Name: Monday Date: _____

Warm-Up

Why do organisms make different proteins? A Darwin's bark spider makes proteins that result in spider silk with high flexibility. A different Darwin's bark spider makes proteins that result in spider silk with low flexibility. Using the space below, explain why you think this happens.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Reading "Hemophilia, Proteins, and Genes"

1. Read and annotate the article "Hemophilia, Proteins and Genes."
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

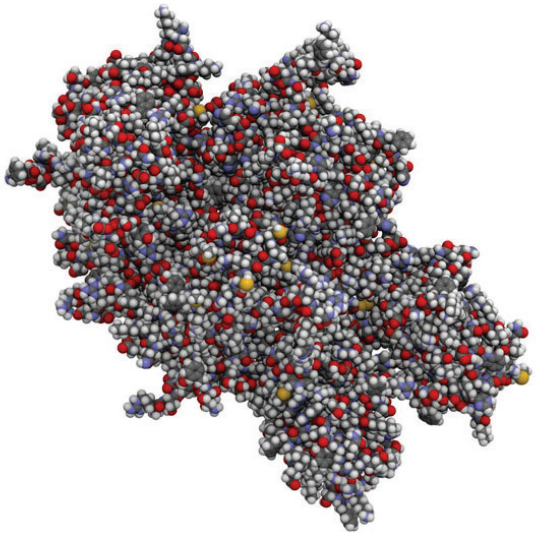
- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Clotting factor proteins work together to bind blood cells into a clot that stops the bleeding.

Hemophilia, Proteins, and Genes



There are thirteen different clotting factor proteins. This model represents a molecule of one of these proteins—the one most hemophilia patients are missing.

You fall off your bike and scrape your knee. Blood drips out, but soon a scab starts to form and the bleeding stops. Sounds simple, doesn't it? However, if you could zoom in to see what's happening on a molecular scale, it's not simple at all. Your blood includes thirteen different protein molecules called clotting factors. When you injure yourself, these clotting factor proteins all connect and work together to form a solid clot (also known as a scab). If you were missing even ONE of those thirteen proteins, the clot wouldn't form, and the dangerous bleeding would continue. This is exactly what happens in a disease called hemophilia (HEE-mo-FEEL-ya). People with hemophilia are missing one of the proteins needed for blood clotting.

Causes of Hemophilia

People with hemophilia are missing clotting factor proteins because of a problem with their genes. Different genes carry instructions for making different proteins. For every gene, there may be several possible versions. (Different versions of a gene can also be

called alleles.) An organism has two copies of each gene. Those gene copies can either be the same version (homozygous) or different versions (heterozygous). If the gene copies are homozygous, just one type of protein is produced, since both gene copies give the same instructions. If the gene copies are heterozygous, two types of protein are produced, since each gene copy gives a somewhat different instruction.

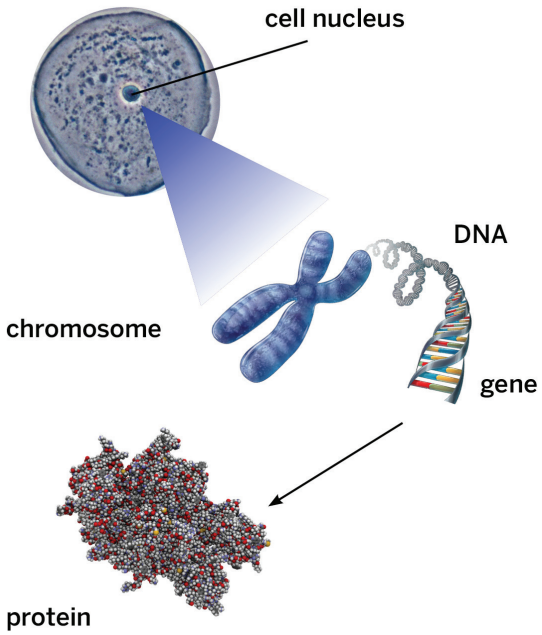
People with hemophilia have a version of the gene that doesn't have the right instructions for making clotting factor protein. Without the right instructions, their cells can't make that protein—or they make a protein that doesn't work. Without functional clotting factor protein, the proteins in their blood can't make the connections needed to form clots and build scabs. Healthy people have at least one copy of the gene version that provides the right instructions for making all of the clotting factor proteins.

Being able to form scabs may seem so basic that it's strange to think of it as a genetic trait like having brown eyes or having freckles. However, just like those other traits, the ability to form scabs is a trait that is determined by proteins. To have that trait, you need to have those proteins—and to make those proteins, you need to have the genes that give your cells the instructions for making them.

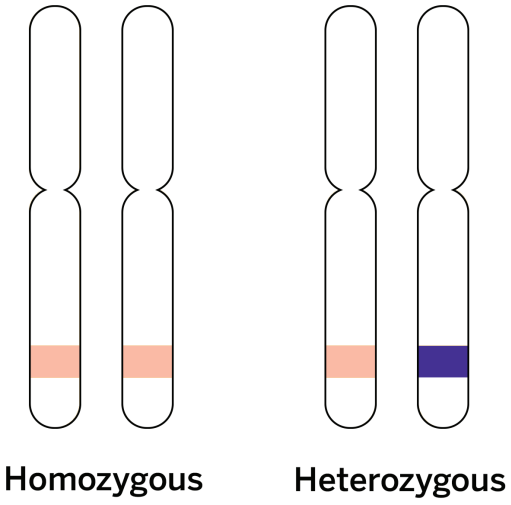
Treating Hemophilia with Proteins

Even though hemophilia is a serious disease, most hemophilia patients can live relatively normal lives if they get proper treatment. Hemophilia is caused by a missing protein, so doctors treat it by replacing that protein. Doctors inject clotting factor protein into a patient with hemophilia so the patient's blood clots the way it is supposed to. Injecting the protein into the body does not change

Genes and Proteins



Genes are located on chromosomes in the cell's nucleus. They provide instructions for building protein molecules. People with hemophilia can't make a clotting factor protein because of a change in one of their genes.



An organism with two gene copies that are the same is homozygous, while an organism with two gene copies that are different is heterozygous.

the proteins the body produces; instead, it supplies the protein the blood needs to clot properly. People with hemophilia need to have the missing protein injected into their bodies throughout their lifetimes because the injected protein will be used up. The patients then need to be injected again for their blood to continue to form clots properly.

For many years, the only way to get clotting factor protein was to separate the protein from donated blood. However, it takes a lot of blood to get just a little bit of clotting factor protein! Today, scientists can make lots of clotting factor protein by inserting human genes into hamster chromosomes. If you put the human gene for making clotting factor protein into the chromosomes in the nucleus of a hamster cell, the cell makes the protein. Even though it's a hamster cell, the cell makes clotting factor protein that's identical to clotting factor protein made in human cells. As long as the cell has the gene with instructions for making clotting factor protein, the cell will make the protein.

Gene Therapy for Hemophilia

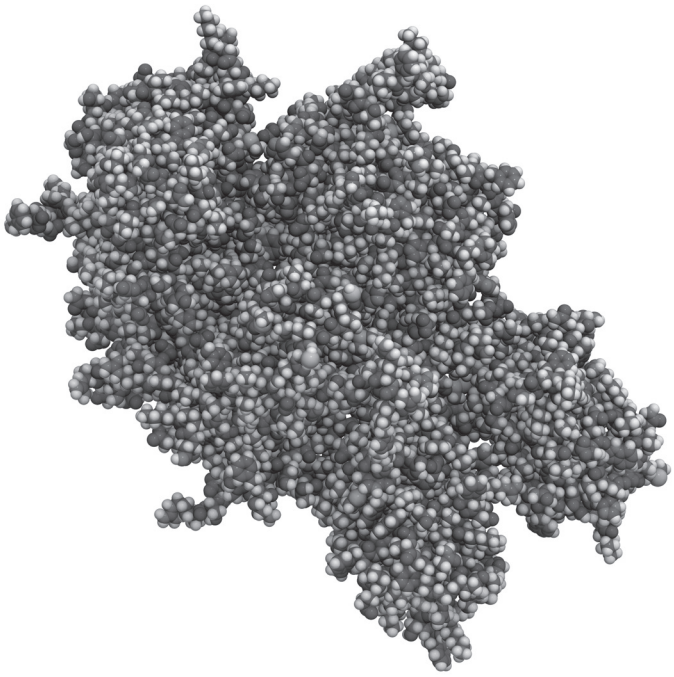
Hemophilia can be treated using clotting factor protein, but it can't be cured...for now, at least. Scientists are researching possible cures for hemophilia: cures that would get the patient's own cells to produce clotting factor protein. For this kind of a cure, scientists would have to figure out how to fix a patient's faulty gene for making clotting factor protein. If the faulty gene were fixed, the patient's cells could start making clotting factor protein naturally. Working to fix or replace genes is called gene therapy. Hemophilia can't be cured with gene therapy yet, but scientists are working on it.

Scientists are making progress in treating hemophilia and other genetic diseases.

Name: Tuesday Date: _____

Warm-Up

Review the diagram below from the "Hemophilia, Proteins, and Genes" article. Then, answer the question.



There are 13 different clotting factor proteins. This model represents a molecule of one of these proteins—the one most hemophilia patients are missing.

Genes provide instructions for making clotting factor proteins. The diagram to the left is an example of just one of hundreds of thousands of different proteins made in the cells of your body. What other types of proteins do you think your body makes? List your ideas below.

Name: _____ Date: _____

Second Read of "Hemophilia, Proteins, and Genes"

You are investigating the question: *Why do some organisms make one type of protein for a feature and other organisms make two?*

1. Read and annotate the first paragraph of the "Causes of Hemophilia" section of the "Hemophilia, Proteins, and Genes" article. Identify evidence that helps you answer the above question.
2. Review the Homozygous/heterozygous diagram from the article. Annotate the image.

Name: _____ Date: _____

Reflecting on the Investigation Question

Use evidence from the Simulation and the "Hemophilia, Proteins, and Genes" article to answer the Investigation Question.

Word Bank

copies	gene	gene version	heterozygous
homozygous	protein	trait	

Why do some organisms make one type of protein for a feature while other organisms make two? Use the above words in your response.

_____

_____

_____

_____

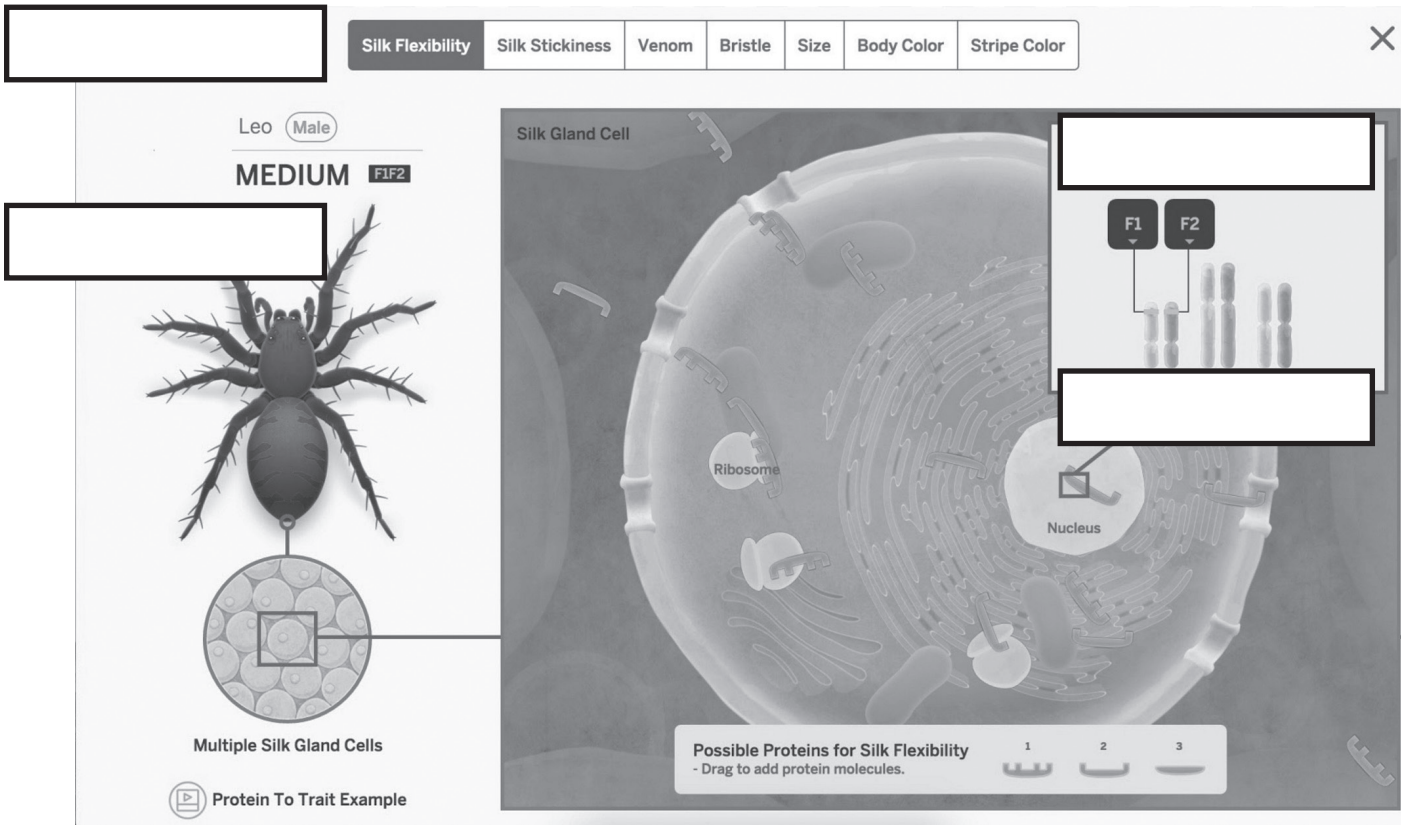
_____

_____

Name: Wednesday Date: _____

Warm-Up

Label the diagram with the words provided below.



Word Bank

copies of genes	feature	gene versions	trait

1. The spider in the diagram above has _____ gene versions for the silk flexibility trait.
   a. homozygous
   b. heterozygous

Name: _____ Date: _____

Homework: Revisiting the Anticipation Guide

Review your original response to this statement from the Anticipation Guide on page 6:

There are two genes that decide each of your traits, and those two genes are always exactly alike.

Do you agree or disagree with this statement now? What evidence supports your ideas about the statement?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Reading "Exploring the Human Genome"

You have learned a lot about genes, proteins, and traits. Read and annotate the "Exploring the Human Genome" article to learn more about current scientific research about genes, proteins, and traits. Then, answer the questions below.

What is the Human Genome Project?

_____

_____

_____

What have scientists learned from the Human Genome Project?

_____

_____

_____

How is the Human Proteome Project different from the Human Genome Project?

_____

_____

_____

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
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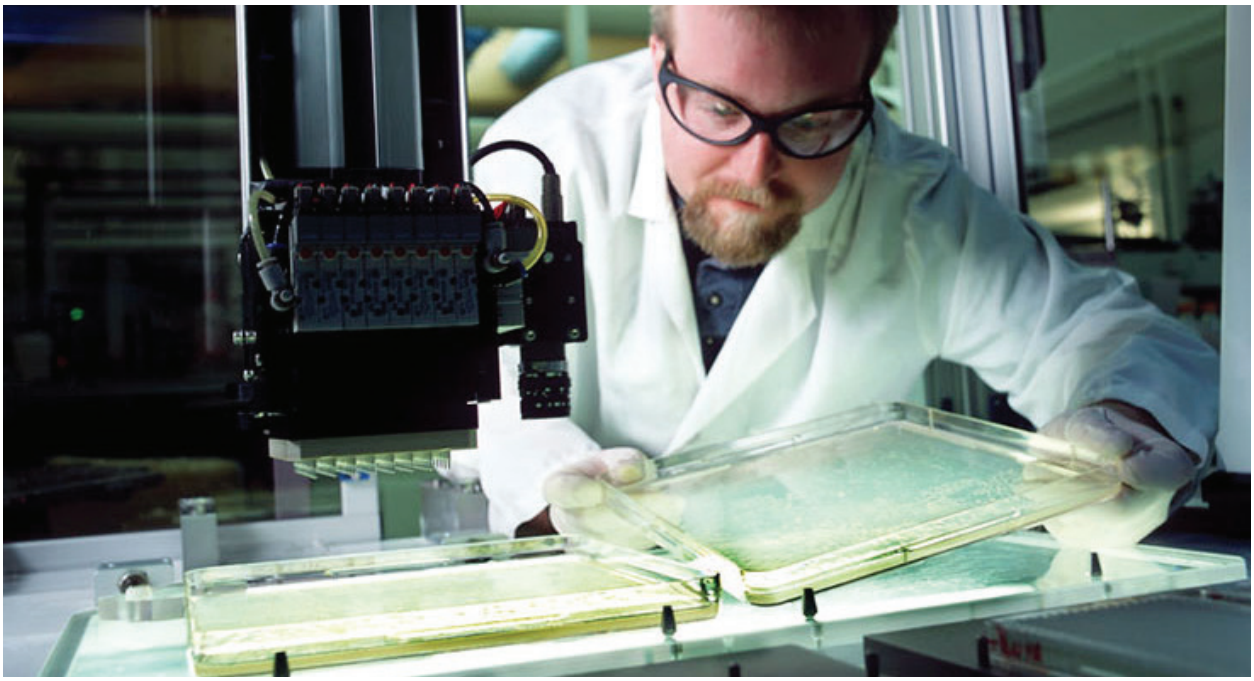

This scientist is working on the Human Genome Project, making a map of all the genes in the human body.

Exploring the Human Genome

The world is full of places to explore. For thousands of years, people have been visiting new places to learn about them—hacking their way through the jungle or climbing the world's tallest peaks. However, not all explorers spend their time learning about new places on the globe. Some scientists explore the human body. Scientists have learned a lot about how the body works, but there is still a lot to learn. Through the Human Genome Project and the Human Proteome Project, scientists all over the world are working to explore and map the genetic landscape of the human body.

The instructions to make and maintain a human are located on thousands of genes inside the nuclei of body cells. All of these instructions together are called the human genome, and as new technologies have developed, scientists have been able to learn more about how it works. Between 1990 and 2003, scientists all over the world worked together to make a map of the human genome. The goal of the Human Genome Project was to find out exactly where, and in what order, each gene of the human body is located. Understanding how many genes there are in the body and where each gene is located is the first step in being able to identify how genes interact—and also the first step in creating medical treatments that target specific genes. As a result of the Human Genome Project, scientists know that there are about 20,500 genes in the human genome.

All people's genes have a lot in common. For example, eye color is determined by multiple genes, and these genes are located in the same place on the same chromosome for all people. However, there's also variation in these genes—different people have different versions of these genes, which is why people have so many different eye colors. There's also lots of variation in other genes, including genes involved in diseases. Through cooperation between many scientists, the Human Genome Project laid the groundwork to create medicine

that is made specifically for each patient, depending on his or her genome.

Having a map of the human genome is a huge step toward understanding our genes and how they affect us. However, genes aren't the end of the story. Each gene instructs the body to produce a particular protein or proteins. The Human Proteome Project is a current collaboration between scientists that takes the work of the Human Genome Project a step further. The goal of the project is to discover which genes code for which proteins in the body. By examining different types of normal tissue from all over the body, scientists are identifying which proteins appear and which genes they come from.

Together, the Human Genome Project and the Human Proteome Project will help us better understand how the body works and will change the way we treat disease. New technology has allowed scientists to see how chromosomes, genes, and proteins work together. Without biomedical research technologies, we would not be able to understand what happens inside the nuclei of body cells. What scientists learn from these projects may unlock many important discoveries for the future.

Name: Thursday Date: _____

Homework: Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond to the questions below.

Scientists investigate in order to figure things out. Are you getting closer to figuring out why the spider family's traits vary?

1. I understand why spiders with different proteins in their cells will have different traits. (check one)
   - ☐ yes
   - ☐ not yet

Explain your answer choice.

_____

_____

_____

2. I understand the role that genes play in making proteins. (check one)
   - ☐ yes
   - ☐ not yet

Explain your answer choice.

_____

_____

_____

3. I understand why some spider offspring have one type of protein, and others have two types of proteins for silk flexibility. (check one)
   - ☐ yes
   - ☐ not yet

Explain your answer choice.

_____

_____

_____

Name: _____ Date: _____

Homework: Check Your Understanding (continued)

4. I understand how sexual reproduction results in variation in the spider offspring's traits. (check one)

   ☐ yes

   ☐ not yet

Explain your answer choice.

_____

_____

_____

5. What do you still wonder about why traits vary?

_____

_____

_____

Name: _____ Date: _____

Warm-Up

The last time you saw the sisters pictured above, you considered how different protein molecules in their cells could lead to different traits. Now, you know that genes provide instructions for proteins that lead to traits. How could these sisters have ended up with different genes, leading to their different proteins and traits? Explain your ideas below.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Discussing Spider Silk Claims

With your partner, review the below claims about the spider family, discussing which claim or claims you find most convincing. Is there any information you still need to support or refute these claims?

Question: *Why do traits for silk flexibility vary within this family of Darwin's bark spiders?*

Claim 1: The offspring have **mutations** that affect their traits.

Claim 2: The offspring's traits depend on **which parent the offspring received more copies of genes from.**

Claim 3: The offspring received **different combinations of gene versions from their parents.**

Name: Friday Date: _____

Reading "Why Are Identical Twins Rare?"

1. Read and annotate the article "Why Are Identical Twins Rare?"
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

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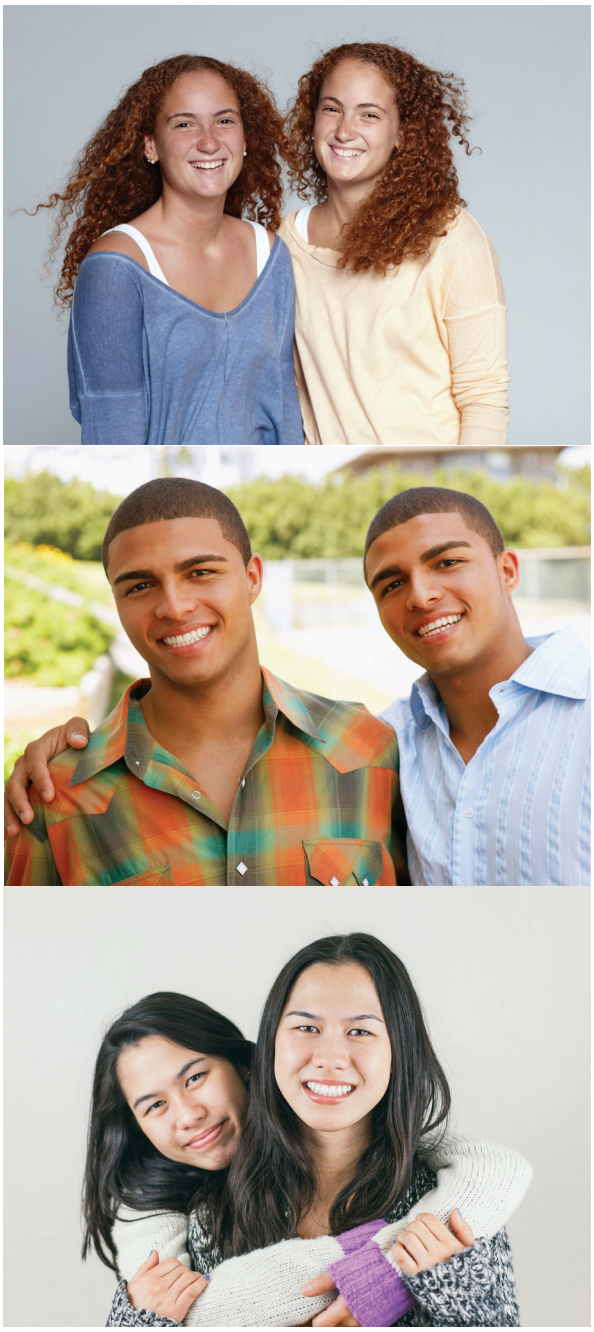
Why Are Identical Twins Rare?

Everyone is different. We can recognize one another's faces because every face is unique, with different combinations of traits like eye color, skin color, nose shape, and so on. All these differences are called variation. Where does variation come from? Genes instruct for proteins, which determine our traits. People have different traits because our protein molecules are different, and our proteins are different because our genes are different. Every human has a unique set of genes, different from anyone else's...at least, almost all of us do.

Imagine knowing someone who looks almost exactly like you—so much like you that people often mistake you for each other. You are the same height, your hair and eyes are the same colors...even the shape of your smile is the same. If you are an identical twin, you already know what that's like.

Identical means "exactly the same." Identical twins look so much alike because they have the same proteins, and they have the same proteins because their genes are the same. How can two different people end up with identical genes?



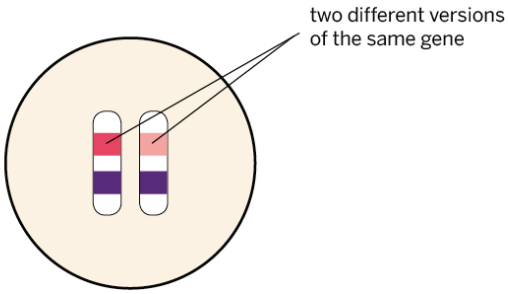
Identical twins are identical because their genes are the same.

How We Get Our Genes

We inherit our genes from our biological parents through the process of sexual reproduction. Each parent has a complete set of genes. These genes are organized on matching pairs of chromosomes. Each chromosome pair has two copies of each gene. However, the two copies of any particular gene can be the same version or different versions.

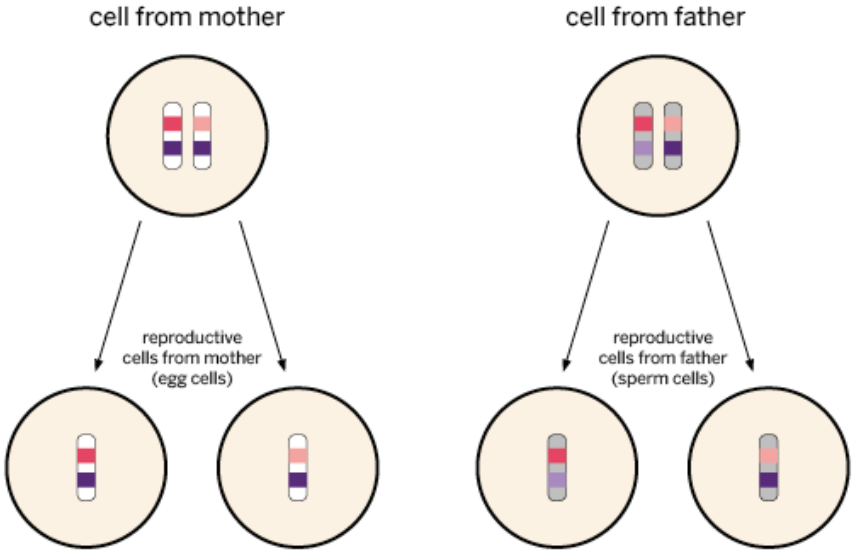
Sexual reproduction involves special reproductive cells from both parents. The mother's reproductive cells are called eggs, and the father's reproductive cells are called sperm. Unlike other cells that have two copies of every gene, egg cells and sperm cells only have one copy of each gene, which means the cell only contains one version of each gene. If a parent has two different versions of the gene, some reproductive cells will end up with one version, while other reproductive cells will end up with the other version. Each time these special cells are produced, the division of genes is different and random. Every sperm or egg cell is unique!

Chromosome Pair



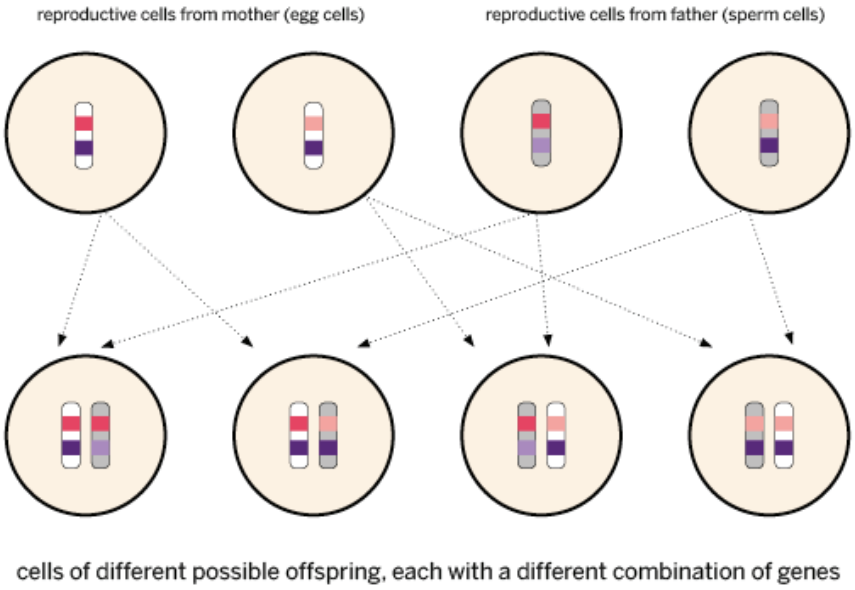
This is a simplified diagram. It shows a cell with just one pair of chromosomes. People don't really have one pair: we have 23 pairs! That's too many to show in this diagram.

Sexual Reproduction



While all other cells contain two gene copies, reproductive cells are different. They contain just one gene copy.

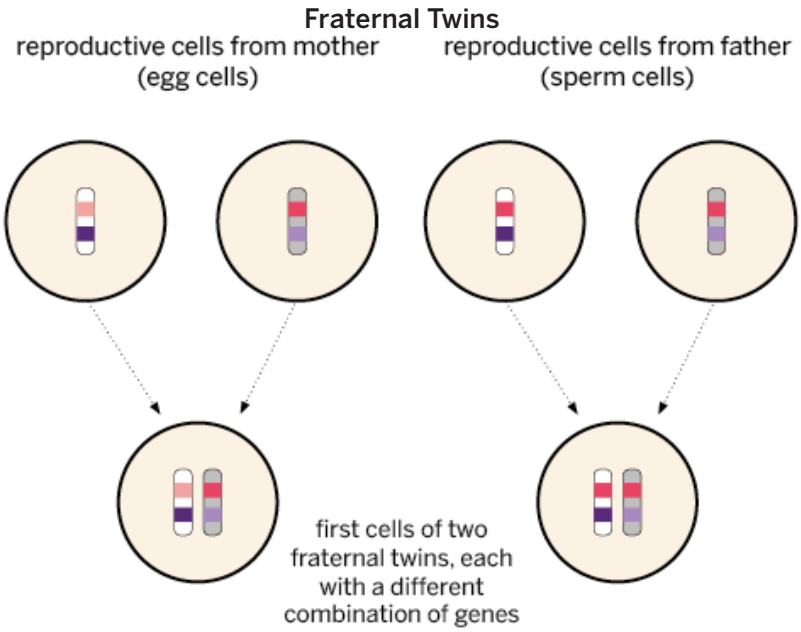
Sexual Reproduction
Possible Reproductive Cell Combinations



Reproductive cells can combine in lots of different ways. This diagram shows four possible combinations for just one chromosome. Remember, humans have 23 chromosomes! The possibilities are practically endless.

When the egg and sperm cells from two parents come together, fertilization occurs. Fertilization is when these cells combine to form the first cell of a new offspring. This new cell has two copies of each gene, one from each parent. Each parent randomly passes on only one copy of each gene, so there can be lots of possible combinations of genes passed on from two parents. The many possible combinations of genes are what give us variation.

All variation in humans comes from sexual reproduction. Identical twins DO vary from their parents; however, identical twins have the same gene versions as each other. How is this possible? To understand why, let's think about the difference between identical twins and fraternal twins.



Because fraternal twins inherit totally different combinations of genes from their parents, they can vary genetically.

Not All Twins Are Identical

Many sets of twins are fraternal twins. Unlike identical twins, fraternal twins have different traits. They may have different eye colors and different heights, and can even be different sexes. There can be lots of variation between fraternal twins.

The difference between fraternal twins and identical twins has to do with fertilization. In fraternal twins, fertilization happens twice. A sperm cell from the father combines with an egg cell from the mother to form the first cell of one twin. At around the same time, a different sperm cell from the father fertilizes another egg cell from the mother to form the first cell of the other twin. The cells of these two twins inherit completely different combinations of genes from the parents. Because they inherited different genes, the fraternal twins will have different proteins—which will interact to determine different traits. Because sexual reproduction happens twice, and each time one copy of each gene is randomly passed on to each of the offspring, fraternal twins have lots of opportunities for genetic variation.

Fraternal twins can be of the same sex or different sexes.

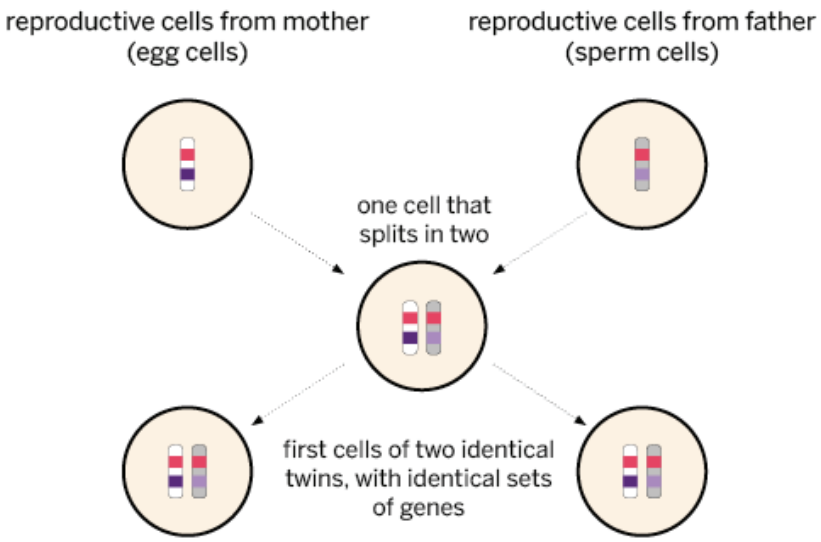
How Identical Twins Get Identical Genes

On the other hand, in identical twins, fertilization happens only once. A sperm cell from the father combines with an egg cell from the mother to form a cell. Then this single cell copies itself and splits, forming two identical cells—the first cells of two identical twins. The cells of these twins inherit the same combinations of gene versions, because they were produced from the same egg and sperm cells. Because they have the same genes, the identical twins will have identical genetic traits.

Of course, even identical twins will develop in different ways over their lives, becoming individual people with different talents and experiences. One twin may train to become a muscular body builder, while the other may sit at a computer writing all day. Just because they inherited the same genes, that doesn't mean they are the same person. Even identical twins aren't identical in every way.

Identical twins are the result of one fertilized egg splitting into two. Both twins have the same genes, which means they also have the same genetic traits.

Identical Twins



Identical twins happen when one fertilized egg splits into two cells. The two cells have exactly the same genes.

Name: Monday Date: _____

Homework: Reading "Invasion of the Periodical Cicada"

You have learned a lot about how organisms pass on their genes through reproduction. Read and annotate the "Invasion of the Periodical Cicada" article to learn more about a unique organism called the cicada and how it increases its chances of reproducing successfully. Then, answer the questions below.

What are two reasons why arriving above ground all at once increases the cicadas' chances of surviving and reproducing?

_____

_____

_____

Why do scientists think it is helpful to the periodical cicadas to emerge every 13 to 17 years?

_____

_____

_____

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Periodical cicadas spend most of their lives underground.

Invasion of the Periodical Cicadas

It sounds like a scary movie: millions of insects spend years maturing underground, only to climb up to the surface and invade a town or city practically overnight. They have buzzing wings and orange eyes. They fly around and settle in the trees, singing a loud, rattling song. A few weeks later, they all die, leaving bug bodies all over the ground. Years later, their children appear and repeat the process.

It sounds like a movie, but it isn't—it really happens in certain parts of the United States. The invading insects are cicadas (si-KAY-dahs), flying insects known for the loud, rattling sound the males make when they try to attract females. Cicadas spend most of their lives underground, but they emerge by the millions at certain times and in certain places to find mates, reproduce, and die.

There are many species of cicada. Some have one-year life spans: they mature for one year, come above ground to reproduce, then die. Others are known as periodical cicadas—they live underground for many years before it's time to come above ground. They are called "periodical" because they appear above ground periodically, or on a predictable schedule. Periodical cicadas come up once every 13 or 17 years to mate. Because some of them live at least 17 years, they may be the longest-living insects on Earth!

Arriving above ground all at once is good for the cicada species for two reasons. When there are millions of cicadas all looking for mates at the same time and in the same place, the odds of successful reproduction are much better. This means there will be a new generation of cicadas that will arrive above ground in another 13 or 17 years, like their parents. Cicadas aren't the only species that meet up at certain places and

times to reproduce: lots of species increase their odds of finding a mate by reproducing this way.

At the same time, having many cicadas above ground at once is a way of protecting the whole species from predators. When they appear, some cicadas will be eaten—but there are so many cicadas around that predators can't possibly eat all of them. Most of the cicadas survive and reproduce successfully. This strategy is bad for the cicadas that do get eaten, but it's a good way to keep the whole species going.

Why do the periodical cicadas emerge every 13 or 17 years? According to scientists, this long, odd-numbered life cycle is a way of avoiding predators with shorter, more regular life cycles. The populations of some bird species rise and fall every few years, so there are certain years where there are more birds around. If periodical cicadas were to appear more often, their mating time would be more likely to match up with the years where their predator populations were strong, causing more cicadas to be eaten. However, 13- and 17-year cycles don't really match up with any other species' cycles. Showing up in years where their predators are less common means fewer cicadas are eaten, and the new generation of cicadas can rise by the millions in another 13 or 17 years.

Name: Tuesday Date: _____

Warm-Up

In this unit, you have been investigating the following question: *Why do traits for silk flexibility vary within this family of Darwin's bark spiders?*

Review claim 2, which is listed below. This claim provides one possible response to this question.

Claim 2: The offspring's traits depend on **which parent the offspring inherited more copies of genes from.**

Do you agree or disagree with this claim? (circle one)

a. **agree**

b. **disagree**

Explain why you either agree or disagree with the claim. Use what you have learned about genes and inheritance to explain your thinking.

_____

_____

_____

_____

_____

_____

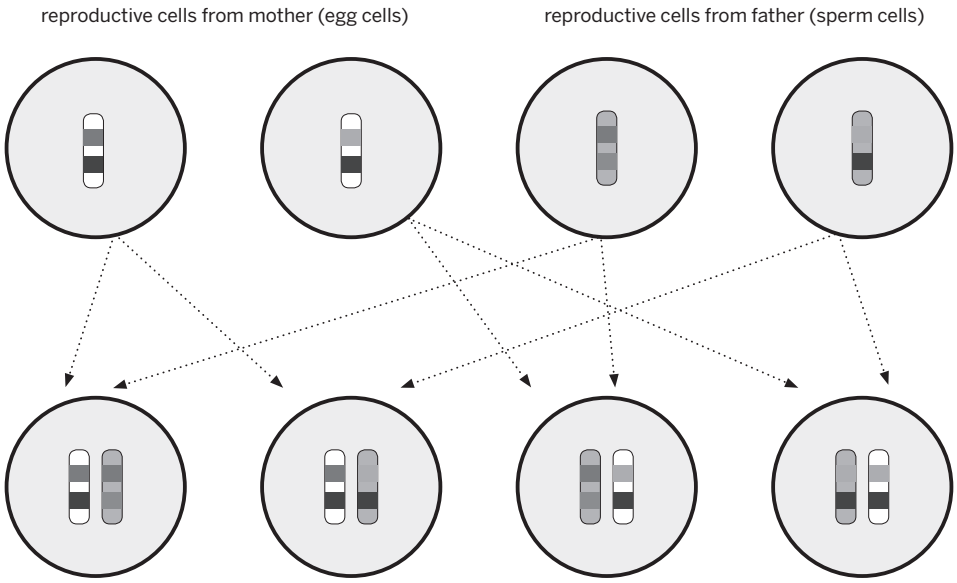
Name: _____ Date: _____

Second Read of "Why Are Identical Twins Rare?

You are investigating the question: *How do organisms get their genes?*

- Read and annotate the second two paragraphs of the "How We Get Our Genes" section of the "Why Are Identical Twins Rare?" article. Identify evidence that helps you answer the above question.
- Review the Sexual Reproduction diagram from the article (included below). Annotate the image.

Sexual Reproduction
Possible Reproductive Cell Combinations



cells of different possible offspring, each with a different combination of genes

Name: Wednesday Date: _____

Homework: Reading "Why the Corpse Flower Smells So Bad"

You have been learning about how spiders pass on their traits through reproduction, but what about plants? Read and annotate the "Why the Corpse Flower Smells So Bad" article to learn more about a unique organism called the corpse flower. Then, answer the questions below.

Why does the corpse flower smell so bad?

_____

_____

_____

Why does the corpse flower need to attract insects to reproduce?

_____

_____

_____

What is another plant adaptation that helps a plant reproduce?

_____

_____

_____

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
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4. After you read, discuss what you have read with others to help you better understand the text.

Why the Corpse Flower Smells So Bad

Sending out a terrible smell may not seem like the best way to increase your chance of reproducing. However, it's a very successful adaptation for the plant *Amorphophallus titanum*, or corpse flower.

Rotting meat smells awful to humans, but that same odor smells like a good meal to insects that eat rotting meat, like flesh flies and carrion beetles. In order to attract these insects, the corpse flower releases a powerful smell of decay. In addition, the plant has structures that increase reproductive success. For example, the petal of its flower is a deep red that's similar to the color of meat, and at the peak of its reproduction process, it gets warm, like a piece of rotting meat would be. All of these adaptations help the corpse flower attract insects that feed on decaying meat. By tricking insects into landing on it, the flower increases its odds of reproducing successfully.

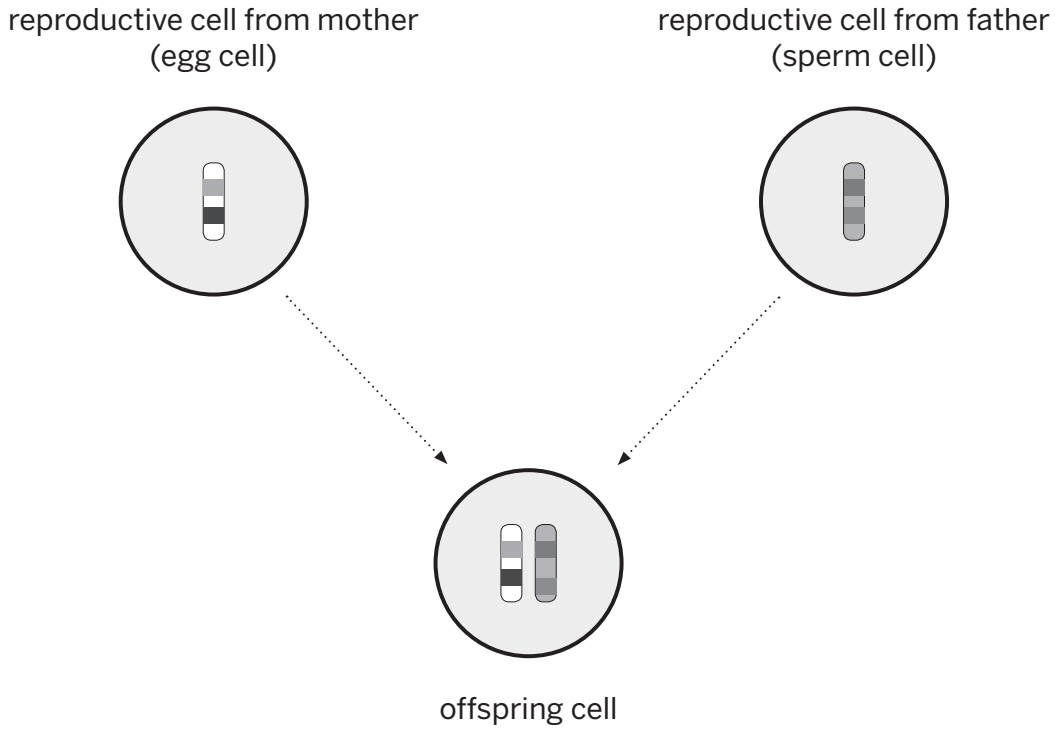
Why does the corpse flower need to attract insects to reproduce? Flowering plants can't reproduce on their own: they need the pollen produced by their flowers to be moved from one plant to another, and they need animals to do the moving. This process is called pollination. Most plants are pollinated by bees, butterflies, moths, or bats. To make pollination more likely, some plants put out smells that attract the type of animal most likely to pollinate them—a sweet smell to attract bees, for example. In the case of the corpse flower, a rotting-meat smell attracts flies and beetles to help with pollination. More insects mean more chances to reproduce.

When it blooms, the corpse flower can reach six feet tall.

Many plants have structures and behaviors that increase their odds of reproducing.. In fact, that's why flowers have scents and colors in the first place—to attract a variety of pollinators. Other plants have structures like seeds that catch the wind or stick to animals passing by, which helps them come into contact with new environments. These adaptations all arose from random mutations in the plants' genes. Even though they were random, these particular mutations happened to help individual organisms reproduce and pass their genes on, and so the genes became more common in the population. So smelling like rotting meat might not be a great strategy for humans—but for the corpse flower, it's just the right thing.

Name: _____ Date: _____

Warm-Up



Word Bank

genes	inherit	offspring	parent

Use the diagram to explain how the offspring receives two copies of each gene. Refer to the word bank above when writing your response.

_____

_____

_____

_____

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_____

Name: _____ Date: _____

Homework: Revisiting the Anticipation Guide

Review your original response to this statement from the Anticipation Guide on page 6:

An offspring cannot have a trait if neither of its parents have it.

Do you agree or disagree with this statement now? What evidence supports your ideas about the statement?

_____

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Name: Thursday Date: _____

Homework: Reading "Sea Anemones: Two Ways to Reproduce"

You have learned a lot about gene inheritance through sexual reproduction. Read and annotate the "Sea Anemones: Two Ways to Reproduce" article to learn more about a unique organism called the sea anemone. Then, answer the questions below.

How is asexual reproduction different from sexual reproduction?

_____

_____

_____

How does a sea anemone reproduce asexually?

_____

_____

_____

Why doesn't asexual reproduction result in variation among offspring and parents?

_____

_____

_____

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Sea anemones are animals that attach themselves to the sea floor.

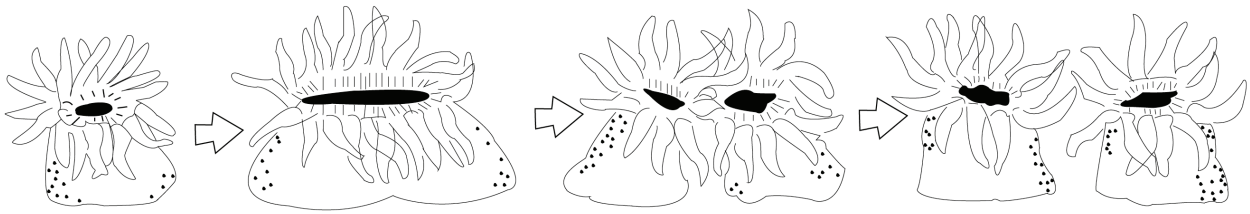
Sea Anemones: Two Ways to Reproduce

Can you split yourself in half to create a new you? You could if you were an aggregating sea anemone (ah-NEH-muh-nee). Sea anemones are animals that attach themselves to the sea floor. Most sea anemones have a thick stalk with finger-like parts at the top. They look a bit like plants growing out of the bottom of the ocean, but they are actually animals that eat tiny organisms they find floating in the water.

Splitting in half is a kind of asexual reproduction. Aggregating sea anemones can reproduce in two ways: through asexual reproduction and sexual reproduction. Either way, the end result is a new offspring sea anemone, so what difference does it make which way they reproduce?

Actually, it makes a big difference. When a sea anemone reproduces asexually, the offspring anemone is identical to the parent anemone, with exactly the same traits. However, when anemones reproduce sexually, the offspring are similar to their parents, but not exactly the same. Offspring produced through sexual reproduction will have variations from their parents—differences in their traits that could make a big difference to their survival.

To understand the difference between sexual reproduction and asexual reproduction, we need to get down to the level of cells. All living



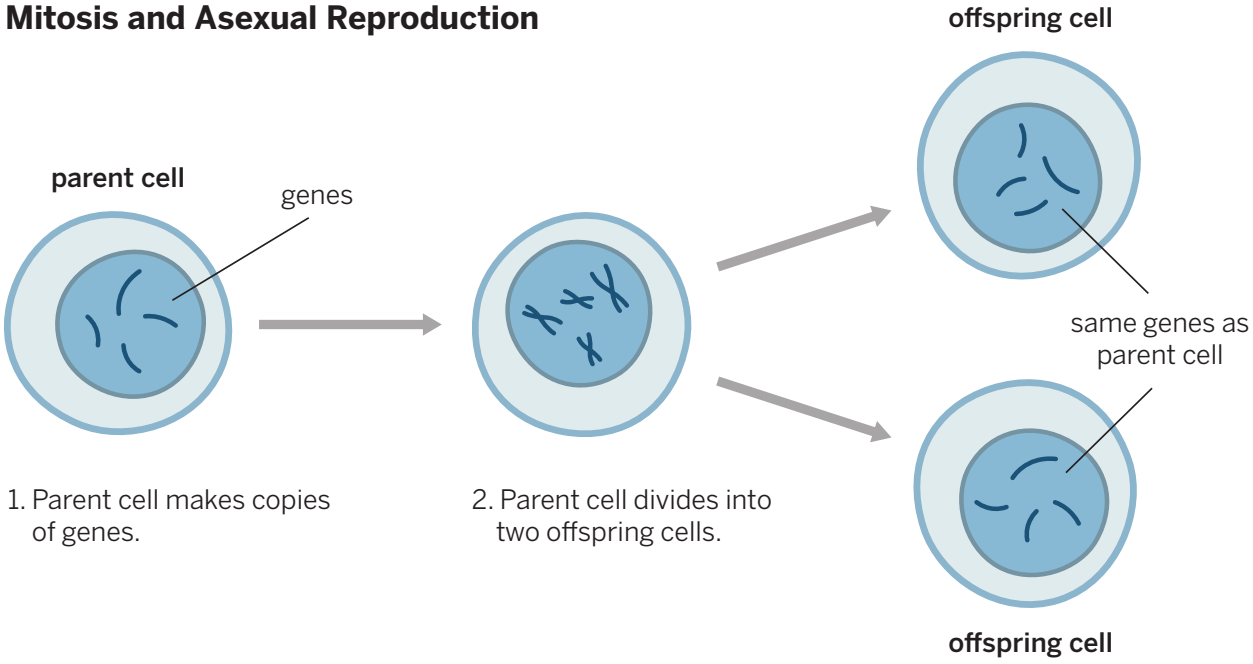
Aggregating sea anemones can reproduce asexually by splitting in half.

things are made of tiny cells—they are the basic building blocks of life, and they contain the genes that determine an organism's traits.

Asexual reproduction begins with a cell from the parent (you only need one parent for asexual reproduction!) dividing to become two cells. This kind of cell division is called mitosis (my-TOE-sis). Before it divides, the parent cell makes copies of the chromosomes that contain all its genes, so the new offspring cell contains a complete set of chromosomes (and genes) that are the same as the parent cell. This new offspring cell is what will develop to become the offspring organism. As the offspring organism grows, it will have the same traits as its parent organism because it has the same genes. Asexual reproduction is simple and convenient: the sea anemone doesn't even need to find a mate in order to reproduce.

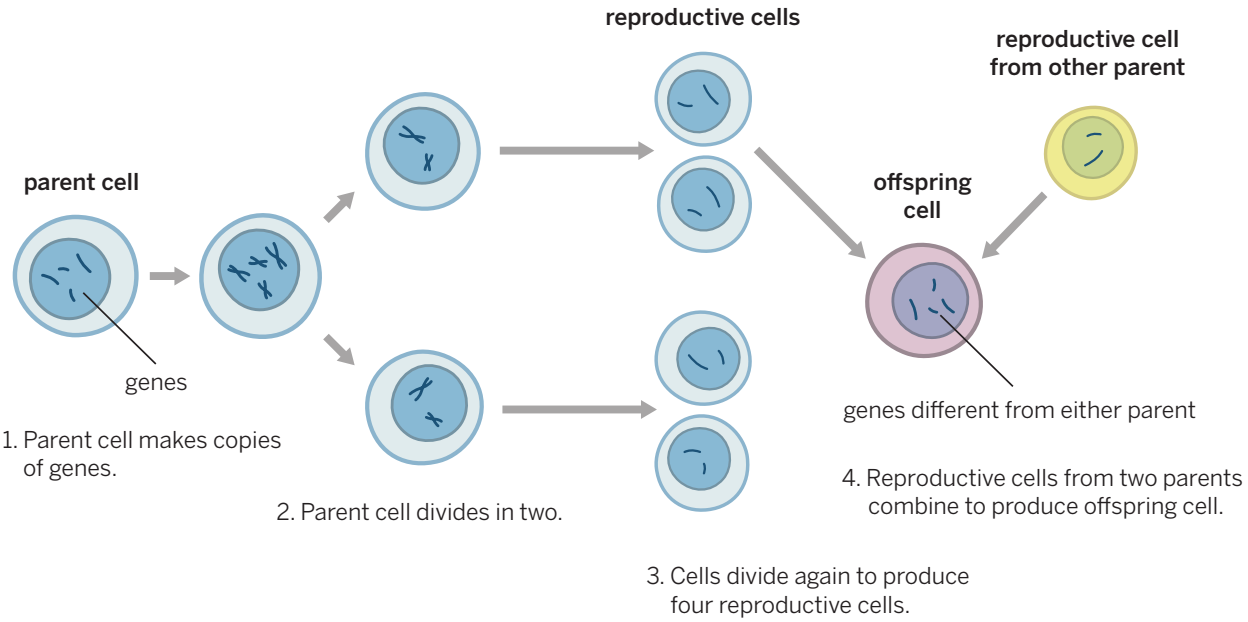
Sexual reproduction also begins with parent cells dividing, but the process is more complicated. For one thing, sexual reproduction requires two parent organisms instead of just one. In each parent organism, a cell copies its chromosomes and then divides in two—and then those two cells

Mitosis and Asexual Reproduction



Mitosis is one way that cells can divide in order to reproduce. Asexual reproduction involves mitosis.

Meiosis and Sexual Reproduction



Meiosis is another way that cells can divide in order to reproduce. Sexual reproduction involves meiosis.

divide in two again. This kind of cell division is called meiosis (my-OH-sis), and it results in four special reproductive cells from each parent. A reproductive cell only has half of the genetic information that an ordinary cell from the organism does.

After the reproductive cells have formed, there's still one more step to sexual reproduction. In a process called fertilization, two reproductive cells—one from each parent—come together to form a new offspring cell. This new offspring cell is what will develop to become the offspring organism. That new offspring has a full set of genes: half the genes came from one parent, and the other half came from the other parent.

Because the offspring gets half its genes from one parent and half from the other, its cells have a unique combination of genes, different from either one of its parents. With a new combination of genes, the offspring will also have a new combination of traits. As it grows, the offspring organism will be similar to its parents, but it won't be exactly the same as either one of its parents.

Sexual reproduction helps produce variation in the traits of the organisms in a population, and variation is important because different traits may be helpful to survival in different conditions. That's why many organisms that can reproduce asexually (like aggregating sea anemones) also reproduce sexually.

Name: Friday Date: _____

Warm-Up

To: Student Researchers
From: Dr. Ada Sattari, Lead Scientist at Bay Medical Company
Subject: Gene Versions

BAY MEDICAL COMPANY

Our scientists have identified the gene versions for silk flexibility in the parents of the Darwin's bark spiders. We have submitted a diagram of the results for you to review. These genes are existing genes, common in this spider species.

We hope this information will help you with your research as you study why the spiders have different traits for silk flexibility.

Traits for Silk Flexibility in the Spider Family

Parent 1: Male
low silk flexibility
F1 F3

Parent 2: Female
medium silk flexibility
F1 F2

Offspring A: Male
low silk flexibility
F1 F1

Offspring B: Female
medium silk flexibility
F1 F2

Offspring C: Male
low silk flexibility
F1 F1

Offspring D: Female
high silk flexibility
F2 F3

Name: _____ Date: _____

Warm-Up (continued)

Do you think the new evidence supports or refutes **Claim 1:** The offspring have mutations that affect their traits?

_____

_____

_____

_____

_____

_____

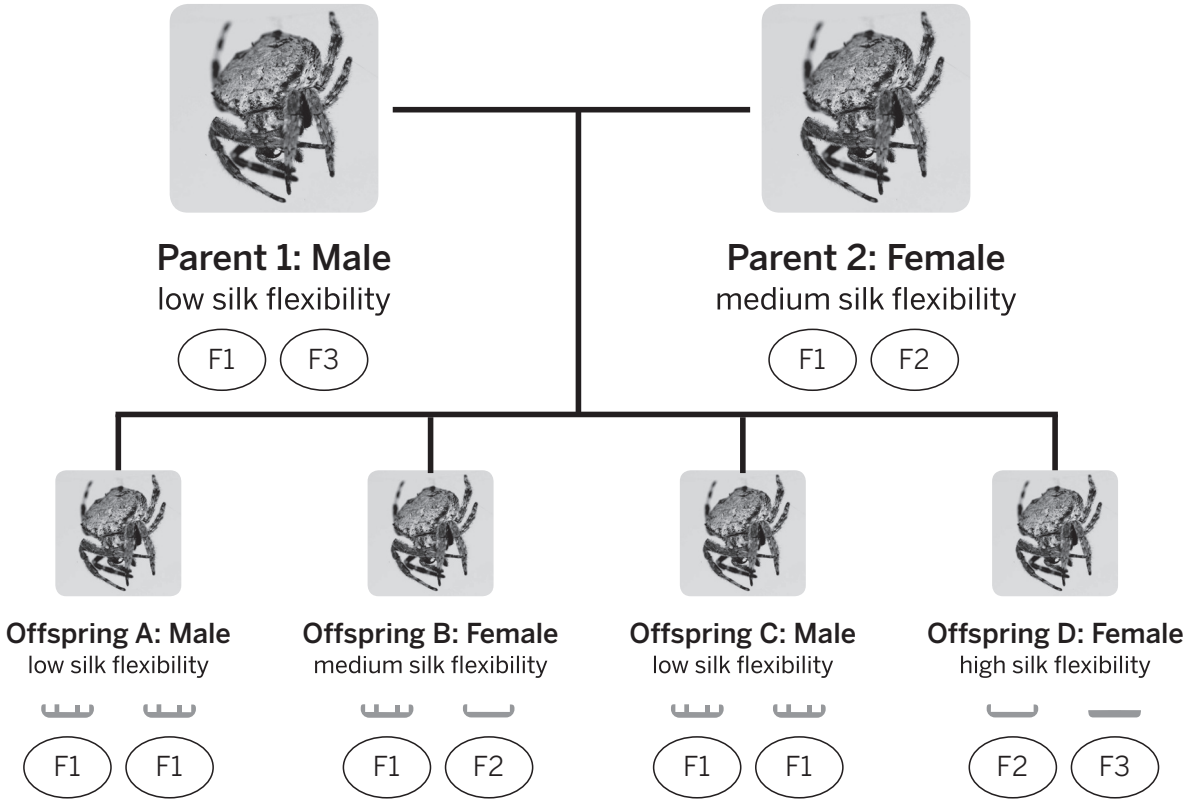
Name: _____ Date: _____

Reasoning About Spider Traits

Dr. Sattari hopes you will share your research about why the Darwin's bark spiders have varying traits for silk flexibility. Follow the steps below, using the new evidence about the parents' gene versions to support or refute the remaining claims.

1. Review the diagram carefully, paying special attention to the spiders' combinations of gene versions.
2. Read the evidence included in the first column of the Reasoning Tool.
3. In the last column, list which claim you think the evidence supports or refutes.
4. In the middle column, explain why the evidence matters or how it supports or refutes the claim you selected.

Traits for Silk Flexibility in the Spider Family



Name: _____ Date: _____

Reasoning About Spider Traits (continued)

Reasoning Tool

Why do traits for silk flexibility vary within this family of Darwin's bark spiders?

Claim 1: The offspring have mutations that affect their traits.

Claim 3: Offspring inherit different combinations of gene versions from their parents.

Evidence	**This evidence matters because. . .** (How does this support or refute the claim?)	**Therefore, . . .** (claim)
None of the spider offspring have a new gene version (a gene version not found in either parent).		
The male parent has F1F3 gene versions while the female parent has F1F2 gene versions. Offspring D has F2F3 gene versions and has the trait for high silk flexibility. This is a trait that neither parent has.		