a vaccine to prevent this disease, but the injections are expensive. Scientists are working on a way to put genes that produce vaccines into genetically modified bananas. Opponents worry that altering fruit may have dangerous side effects.

The Quest for the Perfect Tomato

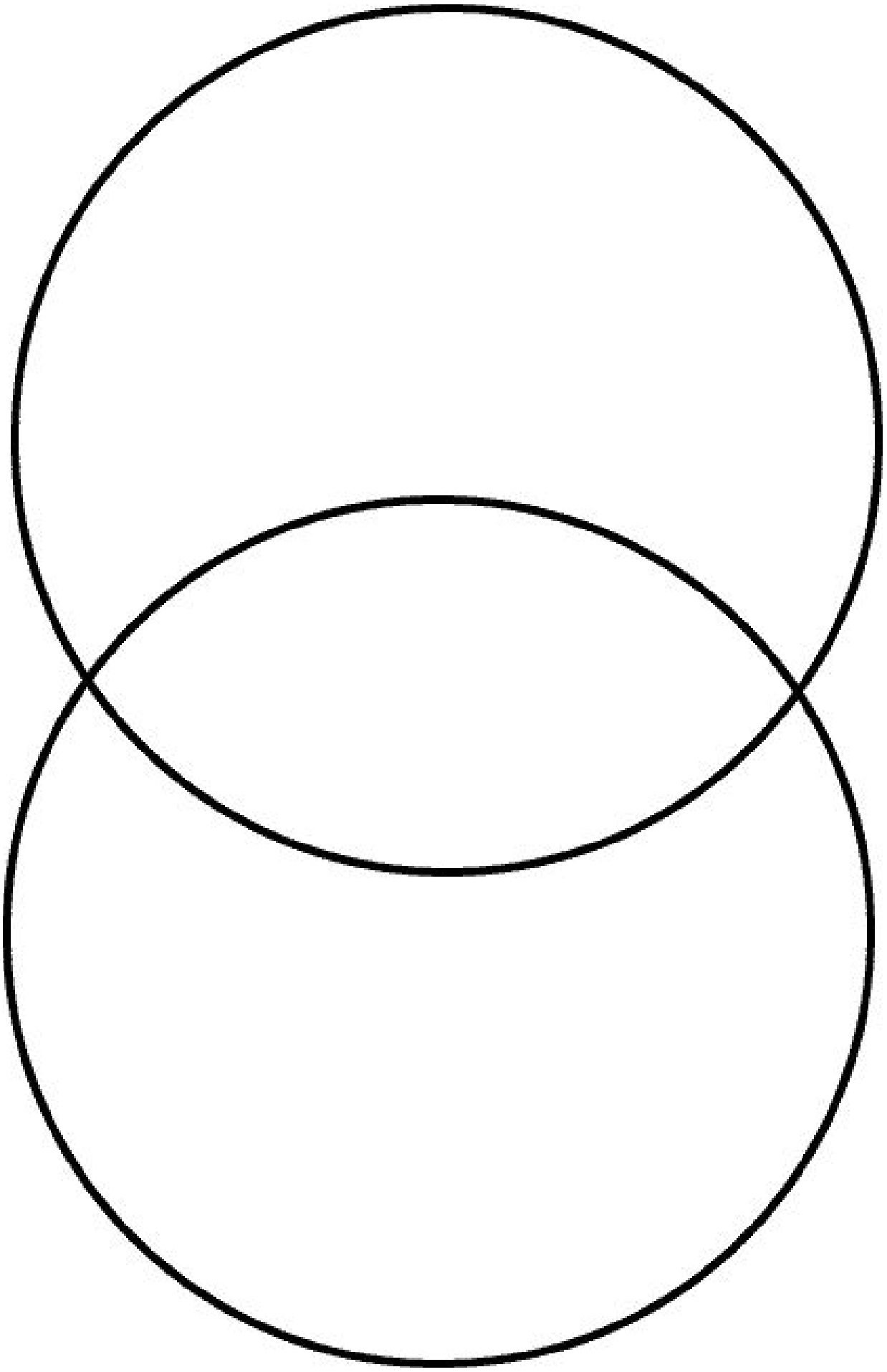


	Selective Breeding	Genetic Engineering
Definition		
Advantages		
Disadvantages		
Example		

2 Ways to Change the Traits in a Species

Use the T-Chart below to compare and contrast these two processes.

Name of the process (Pile A)	*Name of the Process (Pile B)*
Description (Pile A) - DO THIS FIRST ● *this can be a paragraph or bullet points* ● *use lots of details from the cards!*	*Description (Pile B) - DO THIS FIRST* ● *this can be a paragraph or bullet points* ● *use lots of details from the cards!*



Genetic Engineering and Selective Breeding Practice

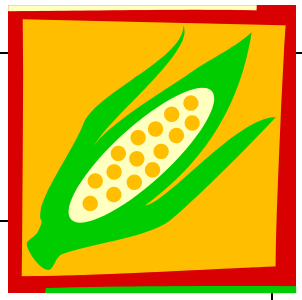
Directions: Read the examples or facts below. Determine whether the examples are describing **genetic engineering (GE)** or **selective breeding (SB)**. *(Note: some examples might describe both GE and SB.)*

Scientific Example or Fact	GE or SB?
Farmers removed the gene in chicken DNA to make them grow featherless.	
This process combines the best traits of organisms through sexual reproduction.	
Dog breeders wanted to breed a dog that would run fast but also be born with long, shiny fur, by looking for the best characteristics from the parents.	
Scientists take out a gene for bioluminescence from a jellyfish and put that gene into a mouse's DNA to see if it will have a glowing effect.	
This process is relatively new and done in science labs.	
This process removes, adds or changes genes.	
This results in organisms with new traits.	
English Shorthorn cattle, which produced good beef were bred with Brahman cattle from India to make the offspring both tasty and resistant to heat.	
This process has been around for thousands of years.	
Scientists removed a gene for fat in bison to make them leaner.	
This results in organisms with desirable traits from both parents.	
This is a costly way to change traits.	
Humans choose the mates for organisms.	
Humans decide on a particular trait that they want to see in a new organism.	
This process can only occur with organisms of the same species.	

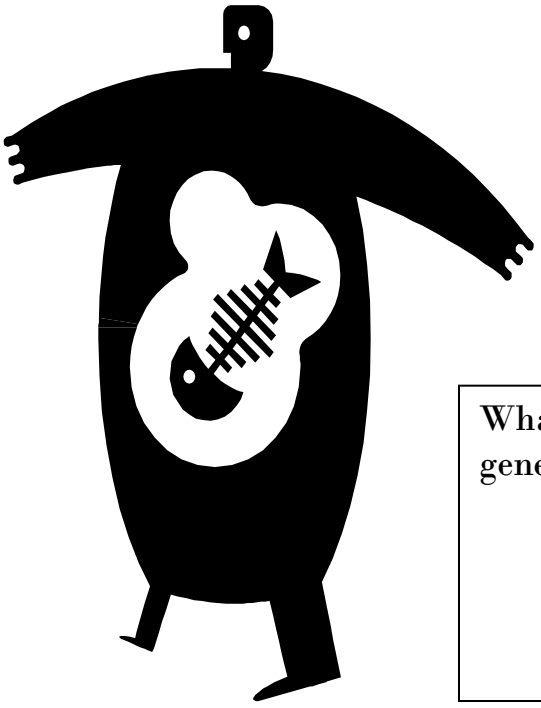
Bill Nye: Genetically Modified Foods

What are genetically modified foods?

How do genetically modified foods differ from traditional foods?



Give three examples of genetically modified foods.

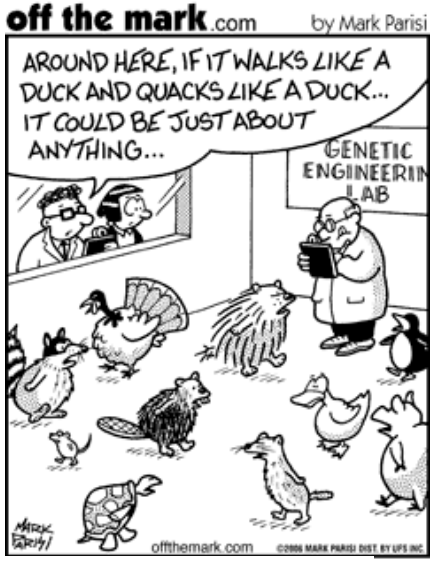


What can happen, for the good, due to growing and eating genetically modified foods?

What can happen, for the bad, due to growing and eating genetically modified foods?

Genetic Engineering: Freaky Science?

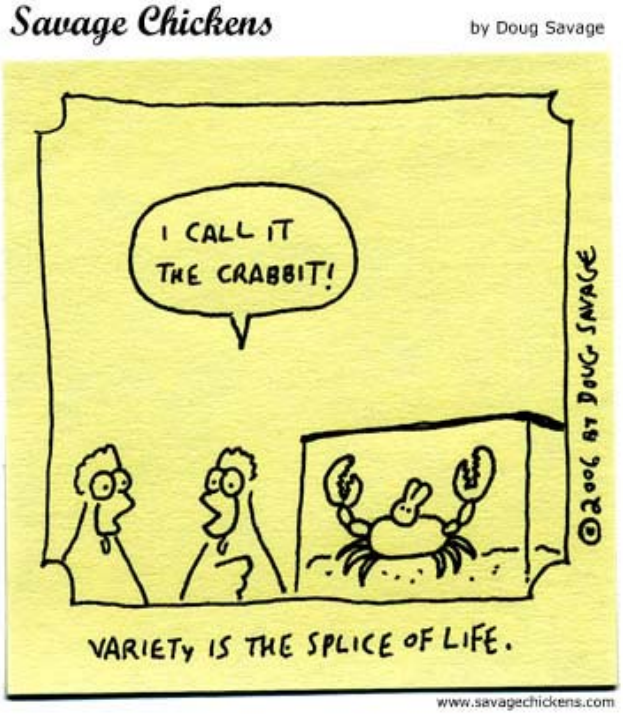
In the space below, using **one** of the cartoons as reference as well as information gained from Bill Nye: Genetically Modified Foods, complete the following (on the back of this sheet), using FULL SENTENCES.

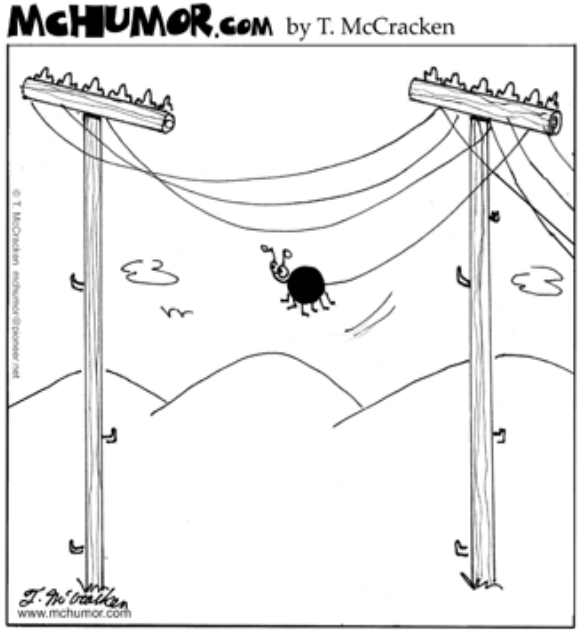


1. Identify and explain something in the cartoon that has been **changed or modified** through genetic engineering.

2. Identify one thing in the cartoon that is **true (or realistic)** based on what you know about genetic engineering.

3. Identify one thing in the cartoon that has been **exaggerated** or is **inaccurate**, based on what you know about genetic engineering.





A genetically bred super spider that spins utility lines.

1. Identify and explain something in the cartoon that has been **changed or modified** through genetic engineering.

2. Identify one thing in the cartoon that is **true (or realistic)** based on what you know about genetic engineering.

3. Identify one thing in the cartoon that has been **exaggerated** or is **inaccurate**, based on what you know about genetic engineering.

Class Notes