# GRADE 6 SCIENCE EOT TERM 3-2023/24

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| Paper part - الأسئلة المقالية | 1 | Calculate the relationship (ratio) for two traits in plants and animals<br>Differentiate between dominant trait and recessive trait and apply it on examples |
| | 2 | Compare between types of reproduction (sexual and asexual) in hydra and plants |
| | 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading |
| | 4 | List the cause-and-effect relationships between human activities and the environmental impacts on land |
| | 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone |

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|---|---|---|---|
| 1 | Calculate the relationship (ratio) for two traits in plants and animals<br>Differentiate between dominant trait and recessive trait and apply it on examples | Textbook, figures, lab, investigations | 13, 18, 20,<br>14, 15 |

**Reappearing Traits** As you observed, some of the offspring had white flowers, even though both parents had purple flowers. The results were similar each time Mendel cross-pollinated two purple-flowering hybrid plants. The trait that had disappeared in the first generation always reappeared in the second generation.

Did the same result happen when Mendel cross-pollinated pea plants for other traits? Let's find out.

## INVESTIGATION

### Look Both Ways Before Crossing the Seed

Mendel counted and recorded the traits of offspring from many experiments in which he cross-pollinated hybrid plants. Data from these experiments are shown below.

**Results of Hybrid Crosses**

| Characteristic of Hybrid Parent | Trait and Number of Offspring | Trait and Number of Offspring | Trait Comparison |
|---|---|---|---|
| Flower Color (purple x purple) | Purple 705 | White 224 | $\frac{705}{224} = \frac{3.15}{1}$ |
| Seed Color (yellow x yellow) | Yellow 6,022 | Green 2,001 | $\frac{6,022}{2,001} = \frac{3.01}{1}$ |
| Seed Shape (round x round) | Round 5474 | Wrinkled 1,850 | $\frac{5474}{1,850} = \frac{2.96}{1}$ |
| Pod Shape (smooth x smooth) | Smooth 882 | Bumpy 299 | $\frac{882}{299} = \frac{2.95}{1}$ |

1. **MATH Connection** Calculate the relationship of purple to white flowers, yellow to green seeds, round to wrinkled seeds, and smooth to bumpy pods by dividing the higher number by the lower number. Record the answers in the table above.

2. What patterns do you notice in Mendel's data?

Students should notice that in each comparison, one trait is seen approximately three times more often than the other.

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# How can you predict what offspring will look like?

Have you ever flipped a coin and guessed heads or tails? Because a coin has two sides, there are only two possible outcomes—heads or tails. You have a 50 percent chance of getting heads and a 50 percent chance of getting tails. The ratio comparing 50 heads to 50 tails can be written 50 to 50 or 50 : 50, or simplified, 1 : 1.

**MATH Connection** A ratio is a comparison of two numbers or quantities by division. For example, the ratio comparing 6,022 yellow seeds to 2,001 green seeds can be written as follows:

6,022 to 2,001 or

6,022 : 2,001 or

$\frac{6,022}{2,001}$

To simplify the ratio, divide the first number by the second number.

$$\frac{6,022}{2,001} = \frac{3}{1} \text{ or } 3:1$$

Given a 3 : 1 ratio, you can expect that an offspring from heterozygous parents has a 3 : 1 chance of having yellow seeds. But you cannot expect that a group of four seeds will have three yellow seeds and one green seed. This is because one offspring does not affect the phenotype of another offspring. In a similar way, the outcome of one coin toss does not affect the outcome of other coin tosses.

**THREE-DIMENSIONAL THINKING**

A cross between two heterozygous pea plants with yellow seeds produced 1,719 yellow seeds and 573 green seeds. What is the ratio of yellow to green seeds? **Construct an explanation** about what the results show regarding inheritance.

The ratio of yellow seeds to green seeds is 3 : 1. These results show that an offspring from heterozygous parents has a 3 : 1 chance of having yellow seeds compared to having green seeds. The results show that yellow seeds are a dominant trait and green seeds are a recessive trait.

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|---|---|---|---|
| 1 | Calculate the relationship (ratio) for two traits in plants and animals<br>Differentiate between dominant trait and recessive trait and apply it on examples | Textbook, figures, lab, investigations | 13, 18, 20,<br>14, 15 |

| Results of Hybrid Crosses | | | |
|---|---|---|---|
| Characteristic of Hybrid Parent | Trait and Number of Offspring | Trait and Number of Offspring | Trait Comparison |
| Flower Color (purple x purple) | Purple 705 | White 224 | $\frac{705}{224} = \frac{\square}{1}$ |
| Seed Color (yellow x yellow) | Yellow 6,022 | Green 2,001 | $\frac{6,002}{2,001} = \frac{\square}{1}$ |
| Seed Shape (round x round) | Round 5,474 | Wrinkled 1,850 | $\frac{5,474}{1,850} = \frac{\square}{1}$ |
| Pod Shape (smooth x smooth) | Smooth 882 | Bumpy 299 | $\frac{882}{299} = \frac{\square}{1}$ |

What is the ratio of the offspring in all crossings?

.....

2.b Across between two heterozygous pea plants with round seed produced 5,474 round seeds and 1,850 wrinkled seeds. What is the ratio of round to wrinkled seeds?

- The ratio in hybrid crossing should be always 3:1
- Dominant trait will be three times the recessive trait.

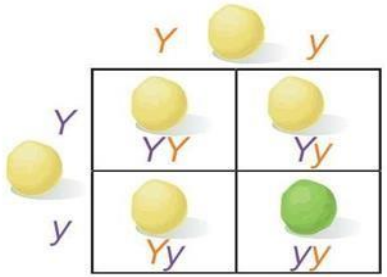
Observe the table and find out the dominant traits .

Circle the dominant trait

| Flower color | Purple | White |
|---|---|---|
| Seed color | Yellow | Green |
| Seed shape | Round | Wrinkled |
| Pod shape | Smooth | Bumpy |

| | | | |
|---|---|---|---|
| 1 | Calculate the relationship (ratio) for two traits in plants and animals<br>Differentiate between dominant trait and recessive trait and apply it on examples | Textbook, figures, lab, investigations | 13, 18, 20,<br>14, 15 |

So, how did you do? Your completed Punnett square should look like this:




Geneticists, or scientists who study genetics, use Punnett squares to explain how traits are inherited from one generation to the next. Now that you know how to fill in a Punnett square, use the Punnett square below to predict the offspring of two fruit flies with different genotypes.

## INVESTIGATION

### Fruit Fly Traits

Curly wings (CC)

**1.** Use the Punnett square below to complete a cross between a female fruit fly with straight wings (cc) and a male fruit fly with curly wings (CC).

Straight wings (cc)

| | C | C |
|---|---|---|
| c | Cc | Cc |
| c | Cc | Cc |

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**2.** According to your Punnett square, which genotypes are possible in the offspring?

The only possible genotype is Cc. All offspring will be hybrids.



**Q3.** Use the punnett square below to complete a cross between a female fruit fly with straight wings (bb) and a male fruit fly with curly wings (BB)

Straight Wings bb

Curly Wings BB

| |
|---|
| 3a. what phenotypes are possible for the offspring of the cross? |
| 3b. what are the genotypes of the offspring? |
| 3c. what is the ratio of offspring that will have curly wings to straight wings? |

| | | | |
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**A Similar Relationship** From the data of crosses between hybrid plants with purple flowers, Mendel found that the relationship of purple flowers to white flowers was about 3 to 1. This means purple-flowering pea plants grew from this cross three times more often than white-flowering pea plants grew from the cross. He calculated similar relationships for all traits he tested.

**Dominant and Recessive Traits** Recall that when Mendel cross-pollinated a true-breeding plant with purple flowers and another with white flowers, the hybrid offspring had only purple flowers. Mendel hypothesized that the hybrid offspring had one genetic factor for purple flowers and one genetic factor for white flowers.

Mendel also hypothesized that the purple factor is the only factor seen or expressed because it blocks the white factor. A genetic factor that blocks another genetic factor is called a **dominant** (DAH muh nunt) **trait.** A genetic factor that is blocked by the presence of a dominant factor is called a **recessive** (rih SE sihv) **trait.**

A dominant trait, such as purple pea flowers, is observed when offspring have either one or two dominant factors.

A recessive trait, such as white pea flowers, is observed only when two recessive genetic factors are present in offspring.

## COLLECT EVIDENCE

What did Mendel's experiments show about how the traits of offspring, such as those of the kittens, are inherited? Record your evidence (A) in the chart at the beginning of the lesson.

**THREE-DIMENSIONAL THINKING**

Now that you have learned about dominant and recessive traits, take a look back at the table on the previous page. **Construct an explanation** for which seed color is the dominant trait.

Answers may vary. Sample answer: The yellow seed color is the dominant trait. Like the purple flowers and white flowers, the yellow seeds show up approximately three times more often than the green seeds. Just like purple flowers are the dominant trait, the yellow seeds are the dominant trait because they occur three times to every one green seed.

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| Dominant trait | Recessive trait |
|---|---|
| i)The trait which appears in the $F_1$progeny, is dominant. | i) the trait which remains hidden or which does not appear in the $F_1$ progeny is the recessive trait. |
| ii) It appears in more numbers . | ii) It appears in less number. |

**I. Match the keywords to the correct description**

| | |
|---|---|
| **Heredity** | **Study of heredity/inheritance** |
| **Genetics** | **A trait that is always expressed** |
| **Dominant trait** | **A trait that can be hidden** |
| **Self-fertilization** | **Passing of traits in a generation** |
| **Recessive trait** | **The pollen is transferred from the male to female organ within the same flower** |

| | | | |
|---|---|---|---|
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# What controls traits?

When other scientists studied the parts of a cell and combined Mendel's work with their work, Mendel's factors were more clearly understood. Scientists discovered that inside each cell is a nucleus that contains threadlike structures called chromosomes. Over time, scientists learned that chromosomes contain genetic information that controls traits. We now know that Mendel's "factors" are parts of chromosomes and that each cell in offspring contains chromosomes from both parents. These chromosomes exist as pairs—one chromosome from each parent.

Scientists have discovered that each chromosome can have information about hundreds or even thousands of traits.

- A **gene** (JEEN) is a section on a chromosome that has genetic information for one trait. The genes on each chromosome can be the same or different, such as purple or white for pea flower color.
- The different forms of a gene are called **alleles** (uh LEELs).
- The two alleles that control the phenotype of a trait are called the trait's **genotype.**

Scientists use symbols to represent the alleles in a genotype, as shown in the table below. In genetics, uppercase letters represent dominant alleles and lowercase letters represent recessive alleles. The table shows the possible genotypes for both round and wrinkled seeds phenotypes.

| Phenotype and Genotype | | | |
|---|---|---|---|
| **Phenotypes (observed traits)** | Round | | Wrinkled |
| **Genotypes (alleles of a gene)** | Homozygous dominant (*RR*) | Heterozygous (*Rr*) | Homozygous recessive (*rr*) |

A round seed can have two genotypes—*RR* and *Rr*. Both genotypes have a round phenotype. A wrinkled seed can have only one genotype—*rr*.

- When the two alleles of a gene are the same, its genotype is **homozygous.**
- Both *RR* and *rr* are homozygous genotypes.
- If the two alleles of a gene are different, its genotype is **heterozygous.**
- *Rr* is a heterozygous genotype.

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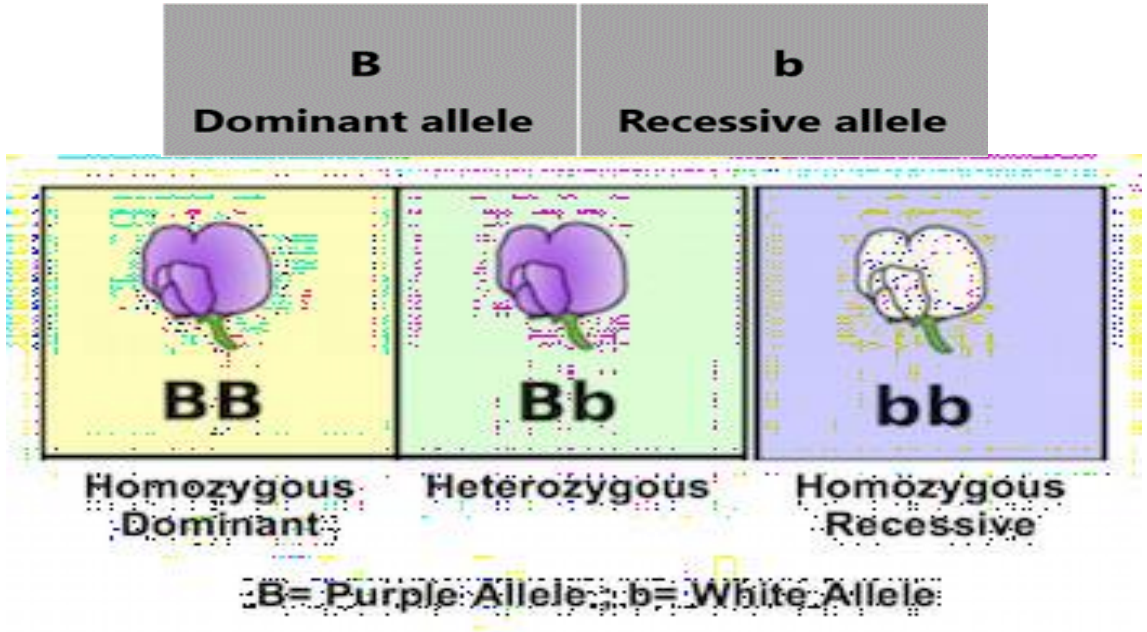



2. If you know that round is dominant trait and wrinkled is recessive complete the following table:

| Phenotype and Genotype | | | |
|---|---|---|---|
| Phenotypes (observed traits) | | Round | Wrinkled |
| Genotypes (alleles of a gene) | | | |

Homozygous

Heterozygous

RR

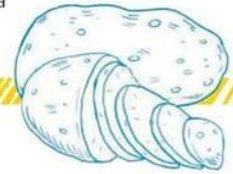
Rr

rr

| | | | |
|---|---|---|---|
| 2 | Compare between types of reproduction (sexual and asexual) in hydra and plants | Textbook, figures, table, investigation | 32, 33, 35, 36 |

# How can one organism make more organisms?

You learned about many sea stars appearing when they were thought to have been removed from the environment. How is it possible that the sea stars increased their numbers after they had been chopped up?



## INVESTIGATION

### Plant Progeny

Observe two plants—a seed potato and a coleus stem—in glasses of water. Look at photos of the plants when they were first placed in water. Draw a detailed diagram of each of the glasses in your Science Notebook. Observe the plants a week after placement in the water and write down your observations in your Science Notebook.

**1.** How did the potato and the coleus plant change after one week?

Students should observe the changes that occurred with the plants. The two plants should have outgrowths.

**2.** How do you think that this relates to the sea stars you heard about in the introduction to this lesson?

Answers may vary. Sample answer: Both were able to make copies of themselves.

**Asexual Reproduction** Recall in the beginning of the lesson you read about sea stars reproducing after being cut up. This happened through regeneration. **Regeneration** occurs when an offspring grows from a piece of its parent. Just like sea stars, some plants don't need seeds to make new plants. Some plants can be grown from a leaf, a stem, or another plant part through vegetative reproduction. **Vegetative reproduction** is a form of asexual reproduction in which offspring grow from a part of a parent plant. **Asexual reproduction** occurs when only one parent organism or part of that organism produces a new organism. The new organism is genetically identical to the parent.

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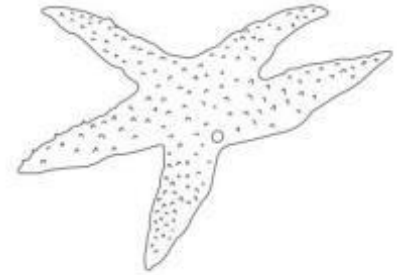
**Want more information?**
Go online to read more about the different types of reproduction.

**FOLDABLES**
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.





Type_____

Examples_____

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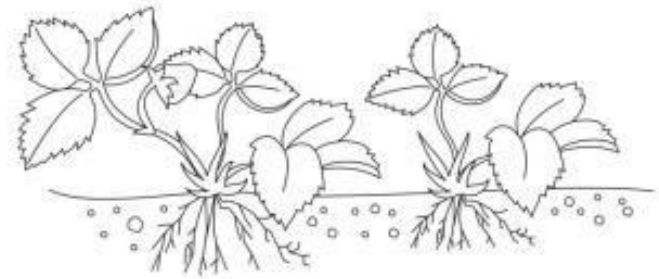


6. Type_____

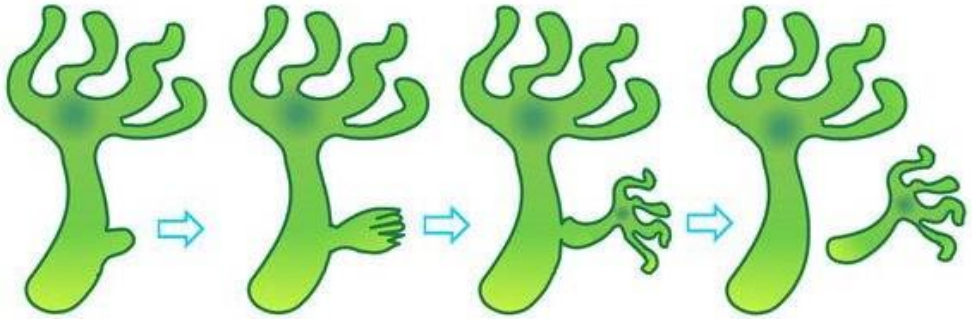
Examples_____

_____

| | | | |
|---|---|---|---|
| 2 | Compare between types of reproduction (sexual and asexual) in hydra and plants | Textbook, figures, table, investigation | 32, 33, 35, 36 |

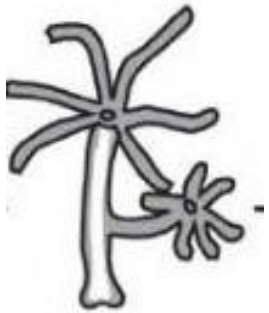
# Hydra

## Asexual Reproduction- Budding



Hydra reproduces by budding using the regenerative cells

Genetically similar Hydra



Type_____

Examples_____

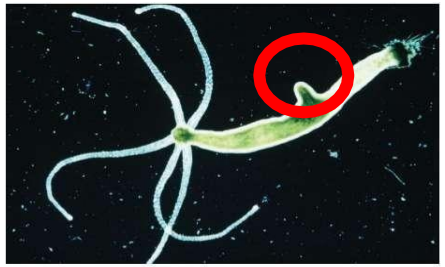
_____

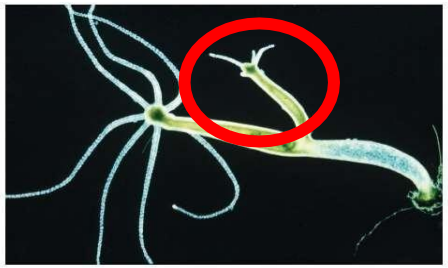
# How do other organisms reproduce asexually?

You just discovered asexual reproduction in plants. Different types of plants, animals, and other organisms can reproduce asexually. However, not all asexually reproducing organisms follow the same type of reproduction. Take a look at the hydra below to see how it reproduces.

## INVESTIGATION

### Break Off a Piece





**1.** Examine the pictures of the hydra above. What evidence do you observe that the hydra reproduced?

Answers may vary. Sample answer: The hydra has a growth that appears to grow larger; it looks like itself in the second photo.

**2.** What are some advantages and disadvantages of this type of reproduction?

Answers may vary. Sample answer: It seems advantageous because it is easy to reproduce quickly. It may be disadvantageous as it may lead to too many individuals who are alike.

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The hydra seen in the photos is budding. **Budding** is a form of asexual reproduction where an organism grows on the body of its parent.

### COLLECT EVIDENCE

How can one organism such as the sea star produce offspring that are identical to itself? Record your evidence (A) in the chart at the beginning of the lesson.

| | | | |
|---|---|---|---|
| 2 | Compare between types of reproduction (sexual and asexual) in hydra and plants | Textbook, figures, table, investigation | 32, 33, 35, 36 |

### Analyze and Conclude

**6.** Compare your group's offspring to another group's offspring. What do you notice?

Sample answer: There were many different combinations.

**7.** Why do you think there are many different combinations of bead colors?

Sample answer: There were many different combinations because $\frac{1}{2}$ of the beads came from the female and $\frac{1}{2}$ from the male. Also, 3 beads were chosen from many different beads in each parent bag.

**8.** What caused any differences you observed? Explain.

Sample answer: The model offspring appeared different because they inherited different traits from their parents.

**9.** Why might this type of reproduction be beneficial to an organism?

Sample answer: The offspring would get genetic information from both parents, which would create variations. Variation within a species may allow organisms to adapt to environmental changes.

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You just modeled the genetic result of organisms reproducing by using two parents through sexual reproduction. **Sexual reproduction** is a type of reproduction in which the genetic materials from two different cells combine, producing offspring that are genetically different from their parents. In sexual reproduction, each parent contributes half of the genes aquired by the offspring. Offspring have two of each chromosome and therefore two alleles of each gene, one acquired from each parent.

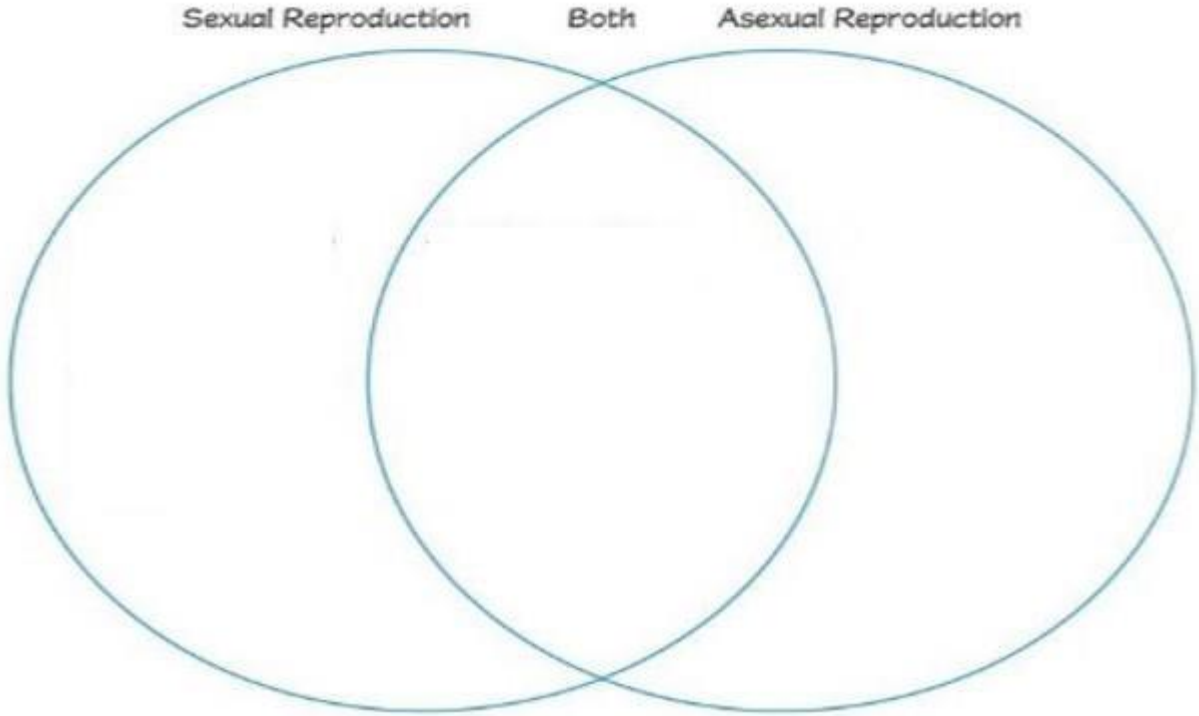
## COLLECT EVIDENCE

How can two organisms produce offspring that are not identical to themselves, unlike the sea star at the beginning of the lesson? Record your evidence (B) in the chart at the beginning of the lesson.



## Summarize It!

**1.** **Compare and contrast** asexual reproduction and sexual reproduction by filling in the Venn diagram below.



| | | | |
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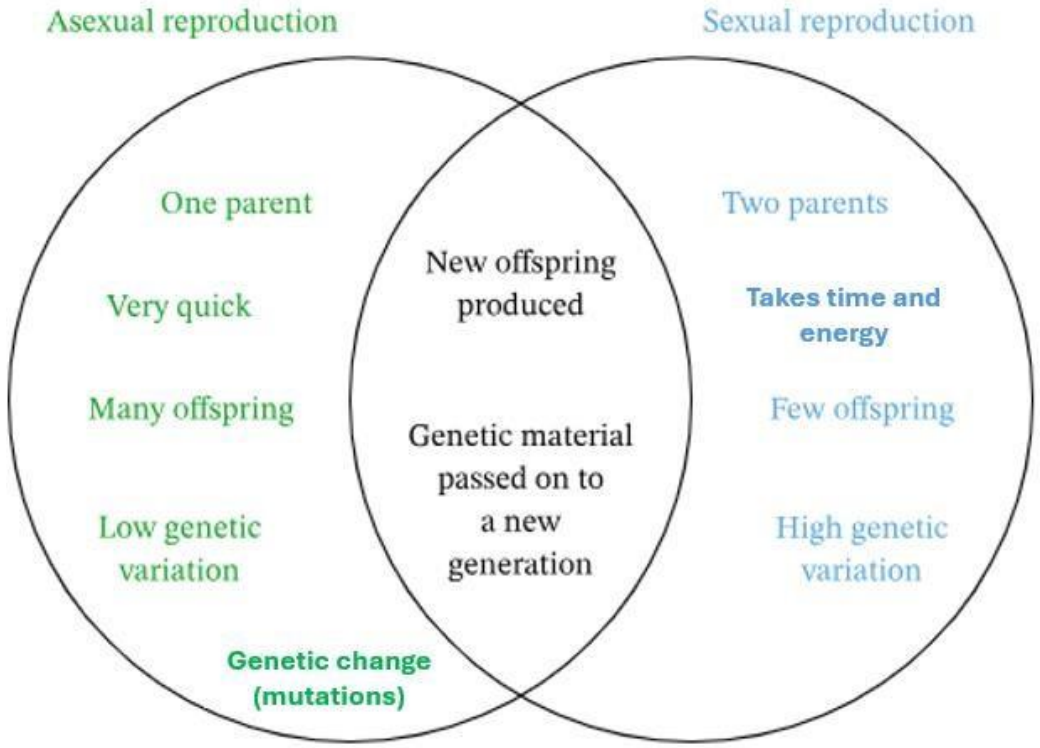


| Question | 5 |
|---|---|

A fatal disease is spreading through an aquarium containing both fish, which reproduce sexually, and sponges, which reproduce asexually. The disease has been identified in both species. Construct an explanation that states which species would be more likely to survive.

Fish, because fish reproduce sexually, two different parents and produce diverse offspring which helps them to survive.

# What are the advantages and disadvantages of sexual and asexual reproduction?

| | Asexual Reproduction | Sexual Reproduction |
|---|---|---|
| **Advantages** | Asexual reproduction enables organisms to reproduce without a mate. Searching for a mate takes time and energy. Asexual reproduction also enables some organisms to rapidly produce a large number of offspring. | Genetic variation occurs in all organisms that reproduce sexually. Due to genetic variation, individuals within a population have slight differences, which might be an advantage if the environment changes. Some individuals might have traits that enable them to survive unusually harsh conditions such as a drought or severe cold. Other individuals might have traits that make them resistant to disease. |
| **Disadvantages** | Asexual reproduction results in little genetic variation within a population. Genetic variation can give organisms a better chance of surviving if the environment changes.<br><br>Another disadvantage of asexual reproduction involves genetic changes, called mutations. If an organism has a harmful mutation in its cells, the mutation will be passed to asexually reproduced offspring. This could affect the offspring's ability to survive. | Sexual reproduction takes time and energy. Organisms have to grow and develop until they are mature enough to produce sex cells. Then the organisms have to form sex cells—either eggs or sperm. Before they can reproduce, organisms usually have to find mates. Searching for a mate can take a long time and requires energy. The search for a mate might also expose individuals to predators, diseases, or harsh environmental conditions. |

**THREE-DIMENSIONAL THINKING**

A fatal disease is spreading through an aquarium containing both fish, which reproduce sexually, and sponges, which reproduce asexually. The disease has been identified in both species. **Construct an explanation** that states which species would be more likely to survive. Write your answer in your Science Notebook.

## COLLECT EVIDENCE

What are the advantages and disadvantages of the different types of reproduction, such as that of the sea star at the beginning of the lesson? Record your evidence (C) in the chart at the beginning of the lesson.



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| | | | |
|---|---|---|---|
| 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading | Textbook, table, organisers "summarize it" | 47, 51, 52, 58, 60, 62<br>75 |

**Courtship Behaviors** In the videos you observed animals engage in different behaviors in order to find a mate. A **behavior** is the way an organism reacts to other organisms or to its environment. The behaviors you observed in the videos are a form of communication. Animals attract mates by communicating in a variety of ways, including the use of sound, light, chemicals, and body language. Often times animals compete with others of the same species for a mate. Sometimes animals even bring gifts to each other in hopes of getting the attention of one another. What are some examples of these courtship behaviors? Let's investigate!

*These sandhill cranes are performing a courtship dance.*

## INVESTIGATION

### Show Off

In order to attract a mate, animals (most often males), frequently "show off" for the other sex. In this activity, your team will investigate an example of an animal reproductive strategy, focusing on external stimuli, sensory receptors, behavioral response, and memory.

1. With your team, choose one of the examples of an animal reproductive strategy provided by your teacher that you would like to investigate, or research and choose one of your own, and record it below.

Answers may vary. Sample answer: Our team will investigate bowerbirds. The males build elaborate structures and decorate them with sticks and other objects to attract a female.

2. READING Connection Use the spaces below to take notes as you conduct your research. Make sure that you use multiple print and digital sources and cite them in your Science Notebook using the format provided by your teacher. For each of the sources used, explain how you assessed its credibility, accuracy, and any possible bias, and cite specific evidence to show that the claims in the sources are supported.

*Stimuli:*

Answers may vary. Sample answer: The males provide visual stimuli by dancing and building structures called bowers out of sticks and other brightly-colored objects.

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A behavior is the way an organism reacts to other organisms or to its environment.

Courtship behavior is when an animal engages in different behaviors in order to find a mate.

Behaviors are a form of communication. Animals can communicate using sound, light, chemicals and body language.

Behaviors That Increase the Probability of Successful Reproduction

| Courtship | Protecting Young |
|---|---|
| Answers may vary. Sample answer: Animals engage in certain courtship behaviors, such as dancing, competing with others, and bringing gifts in order to attract a mate. | Answers may vary. Sample answer: Animals engage in certain behaviors in order to protect their eggs and their young. Some animals build nests and herd young in order to protect them. |

| 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading | Textbook, table, organisers "summarize it" | 47, 51, 52, 58, 60, 62<br>75 |
|---|---|---|---|

| Courtship behaviors examples | Picture (animals) |
|---|---|
| Competition: physical strength (Male mule deer)<br>become very aggressive | |
| Competition: display (Male frigate birds)<br>inflate their throat sacks | |
| Competition: display (Male Peacocks)<br>showing off their feathers. | |
| Release chemical (White Female gypsy moth)<br>Pheromones | |
| Behavior strategy: (Birds-frog)<br>mating songs | |
| Male Birds<br>a gift of food | |
| Male fiddler crabs<br>wave their enlarged claws | |
| Male bowerbirds<br>build elaborate nests | |
| Birds Sandhill cranes<br>Performing dance | |

Most animals have specialized behaviors that help them find and attract mates. Some examples of courtship behaviors are in the table below.

They often compete with members of the same species, either physically, or through displays, for a mate. Male mule deer, such as those shown to the right, become very aggressive towards each other when competing for a mate. Peacocks compete by showing off their feathers, and male frigate birds inflate their throat sacks when competing for mates.

Some animals, such as the white female gypsy moth shown to the right, release chemical substances called pheromones that attract males. Many moths and butterflies can detect these pheromones using their sense of smell from up to six miles away.

Other animals, such as birds and the frog shown to the right, use mating songs that gain the attention of mates. Some male birds bring the female a gift of food, such as a male tern bringing a fish to a female. Male fiddler crabs wave their enlarged claws and skitter across the ocean floor in the hopes of getting a female fiddler crab's attention. Male bowerbirds build elaborate nests using brightly colored objects during courtship.

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## COLLECT EVIDENCE

How do animals, such as the birds of paradise, find mates? Record your evidence (A) in the chart at the beginning of the lesson.

| | | | |
|---|---|---|---|
| 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading | Textbook, table, organisers "summarize it" | 47, 51, 52, 58, 60, 62<br>75 |

# How are young animals protected?

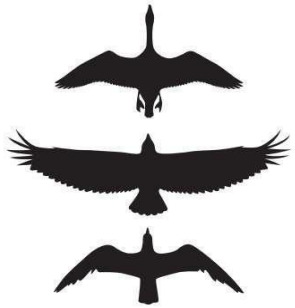
You've learned about courtship behaviors that increase the probability of finding a mate, but what are behaviors that increase the chance that offspring will survive after animals reproduce?

A Western gull and her chicks

## INVESTIGATION

### Staying Safe

When goslings, or baby geese, see a bird in the air that has a different wingspan or shape than the parent goose, they duck down.



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1. Look at the images of the three birds in flight. Describe the differences between each silhouette.

Answers may vary. Sample answer: The wingspans are different shapes and lengths. The necks and the beaks are also different.

2. Choose at least two characteristics that are different for each bird.

Anwers may vary. Sample answer: The lengths of the necks and the wingspans are different for each bird.

3. How could recognizing differences help a gosling survive?

Answers may vary. Sample answer: The gosling would duck upon seeing a predatory bird, thus becoming less visible to the predator.



**Protecting Offspring** Birds aren't the only animals that engage in nest building behaviors in order to protect their young. Some mammals, amphibians, fish, reptiles, and insects have the instinct to protect their eggs and their young, or even themselves, by building nests. Animals build different types of nests, or dens, out of a variety of materials for protection from predators and the environment.

Another example of a nurturing behavior is herding. Many animals herd their offspring to ensure the young animals are not left behind and are safe from predators. Elephants take turns watching over each other's babies so the mother can take breaks!

Some animals, such as musk oxen, circle their young with their horns facing out to protect them from predators. Bison form two circles around their young for protection—the females form a circle around the young, and males form a circle around the females.

A wild horse protecting its young

## COLLECT EVIDENCE

How are young animals, such as bird of paradise chicks, protected? Record your evidence (B) in the chart at the beginning of the lesson.

**Behaviors That Increase the Probability of Successful Reproduction**

| Courtship | Protecting Young |
|---|---|
| Answers may vary. Sample answer: Animals engage in certain courtship behaviors, such as dancing, competing with others, and bringing gifts in order to attract a mate. | Answers may vary. Sample answer: Animals engage in certain behaviors in order to protect their eggs and their young. Some animals build nests and herd young in order to protect them. |

| | | | |
|---|---|---|---|
| 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading | Textbook, table, organisers "summarize it" | 47, 51, 52, 58, 60, 62<br>75 |

# What factors affect how baby animals grow?

When baby birds hatch, will they all grow up to be the same? No, there are many factors that determine how animals will grow. Some of these factors are genetic—traits are inherited from the parents, and some factors are environmental—the animal's environment influences how it will grow. Can some factors be both genetic and environmental?

## INVESTIGATION

### Just Grow with It

In this activity, you and your team will explain how genetic and environmental factors influence the growth of an animal.

1. Choose an animal that you are somewhat familiar with (does anyone on your team have any pets?) to base your explanation on.

Answers may vary. Sample answer: Our group will focus on dogs.



1. **Genetic factors:**
   - Inherited from parents
   - Example: color of fur
2. **Environmental factors**
   Examples: obedience of a dog
3. **Genetic and environmental**
   Example: weight of the animal

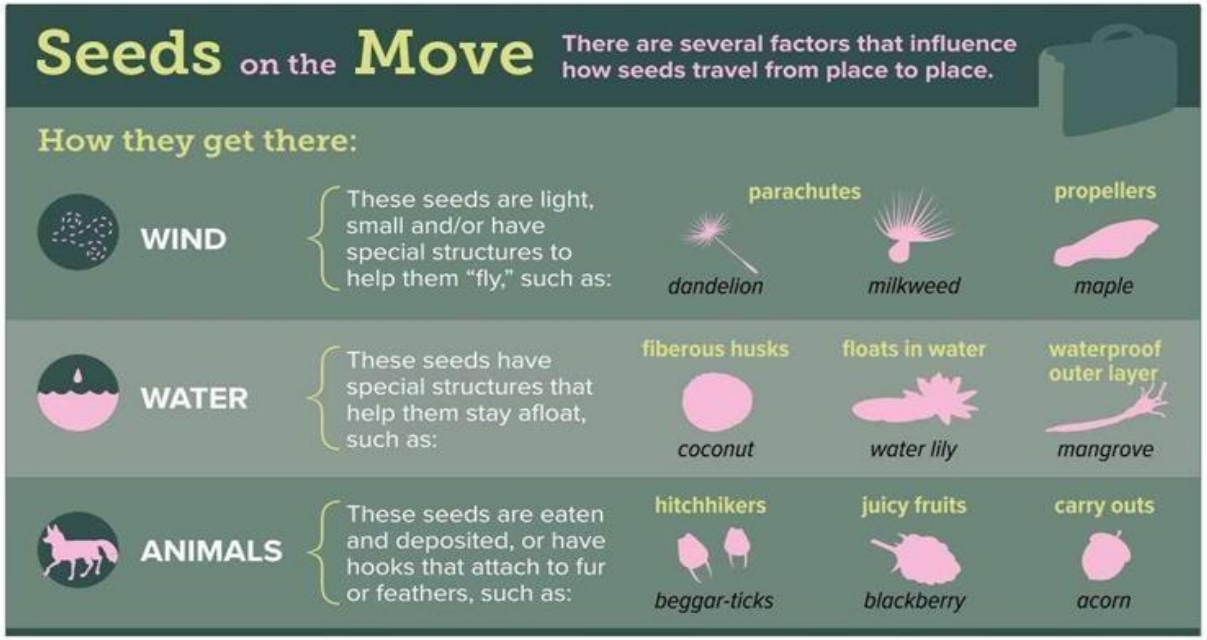
Factors That Affect the Growth of Young Animals

| Environmental Factors | Genetic Factors |
|---|---|
| Answers may vary. Sample answer: Environmental factors such as diet, exercise, availability of water and space, and interactions with other organisms determine how an animal will grow. | Answers may vary. Sample answer: Genetic factors such as hair color and eye color are passed down through the genes of the parents. |

4. Complete the graphic organizer below to determine causes and effects of the growth of your animal.

| Environmental Causes | Genetic Causes |
|---|---|
| Answers may vary. Sample answer: food availability, exercise, and diet | Answers may vary. Sample answer: traits of parents such as fur color |
| **Mechanisms (What processes lead to the effects?)** | **Mechanisms (What processes lead to the effects?)** |
| Answers may vary. Sample answer: interactions with others, routine, training | Answers may vary. Sample answer: genes are transferred from parents to offspring |
| **Effects** | **Effects** |
| Answers may vary. Sample answer: personality, ability to do tricks, muscle tone, weight | Answers may vary. Sample answer: color of fur and eyes, length of hair |

| | | | |
|---|---|---|---|
| 3 | Compare animal behaviours (courtship and protecting young) by giving examples, and between factors that affect the growth of young animals<br>Assign the factors (wind, water, animals) for seed spreading | Textbook, table, organisers "summarize it" | 47, 51, 52, 58, 60, 62<br>75 |




**15)** Match the type of dispersal with the seed description.

water _____ **A)** able to float, fibrous husks

wind _____ **B)** lightweight, parachute or propeller shape

animals _____ **C)** able to attach or contained in fruit

**Correct Answer**

water ⟷ able to float, fibrous husks

wind ⟷ lightweight, parachute or propeller shape

animals ⟷ able to attach or contained in fruit

## 9. Complete the following table :

| | | | | |
|---|---|---|---|---|
| *Animal* | *wind* | *water* | *light and small* | *can float* |
| *eaten and disposed* | *or* | *catch in the fur* | | |

| Way of seed dispersal | Properties | Example |
|---|---|---|
| | | |
| | | |
| | | |



**ASK:** What characteristics help a seed get dispersed by wind?
small size, light weight, structures that catch the wind

**ASK:** What characteristics help a seed get dispersed by water?
structures that help them float and protect them from water

**ASK:** What characteristics help a seed get dispersed by animals? hooks that attach to fur or feathers, ease of being carried, juicy fruits

| 4 | List the cause-and-effect relationships between human activities and the environmental impacts on land | Testbook, table, 3D | 22 |
|---|---|---|---|

**THREE-DIMENSIONAL THINKING**

Summarize your understanding of the **cause-and-effect** relationships between human activities and the environmental impacts on land in the table below.

| Type | Causes | Effects |
|---|---|---|
| Deforestation | needing land for living space, urban development, agriculture, and resources from trees | loss of biodiversity; decrease in soil quality; increase in carbon dioxide levels |
| Agriculture | As human populations grow, so does our need for food. | groundwater contamination from fertilizers; desertification; takes up space |
| Urbanization | Increase in population leads to the development of land for houses and other buildings. | increased flooding; habitat disruption; disappearance of wetlands |
| Waste Disposal | Increase in population means more waste produced. | landfills take up space; hazardous substances can leak into groundwater; increased pollution |

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## COLLECT EVIDENCE

What are the impacts of land usage? Record your evidence (A) in the chart at the beginning of the lesson.



**THREE-DIMENSIONAL THINKING**

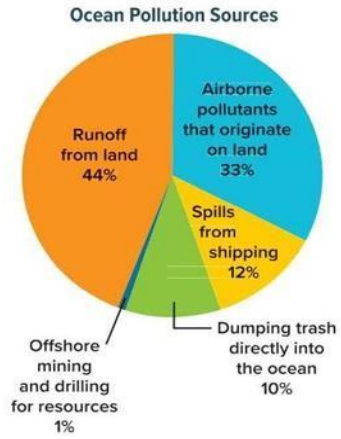
Summarize your understanding of the **cause-and-effect** relationships between human activities and the environmental impacts on land in the table below.

| Type | Causes | Effects |
|---|---|---|
| Deforestation | | |
| Agriculture | | |
| Urbanization | | |
| Waste Disposal | | |

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

**Ocean Pollution** Have you ever seen a photograph of a shorebird or seal covered with oil? Spills from oil tankers harm wildlife. They also harm the ocean. Any harm to the physical, chemical, or biological health of the ocean ecosystem is ocean pollution. Sometimes ocean pollution comes from a natural source, such as a volcanic eruption. More often, human activities cause ocean pollution.

The figure to the right shows the proportion of different sources of ocean pollution caused by humans. Notice that only 13 percent of this pollution comes from shipping or offshore mining activity. The rest comes from land. Land-based pollution includes garbage, hazardous waste, and fertilizers. Airborne pollution that originates on land, such as emissions from power plants or cars, is also included in this category. So is trash dumped directly into the oceans. Have you ever seen a turtle tangled in plastic? How did this happen?




# LAB Waves of Waste

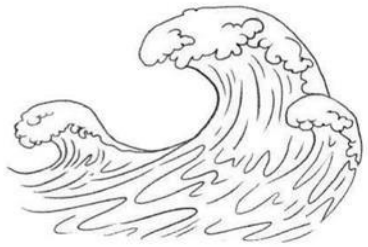
**Safety**

**Materials**

bowl

water

objects



**Procedure**

1. Read and complete a lab safety form.
2. Half-fill a large bowl with water.
3. Sprinkle the objects you have collected into the water.
4. Gently swirl the water in the bowl until the water moves at a constant speed. Try not to create a whirl pool.
5. Follow your teacher's instructions for proper clean up.

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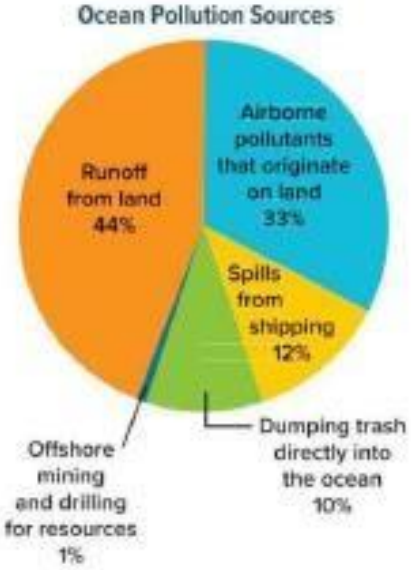
a) Look at the pie chart and answer the questions that follow:




1. Complete the sentence: Any harm to the _____, chemical, _____ or biological health of the ocean _____ is called ocean pollution.
2. What natural source can cause ocean pollution? _____
3. Which sector was the highest source for ocean pollution?

   _____
4. What sector amounts to 10% of ocean pollution?

   _____

ali School Al A
Compiled by:

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

| Ocean pollutions | effect |
|---|---|
| Solid waste<br><br>(plastic bottles-bags-glass) | Many bird and fish eat plastic by mistake<br><br>The great pacific Garbage patch |
| Excess sediments<br><br>Erosion of soil into ocean | Clog the filtering structures of marine filter feeder (clams-sponges)<br><br>Block light |
| Excess Nutrients<br><br>(nitrogen and phosphorus from agriculture) | Algal bloom (large number)<br><br>Block light reduce photosynthesis reduce oxygen |

**Solid Waste** Trash, including plastic bottles and bags, glass, and foam containers, causes problems for marine organisms. Many birds, fish, and other animals become entangled in plastic or mistake it for food. Plastic breaks up into small pieces, but it does not degrade easily. Some of it becomes trapped in circular currents, or gyres. The North Pacific Gyre has collected so much plastic and other debris that a portion of it has been dubbed "The Great Pacific Garbage Patch." The patch is thought to be twice the size of Texas. About 80% of the debris originates from land-based activities in North America and Asia.

**Excess Sediments** Large amounts of land-based sediment wash into oceans, as shown to the right. Some erosion is natural. However, some is caused by humans, who cut down trees near rivers and ocean shorelines. Without the roots of trees and other vegetation to hold sediments in place, the sediments more readily erode. Excess sediments can clog the filtering structures of marine filter feeders, such as clams and sponges. Excess sediments also can block light from reaching its normal depth. Organisms that use light for photosynthesis could die.

**Excess Nutrients** Algae need nutrients such as nitrogen and phosphorus to survive and grow. For this reason pollution from excess nutrients is beneficial to algae. However, too many nutrients can cause an explosion in algal populations. An algal bloom occurs when algae grow and reproduce in large numbers. Algal blooms also can cause water to appear red, green, brown, or even glow at night. Nitrates and phosphates can be abundant in agricultural runoff as well as coastal upwelling zones. Many scientists have found that a major source of excess nitrates and phosphates is from land-based fertilizers that wash into oceans.

*These algae are bioluminescent—they glow!*

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## COLLECT EVIDENCE

What are the causes and effects of water pollution? Record your evidence (B) in the chart at the beginning of the lesson.

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

**Management Solutions** Legislation is an effective way to reduce water pollution. The U.S. Clean Water Act legislates the reduction of water pollution. This act established the basic procedures for regulating wastewater and setting pollution controls. While the Clean Water Act has greatly helped reduce pollution, water pollution in the U.S. still exists.

The Safe Drinking Water Act legislates the protection of drinking water supplies. By reducing pollution, these laws help ensure that all living things have access to clean water.

**What You Can Do** An easy way for you to make an impact on water conservation is to use less. This could be as simple as taking shorter showers or turning off the water while you brush your teeth. You can have an even bigger impact by getting others to conserve with you.

To reduce pollution, you could recycle. By recycling your plastic drinking bottles, you can ensure they won't end up floating in the ocean. Another approach is to stop it before it starts—by reducing! If you reduce your plastic use there will be less in the garbage or even the recycling.

You also can help reduce water pollution by properly disposing of harmful chemicals so that less pollution runs off into rivers and streams. You can volunteer to help clean up litter from a local stream. You also can conserve water so there is enough of this resource for you and other living things in the future.

*In 1969, the Cuyahoga River caught on fire, prompting the Clean Water Act.*

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## COLLECT EVIDENCE

What are ways in which we can monitor or minimize human impact on Earth's water? Record your evidence (C) in the chart at the beginning of the lesson.

Management solutions (Legislation)

The U.S. Clean Water Act legislations the reduction of water pollution

The Safe Drinking Water Act legislates the protection of drinking water supplies

THE SAFE DRINKING WATER ACT

By reducing pollution, These law help ensure that all living things have access to clean water

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

# What is air pollution?

**ENVIRONMENTAL Connection** As the human population grows, people use more energy to heat and cool homes; to fuel cars, airplanes, and other forms of transportation; and to produce electricity. This energy use contributes to air pollution that affects the composition and viability of the atmosphere. The contamination of air by harmful substances including gases and smoke is called **air pollution.** Types of air pollution include smog, chlorofluorocarbons (CFCs), particulate matter, and acid precipitation. Let's take a closer look at each type of air pollution.

## INVESTIGATION

### In a Haze

Compare the atmosphere in the two images below.

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1. How would you describe the change from one image to the other?

Students should note that the air appears brown or hazy in the photograph on the right. Visibility is reduced.

2. What do you think causes this type of change? Write your response in your Science Notebook.

**Want more information?**
Go online to read more about the impact of human activities on Earth's atmosphere.

**FOLDABLES**
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.



**Air pollution:** The contamination of air by substances including gases and smoke.

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

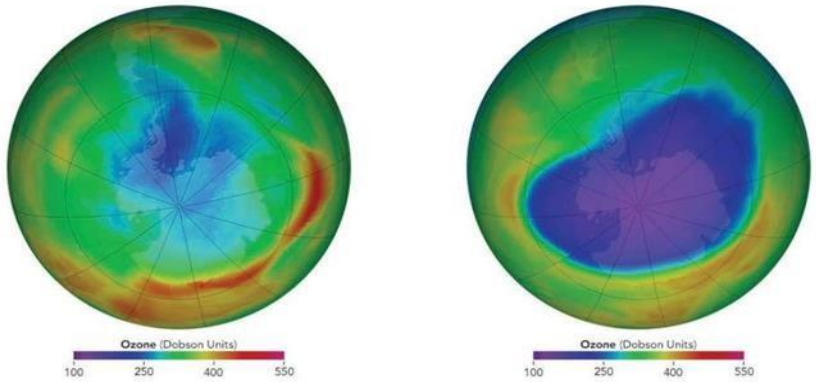
**Photochemical Smog** The brownish haze in the sky pictured in the right image on the previous page is photochemical smog. **Photochemical smog** is caused when nitrogen and carbon compounds in the air react in sunlight. Nitrogen and carbon compounds are released when fossil fuels are burned to provide energy for vehicles and power plants. These compounds react in sunlight and form other substances. One of these substances is ozone. Ozone close to Earth's surface makes air difficult to breathe. It can also damage the tissues of plants and animals.

While ozone in the lower atmosphere is harmful, ozone high in the atmosphere in the ozone layer helps protect living things from the Sun's ultraviolet (UV) radiation. Does air pollution impact the ozone layer?

## INVESTIGATION

### Oh Ozone

Compare the ozone layer in 1979 (left) to the ozone layer in 2016 (right).

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Which image shows a decrease in total ozone? What do you think caused the decrease in ozone?

The image from 2016 shows a decrease in ozone. Allow students to speculate. Some students might be aware that chlorofluorocarbons (CFCs) are strongly implicated in the ozone reduction in the upper atmosphere. Others may simply suggest air pollution.



**CFCs** In the 1970s, scientists suggested that CFCs could destroy ozone in the upper atmosphere. Studies revealed a thinning of the ozone layer, particularly over Antarctica.

All of the CFCs in the atmosphere are a result of human activity. CFCs are released from products such as old refrigerators and air conditioners, and propellants in aerosol cans. Ozone in the upper atmosphere absorbs harmful UV rays from the Sun. CFCs react with sunlight and destroy ozone molecules. As a result, the ozone layer thins and more UV rays reach Earth's surface. This, in turn, can harm the tissues of plants and animals.

While CFCs indirectly harm organisms, another form of pollution has a direct effect on Earth's biosphere. Let's explore.

## INVESTIGATION

### As a Matter of Fact

Compare areas along the Yangtze River in China.

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How would you describe the atmosphere in the above locations? What might cause the differences you observed?

The air appears clear in the photo on the left, and smoky in the photo on the right; dust and smoke from industrial processes.

**Particulate Matter** The mix of both solid and liquid particles in the air is called **particulate matter.** Solid particles include smoke, dust, and dirt. These particles enter the air from natural processes, such as volcanic eruptions and forest fires. Human activities, such as burning fossil fuels at power plants and in vehicles, also release particulate matter. Inhaling particulates can cause asthma, bronchitis, and lead to heart attacks. It can also interfere with the processes of cellular respiration and photosynthesis in plants.

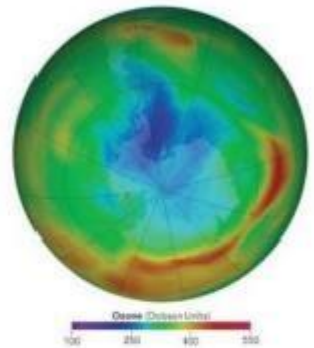
| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

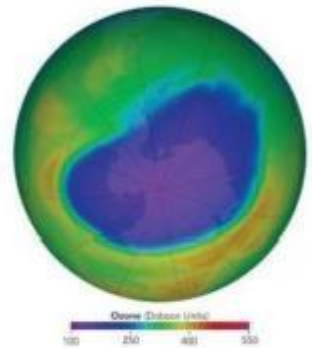
e) Look at the two pictures and answer the questions that follow?

1. How would you describe the change in the two pictures?

2. What do we call this type of air pollution? _____
3. What two chemical compounds react with sunlight to form this type of air pollution. _____
4. How does this affect the atmosphere?

f) Use the picture to describe what has happened to the ozone layer from 1979 to 2016.





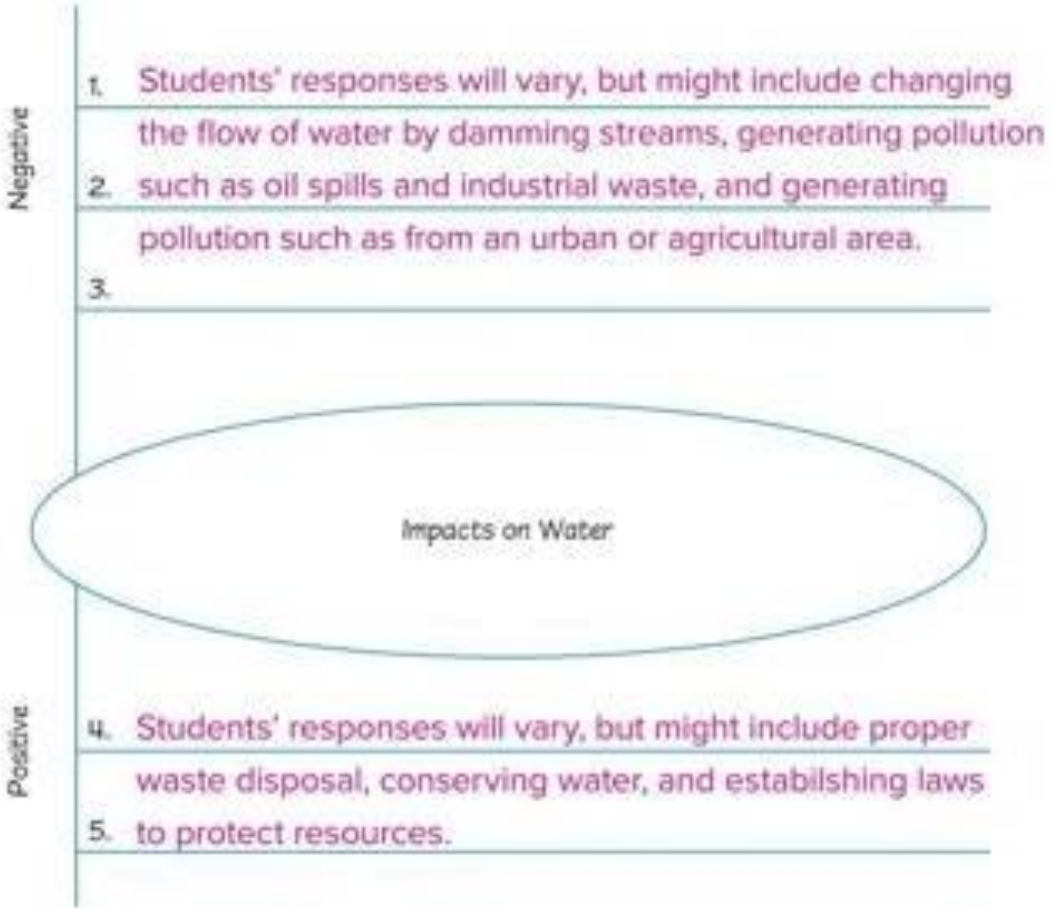
g) Describe the change you see in these two pictures? How is the atmosphere affected?

Created by: Ms Taybah Jaffar Al

| | | | |
|---|---|---|---|
| 5 | Describe how humans pollute Earth's water, and ocean pollution sources, and how to minimize this impact<br>Explain what is air pollution, and how it affects our atmosphere and ozone | Textbook, figures, graphs | 49, 51, 55<br>64, 65, 66 |

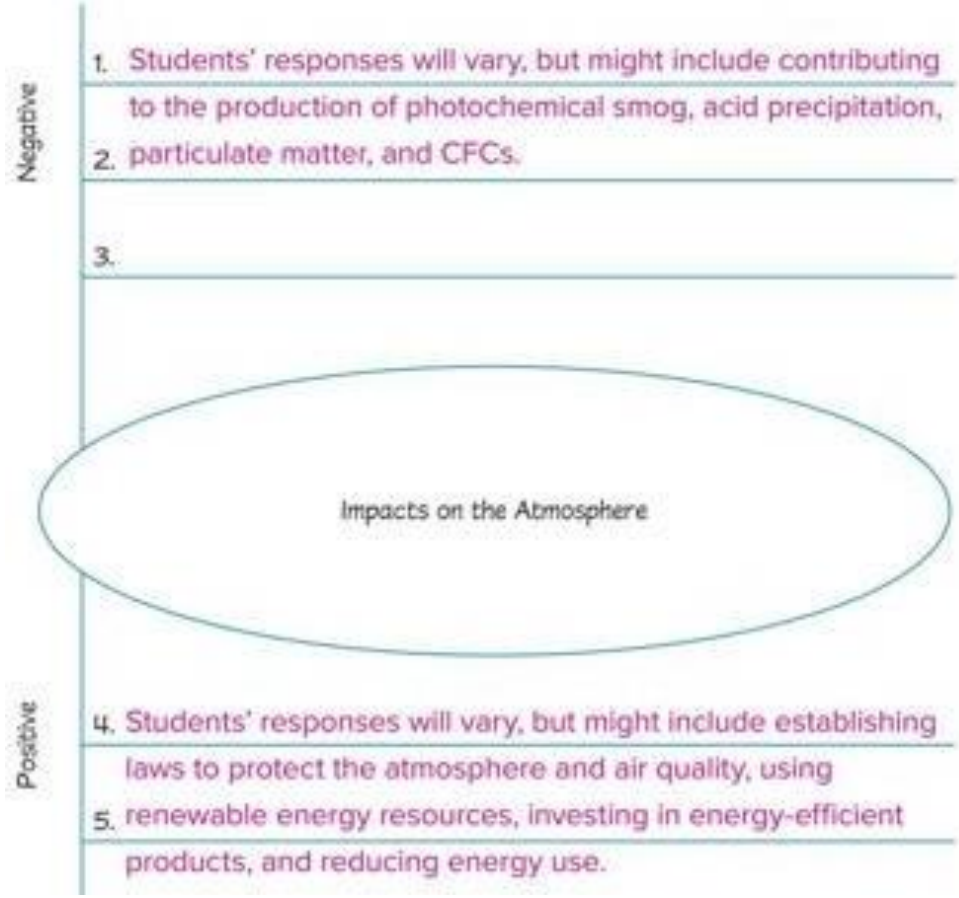
## Summarize It!

1. **Record** some of the negative and positive impacts that humans have on Earth's water.




## Summarize It!

1. **Record** some of the negative and positive impacts that humans have on the atmosphere using the graphic organizer below.



| | | |
|---|---|---|
| MCQ - الأسئلة الموضوعية | 6 | Define: phenotype, traits, heredity, and genetics |
| | 7 | Explain the meaning of genes, alleles, and genotypes. |
| | 8 | Define alleles and compare between homozygous and heterozygous with examples |
| | 9 | Explain the occurrence of Asexual reproduction in plants |
| | 10 | Compare the advantages and disadvantages between Asexual and Sexual Reproduction, and decided which is favorable in certain conditions |
| | 11 | Define courtship animal behaviours and relate examples to it |
| | 12 | Differentiate between Environmental factors and Genetic factors and give examples on both |
| | 13 | Explore the parts of seed plants' flower and define fertilization and pollination |
| | 14 | Interpret the factors that affect the growth of plants, and increases the probability of successful reproduction |
| | 15 | List actions that help protect the land, and Describe the positive effect of recycling on land |
| | 16 | Illustrate how land resources can be managed and restored, and define reforestation and reclamation |
| | 17 | Explain the meaning of aquifer and groundwater and how humans activity impact them |
| | 18 | Describe humans impact on water distribution and availability and label it as positive and/or negative impact |
| | 19 | List and compare air pollutants and their effect on the atmosphere |
| | 20 | List of measures and positive actions that can be taken to minimize and monitor impacts on the atmosphere |

| 6 | Define: phenotype, traits, heredity, and genetics | Textbook, figures, table, investigation | 10, 11 |
|---|---|---|---|

# What are traits?

Your characteristics are what make you unique. They could be things like hair color or height. These characteristics are called traits. How a trait appears, or is expressed, is the trait's **phenotype** (FEE nuh tipe). Traits such as eye color have many different types, but some traits have only two types.

**Want more information?** Go online to read more about inheritance of traits.

## INVESTIGATION

### Understanding Traits

By a show of hands, determine how many students in your class have each type of trait below. Write your observations in your Science Notebook.

| Student Traits | | |
|---|---|---|
| **Trait** | **Type 1** | **Type 2** |
| Earlobes | Unattached | Attached |
| Thumbs | Curved | Straight |
| Interlacing fingers | Left thumb over right thumb | Right thumb over left thumb |

What do you think determines the types of traits you have?

Answers may vary. Sample answer: I think that my traits are inherited from my family. I look like my parents because they share some of my characteristics.

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You have just observed a variety of traits within your classroom. These traits were passed to your classmates from their parents. **Heredity,** the passing of traits from parents to offspring, is complex. For example, you might have straight thumbs, but both of your parents have curved thumbs.



# Why do offspring look like their parents?

**FOLDABLES** Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.

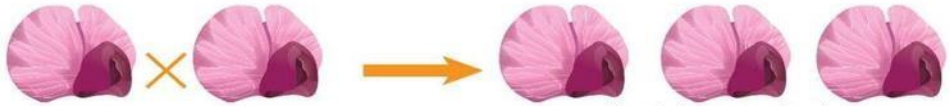
You may have noticed that the kittens at the beginning of the lesson looked similar to their parents. How did the traits of the parents pass to the offspring?

**HISTORY Connection** More than 150 years ago, Gregor Mendel, an Austrian monk, performed experiments that helped answer this question. Because of his research, Mendel is known as the father of **genetics** (juh NEH tihks)—the study of how traits are passed from parents to offspring.

Mendel performed controlled breeding experiments with pea plants. He began with plants that were true-breeding for a certain trait. When a true-breeding plant pollinates itself, it always produces offspring with traits that match the parent. For example, when a true-breeding pea plant with wrinkled seeds self-pollinates, it produces only plants with wrinkled seeds.

Observe some of Mendel's findings from cross-pollinating (one plant pollinates another) true-breeding plants below. What do you think Mendel discovered when he crossed true-breeding plants with purple flowers and true-breeding plants with white flowers? Illustrate your predictions below.

**Purple x Purple**

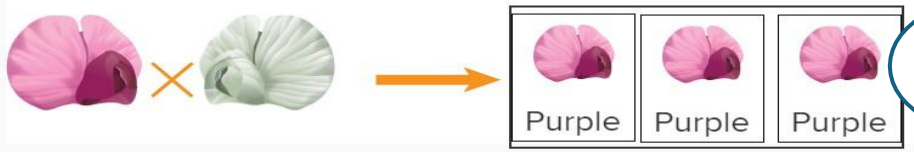


All purple flowers (true-breeding)

**White x White**

All white flowers (true-breeding)

**Purple (true-breeding) x White (true-breeding)**




Hybrid Plants

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| | | | |
|---|---|---|---|
| 6 | Define: phenotype, traits, heredity, and genetics | Textbook, figures, table, investigation | 10, 11 |

- Traits : are characteristics like your hair color or height
- Phenotype : how the trait appears or express for example eye color might be (blue, brown , green)
- Heredity: passing traits from parents to offspring
- Genetics: The study of how the traits are passing from parents to offspring.
- The trait disappears in first generation always re-appears in the second generation.

**In the figure below. the trait of the earlobes might be expressed as attached or unattached. How the trait appeared or expressed is called:**

Unattached



Attached

A. Alleles
B. Genotype
C. Phenotype
D. Genes

**What is a trait?**

- a) The genetic material found in the nucleus of a cell
- b) The combination of alleles that determines a specific characteristic
- c) The physical features or characteristics of an organism
- d) The process of passing on genetic information from one generation to the next

**4)** The study of _____ is called genetics.

- ○ **A)** heredity
- ○ **B)** dominance
- ○ **C)** pea plants
- ○ **D)** mutations

**5)** Passing of traits from parents to offspring is _____.

## Correct Answer

heredity

## Correct Answer

**A)** heredity

| | | | |
|---|---|---|---|
| 7 | Explain the meaning of genes, alleles, and genotypes. | Textbook, figures, table, investigation | 15, 20 |

# What controls traits?

When other scientists studied the parts of a cell and combined Mendel's work with their work, Mendel's factors were more clearly understood. Scientists discovered that inside each cell is a nucleus that contains threadlike structures called chromosomes. Over time, scientists learned that chromosomes contain genetic information that controls traits. We now know that Mendel's "factors" are parts of chromosomes and that each cell in offspring contains chromosomes from both parents. These chromosomes exist as pairs—one chromosome from each parent.

Scientists have discovered that each chromosome can have information about hundreds or even thousands of traits.

- A **gene** (JEEN) is a section on a chromosome that has genetic information for one trait. The genes on each chromosome can be the same or different, such as purple or white for pea flower color.
- The different forms of a gene are called **alleles** (uh LEELs).
- The two alleles that control the phenotype of a trait are called the trait's **genotype.**

Scientists use symbols to represent the alleles in a genotype, as shown in the table below. In genetics, uppercase letters represent dominant alleles and lowercase letters represent recessive alleles. The table shows the possible genotypes for both round and wrinkled seeds phenotypes.

| Phenotype and Genotype | | | |
|---|---|---|---|
| **Phenotypes (observed traits)** | **Round** | | **Wrinkled** |
| **Genotypes (alleles of a gene)** | Homozygous dominant (*RR*) | Heterozygous (*Rr*) | Homozygous recessive (*rr*) |

A round seed can have two genotypes—*RR* and *Rr*. Both genotypes have a round phenotype. A wrinkled seed can have only one genotype—*rr*.

- When the two alleles of a gene are the same, its genotype is **homozygous.**
- Both *RR* and *rr* are homozygous genotypes.
- If the two alleles of a gene are different, its genotype is **heterozygous.**
- *Rr* is a heterozygous genotype.

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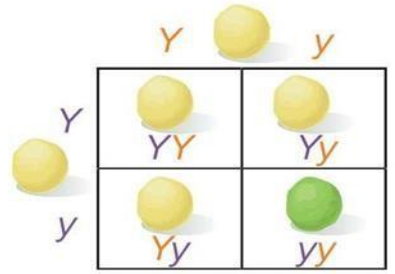
So, how did you do? Your completed Punnett square should look like this:




Geneticists, or scientists who study genetics, use Punnett squares to explain how traits are inherited from one generation to the next. Now that you know how to fill in a Punnett square, use the Punnett square below to predict the offspring of two fruit flies with different genotypes.

## INVESTIGATION

### Fruit Fly Traits

Curly wings (*CC*)

1. Use the Punnett square below to complete a cross between a female fruit fly with straight wings (*cc*) and a male fruit fly with curly wings (*CC*).

Straight wings (*cc*)

| | C | C |
|---|---|---|
| c | Cc | Cc |
| c | Cc | Cc |

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2. According to your Punnett square, which genotypes are possible in the offspring?

The only possible genotype is *Cc*. All offspring will be hybrids.

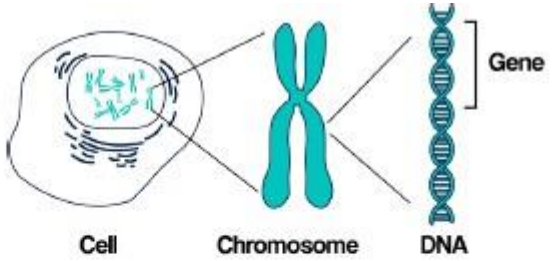
| | | | |
|---|---|---|---|
| 7 | Explain the meaning of genes, alleles, and genotypes. | Textbook, figures, table, investigation | 15, 20 |

Offspring contains chromosomes from both parents.
These chromosomes exist in pairs. One from each parent.

- **Gene:** section on a chromosome that has genetic information for one trait.
- **Alleles:** different forms of a gene.
- **Genotype:** Two alleles controls the phenotype of a trait.

**What is a genotype?**

- a) The physical expression of a trait
- b) The genetic makeup of an organism
- c) The observable characteristics of an organism
- d) The study of inheritance patterns




**What is an allele?**

- a) A specific form of a gene
- b) The combination of genes in an organism
- c) The physical appearance of a trait
- d) The process of genetic mutation

**Chromosomes contain genetic material (DNA), sections of DNA are called .....**

A. Genes
B. Alleles
C. Genotypes
D. Phenotype

| 8 | Define alleles and compare between homozygous and heterozygous with examples | Textbook, figures, table, investigation, 3D | 21, 22 |
|---|---|---|---|

3. If you switch the locations of the parent genotypes around the Punnett square, does it affect the potential genotypes of their offspring? Explain.

No, the results do not depend on where the parents' genotypes are in the Punnett square.

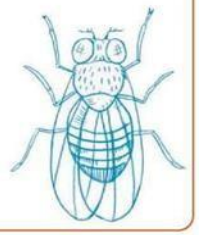
4. Based on the information in your Punnett square, what is the ratio of offspring that will have curly wings to straight wings?

All offspring will have curly wings, therefore, the ratio will be 4 : 0.

**THREE-DIMENSIONAL THINKING**

Design and complete a Punnett square to **model** a cross between two fruit flies that are heterozygous for curly wings (*Cc*). What is the phenotype ratio of the offspring? **Explain** how you are able to predict the phenotype ratio based on a **cause and effect** relationship.

Check students' Punnett squares for accuracy. The phenotype ratios will be 3 : 1 (curly wings: straight wings). Sample answer: I am able to predict the phenotype ratio based on the genotypes of the parents and an understanding of how those genotypes may transfer to offspring.



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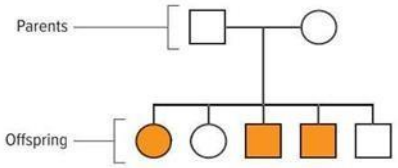
# How can you model a family's phenotypes?

Another model that can show inherited traits is a pedigree. A **pedigree** shows phenotypes of genetically related family members. It can also help determine genotypes. In the pedigree below, three offspring have a trait—attached earlobes—that the parents do not have. If these offspring received one allele for this trait from each parent, but neither parent displays the trait, the offspring must have received two recessive alleles.

Attached lobe




**Recessive phenotype**
- Female with attached lobes
- Male with attached lobes

**Dominant phenotype**
- Female with unattached lobes
- Male with unattached lobes

Unattached lobe

**THREE-DIMENSIONAL THINKING**

If the genotype of the offspring with attached lobes is *uu*, what is the genotype of the parents? **Explain** your answer.

The genotype of both parents is *Uu*. In order for any offspring to show the recessive phenotype, each parent must have one recessive allele to contribute.

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## COLLECT EVIDENCE

How can inheritance of traits in offspring, such as kittens, be modeled? Record your evidence (C) in the chart at the beginning of the lesson.

| 7 | Explain the meaning of genes, alleles, and genotypes. | Textbook, figures, table, investigation | 15, 20 |
|---|---|---|---|

**What does it mean for an organism to be homozygous?**

- a) It has two different alleles for a specific trait.
- b) It has two identical alleles for a specific trait.
- c) It has no alleles for a specific trait.
- d) It has three alleles for a specific trait.

**What does it mean for an organism to be heterozygous?**

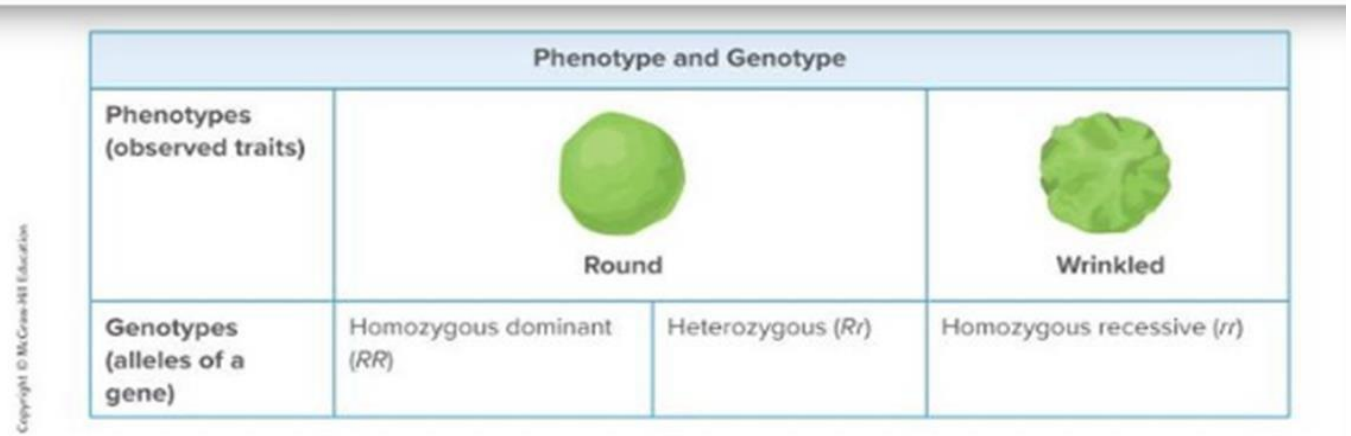
- a) It has two identical alleles for a specific trait.
- b) It has two different alleles for a specific trait.
- c) It has no alleles for a specific trait.
- d) It has three alleles for a specific trait.

**Which of the following is an example of a homozygous genotype?**

- a) Aa
- b) BB
- c) AB
- d) ABBA

**Which of the following is an example of a heterozygous genotype?**

- a) AA
- b) CC
- c) TT
- d) Bb



| Phenotype and Genotype | | | |
|---|---|---|---|
| Phenotypes (observed traits) | Round | | Wrinkled |
| Genotypes (alleles of a gene) | Homozygous dominant (*RR*) | Heterozygous (*Rr*) | Homozygous recessive (*rr*) |

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A round seed can have two genotypes—*RR* and *Rr*. Both genotypes have a round phenotype. A wrinkled seed can have only one genotype—*rr*.

- When the two alleles of a gene are the same, its genotype is **homozygous.**
- Both *RR* and *rr* are homozygous genotypes.
- If the two alleles of a gene are different, its genotype is **heterozygous.**
- *Rr* is a heterozygous genotype.

**How many alleles does an organism inherit for each trait?**

- a) One allele from one parent
- b) Two alleles from one parent
- c) One allele from each parent
- d) Three alleles from each parent

**What is the difference between homozygous and heterozygous genotypes?**

- a) Homozygous has more alleles than heterozygous.
- b) Homozygous has two different alleles, while heterozygous has two identical alleles.
- c) Homozygous has two identical alleles, while heterozygous has two different alleles.
- d) Homozygous and heterozygous have the same genotype.

| 9 | Explain the occurrence of Asexual reproduction in plants | Textbook, figure, investigation | 32 |
|---|---|---|---|

# How can one organism make more organisms?

You learned about many sea stars appearing when they were thought to have been removed from the environment. How is it possible that the sea stars increased their numbers after they had been chopped up?

## INVESTIGATION

### Plant Progeny

Observe two plants—a seed potato and a coleus stem—in glasses of water. Look at photos of the plants when they were first placed in water. Draw a detailed diagram of each of the glasses in your Science Notebook. Observe the plants a week after placement in the water and write down your observations in your Science Notebook.

1. How did the potato and the coleus plant change after one week?

Students should observe the changes that occurred with the plants. The two plants should have outgrowths.

2. How do you think that this relates to the sea stars you heard about in the introduction to this lesson?

Answers may vary. Sample answer: Both were able to make copies of themselves.

**Asexual Reproduction** Recall in the beginning of the lesson you read about sea stars reproducing after being cut up. This happened through regeneration. **Regeneration** occurs when an offspring grows from a piece of its parent. Just like sea stars, some plants don't need seeds to make new plants. Some plants can be grown from a leaf, a stem, or another plant part through vegetative reproduction. **Vegetative reproduction** is a form of asexual reproduction in which offspring grow from a part of a parent plant. **Asexual reproduction** occurs when only one parent organism or part of that organism produces a new organism. The new organism is genetically identical to the parent.

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**Want more information?**
Go online to read more about the different types of reproduction.

FOLDABLES
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.



Asexual reproduction in plants

**Vegetative Reproduction:** offspring grow from a part of a parent plant.

Leaf

Stem

| 10 | Compare the advantages and disadvantages between Asexual and Sexual Reproduction, and decided which is **favorable** in certain conditions | Textbook, Table, 3D | 36 |
|---|---|---|---|

# What are the advantages and disadvantages of sexual and asexual reproduction?

| | Asexual Reproduction | Sexual Reproduction |
|---|---|---|
| **Advantages** | Asexual reproduction enables organisms to reproduce without a mate. Searching for a mate takes time and energy. Asexual reproduction also enables some organisms to rapidly produce a large number of offspring. | Genetic variation occurs in all organisms that reproduce sexually. Due to genetic variation, individuals within a population have slight differences, which might be an advantage if the environment changes. Some individuals might have traits that enable them to survive unusually harsh conditions such as a drought or severe cold. Other individuals might have traits that make them resistant to disease. |
| **Disadvantages** | Asexual reproduction results in little genetic variation within a population. Genetic variation can give organisms a better chance of surviving if the environment changes.<br><br>Another disadvantage of asexual reproduction involves genetic changes, called mutations. If an organism has a harmful mutation in its cells, the mutation will be passed to asexually reproduced offspring. This could affect the offspring's ability to survive. | Sexual reproduction takes time and energy. Organisms have to grow and develop until they are mature enough to produce sex cells. Then the organisms have to form sex cells—either eggs or sperm. Before they can reproduce, organisms usually have to find mates. Searching for a mate can take a long time and requires energy. The search for a mate might also expose individuals to predators, diseases, or harsh environmental conditions. |

**THREE-DIMENSIONAL THINKING**

A fatal disease is spreading through an aquarium containing both fish, which reproduce sexually, and sponges, which reproduce asexually. The disease has been identified in both species. **Construct an explanation** that states which species would be more likely to survive. Write your answer in your Science Notebook.

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## COLLECT EVIDENCE

What are the advantages and disadvantages of the different types of reproduction, such as that of the sea star at the beginning of the lesson? Record your evidence (C) in the chart at the beginning of the lesson.



**ASK:** Which type of reproduction takes less time and energy? asexual reproduction

**ASK:** Which type of reproduction provides an advantage in a changing environment? sexual reproduction

**What is the main advantage of sexual reproduction in flowering plants?**

- a) Rapid reproduction and colonization of new areas
- b) Production of genetically identical offspring
- c) Increased genetic diversity and adaptability
- d) Independence from pollinators

**All of the following are advantages of asexual reproduction EXCEPT**

A. the population can increase rapidly
B. only one parent is needed
C. less time and energy as you don't need a mate
D. A disease is less likely to affect all the individuals in a population

**All of the following are disadvantages of asexual reproduction EXCEPT**

A. it does not lead to variation in a population
B. the population can increase rapidly
C. the species may only be suited to one habitat
D. disease may affect all the individuals in a population

| | | | |
|---|---|---|---|
| 11 | Define courtship animal behaviours and relate examples to it | Textbook, figures, tables | 47, 51 |

**Courtship Behaviors** In the videos you observed animals engage in different behaviors in order to find a mate. A **behavior** is the way an organism reacts to other organisms or to its environment. The behaviors you observed in the videos are a form of communication. Animals attract mates by communicating in a variety of ways, including the use of sound, light, chemicals, and body language. Often times animals compete with others of the same species for a mate. Sometimes animals even bring gifts to each other in hopes of getting the attention of one another. What are some examples of these courtship behaviors? Let's investigate!

*These sandhill cranes are performing a courtship dance.*

## INVESTIGATION

### Show Off

In order to attract a mate, animals (most often males), frequently "show off" for the other sex. In this activity, your team will investigate an example of an animal reproductive strategy, focusing on external stimuli, sensory receptors, behavioral response, and memory.

1. With your team, choose one of the examples of an animal reproductive strategy provided by your teacher that you would like to investigate, or research and choose one of your own, and record it below.

Answers may vary. Sample answer: Our team will investigate bowerbirds. The males build elaborate structures and decorate them with sticks and other objects to attract a female.

2. **READING Connection** Use the spaces below to take notes as you conduct your research. Make sure that you use multiple print and digital sources and cite them in your Science Notebook using the format provided by your teacher. For each of the sources used, explain how you assessed its credibility, accuracy, and any possible bias, and cite specific evidence to show that the claims in the sources are supported.

*Stimuli:*

Answers may vary. Sample answer: The males provide visual stimuli by dancing and building structures called bowers out of sticks and other brightly-colored objects.

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A behavior is the way an organism reacts to other organisms or to its environment.

Courtship behavior is when an animal engages in different behaviors in order to find a mate.

Behaviors are a form of communication. Animals can communicate using sound, light, chemicals and body language.

When an animal engages in different behaviors in order to find a mate...

answer choices

- innate behavior
- courtship behavior
- learned behavior

Most animals have specialized behaviors that help them find and attract mates. Some examples of courtship behaviors are in the table below.

They often compete with members of the same species, either physically, or through displays, for a mate. Male mule deer, such as those shown to the right, become very aggressive towards each other when competing for a mate. Peacocks compete by showing off their feathers, and male frigate birds inflate their throat sacks when competing for mates.

**Competition**

become very aggressive

showing off their feathers.

inflate their throat sacks

Some animals, such as the white female gypsy moth shown to the right, release chemical substances called pheromones that attract males. Many moths and butterflies can detect these pheromones using their sense of smell from up to six miles away.

**Release Chemicals**

Pheromones

Other animals, such as birds and the frog shown to the right, use mating songs that gain the attention of mates. Some male birds bring the female a gift of food, such as a male tern bringing a fish to a female. Male fiddler crabs wave their enlarged claws and skitter across the ocean floor in the hopes of getting a female fiddler crab's attention. Male bowerbirds build elaborate nests using brightly colored objects during courtship.

**Behavioral strategy**

mating songs

a gift of food

wave their enlarged claws

build elaborate nests

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## COLLECT EVIDENCE

How do animals, such as the birds of paradise, find mates? Record your evidence (A) in the chart at the beginning of the lesson.

| | | | |
|---|---|---|---|
| 11 | Define courtship animal behaviours and relate examples to it | Textbook, figures, tables | 47, 51 |

**What is the purpose of the mating dance performed by male spiders?**

- a) To find food
- b) To attract prey
- c) To communicate with other spiders
- d) To attract a female mate

**Which of the following statements is true about spider mating dances?**

- a) Only female spiders perform the mating dance.
- b) The mating dance is performed by spiders of all species.
- c) The mating dance is primarily performed by male spiders.
- d) The mating dance is a solitary behavior and not influenced by other spiders.

**What is the primary purpose of a male spider using its pedipalps and gifting behavior, such as offering a fly wrapped in silk, during courtship?**

- a) To protect itself from predators
- b) To build a nest for the female spider
- c) To ensure successful mating and reproductive success
- d) To mark its territory and establish dominance over other males

**5)** Female gypsy moths release chemicals called _____ to attract males.

## Correct Answer

pheromones

**A male peacock spreads his feathers in the near a female peahen. This behavior helps the peacock _____.**

answer choices

- scare off female birds.
- hide from predators.
- attract a mate.
- find food to eat.

**2)** Animal communication includes _____.

- **A)** courtship behavior
- **B)** aggression
- **C)** pheromones
- **D)** all of the above

## Correct Answer

**D)** all of the above

**7)** The mating season for white-tailed deer is just two to three months long. Male deer grow antlers before each breeding season. They use their antlers to fight each other to establish dominance in bachelor herds and earn the right to mate with certain females.
Scientists claim that this aggressive behavior increases the chances of successful reproduction for the entire deer population.
Which statement best supports this claim?

- **A)** Healthier male deer are able to grow larger antlers.
- **B)** Healthier males are better able to protect their young.
- **C)** This behavior extends the length of the mating season.
- **D)** This behavior gives healthier males a better chance to mate.

## Correct Answer

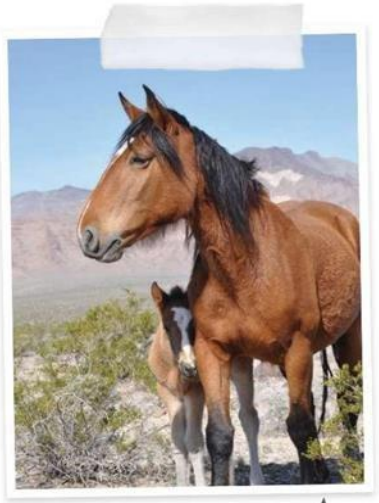
**D)** This behavior gives healthier males a better chance to mate.

| 12 | Differentiate between Environmental factors and Genetic factors and give examples on both | Textbook, figures, 3D | 58, 61, 63 |
|---|---|---|---|

**Protecting Offspring** Birds aren't the only animals that engage in nest building behaviors in order to protect their young. Some mammals, amphibians, fish, reptiles, and insects have the instinct to protect their eggs and their young, or even themselves, by building nests. Animals build different types of nests, or dens, out of a variety of materials for protection from predators and the environment.

Another example of a nurturing behavior is herding. Many animals herd their offspring to ensure the young animals are not left behind and are safe from predators. Elephants take turns watching over each other's babies so the mother can take breaks!

Some animals, such as musk oxen, circle their young with their horns facing out to protect them from predators. Bison form two circles around their young for protection—the females form a circle around the young, and males form a circle around the females.



A wild horse protecting its young

## COLLECT EVIDENCE

How are young animals, such as bird of paradise chicks, protected? Record your evidence (B) in the chart at the beginning of the lesson.

# What factors affect how baby animals grow?

When baby birds hatch, will they all grow up to be the same? No, there are many factors that determine how animals will grow. Some of these factors are genetic—traits are inherited from the parents, and some factors are environmental—the animal's environment influences how it will grow. Can some factors be both genetic and environmental?

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## INVESTIGATION

### Just Grow with It

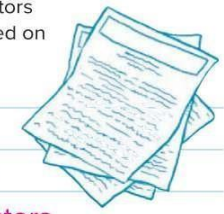
In this activity, you and your team will explain how genetic and environmental factors influence the growth of an animal.

1. Choose an animal that you are somewhat familiar with (does anyone on your team have any pets?) to base your explanation on.

Answers may vary. Sample answer: Our group will focus on dogs.



5. Write a short report that explains how genetic and environmental factors influence the growth of your animal. Your explanation should be based on valid and reliable evidence from your sources.



Answers may vary. Students should use this space to construct their explanation of how both genetic and environmental factors affect the growth of their animal. Sample answer: There are many different factors that influence the growth of dogs. Some factors are genetic, some are environmental. and some are a combination of both. Traits such as color of fur, eye color, and hair length, are influenced by genetics. Traits such as muscle tone, weight, and obedience, are influenced more by the environment in which the puppies grow up in. However, genetics can also influence these traits. Both genetics and the environment influence the personality of dogs. For example, a dog might inherit a trait that makes him aggressive from his parents, but if he grows up with owners that train him not to show these behaviors, the dog could learn to be less aggressive.

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**Factors Influencing the Growth of Animals** Both genetic and environmental factors affect the growth of animals. Genetic factors that affect growth are inherited from the parents. They are determined by genes. For example, the type of fur a dog has (straight, curly, wiry) is determined by the genes of the parents. Some traits, such as obedience of a dog, are influenced by the environment. Some traits of animals are influenced by both genetic and environmental factors. The weight of an animal is partially determined by genes, and partially determined by its diet. For many traits, it is still unknown whether they are determined by genetics, the environment, or both. Since many factors influence the growth of animals, the traits of animals can often not be predicted.

## COLLECT EVIDENCE

What factors affect the growth of animals, such as birds of paradise? Record your evidence (C) in the chart at the beginning of the lesson.

| 12 | Differentiate between Environmental factors and Genetic factors and give examples on both | Textbook, figures, 3D | 58, 61, 63 |
|---|---|---|---|

## Three-Dimensional Thinking

In order to attract a mate, male peacocks fan out their colorful feathers and dance. Females tend to choose males that have larger displays of feathers and feathers with more eyespots. The peahen then builds her nest by scraping a hole in the ground in a hidden area. Once the chicks hatch, the peahen stays close to them, teaching them what foods to eat and defending them from predators.

**2.** Which of the following is a courtship behavior that increases the probability of successful reproduction for the peacock?

**A** fanning feathers
**B** nest building
**C** protecting from predators
**D** all of the above

---

Observe the hamsters' environment below.

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**3.** Which of the following is NOT an environmental factor that would affect the hamsters' growth?

**A** the amount of food the hamster is given
**B** gene for fur color
**C** the amount of time spent on the exercise wheel
**D** interactions with other hamsters



Factors That Affect the Growth of Young Animals

| Environmental Factors | Genetic Factors |
|---|---|
| Environmental factors: diet, exercise, availability of food & water, and interaction with other organisms determine how an animal will grow. | Traits inherited from their parents affect how the animal grows. |

A factor from an organism's surroundings that influences it in some way

answer choices

- Environmental factor
- Genetic factor
- Limiting factor
- system

Genes passed (DNA) from parent to offspring that determine characteristics for success

answer choices

- Genetic factor
- Environmental factor
- Limiting Factor
- System

The shape of a plant's leaf is an example of a

answer choices

- Genetic factor
- Environmental factor

The amount of water available is an example of a

answer choices

- Genetic factor
- Environmental factor

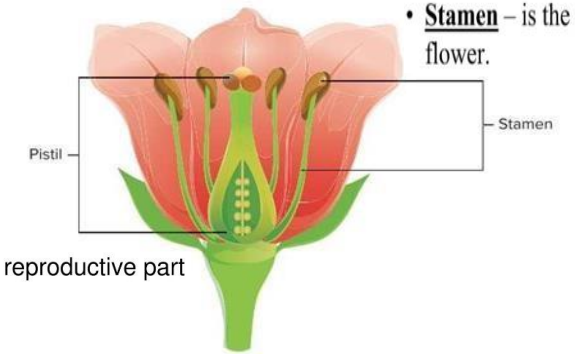
| 13 | Explore the parts of seed plants' flower and define fertilization and pollination | Textbook, figure | 72 |
|---|---|---|---|

**Types of Plant Reproduction** Some plants reproduce sexually, some plants reproduce asexually, and some plants can reproduce in both ways. Asexual reproduction occurs when a portion of a plant develops into a separate new plant. Sexual reproduction occurs when a plant's male reproductive cell (sperm) combines with a plant's female reproductive cell (egg). The way a plant reproduces depends on the structures it has.

*These hens and chicks can reproduce without seeds, or asexually. New "chicks" can grow from the stolons on the main "hen" plant.*

**Seedless Plants** Not all plants grow from seeds. The first land plants to inhabit Earth most likely were seedless plants—plants that grow from spores, not from seeds. Mosses and ferns are examples of seedless plants found on Earth today.

**Seed Plants** There are two groups of seed plants—flowerless seed plants and flowering seed plants. Both produce seeds that result from sexual reproduction. The plants produce pollen grains, which contain sperm. They also produce female structures, which contain one or more eggs. **Pollination** occurs when pollen grains land on a female plant structure of the same species. If the pollen joins with an egg, fertilization occurs and a seed develops. In nonflowering plants, the pollen is produced by the male cone, and the eggs are contained within the female cone. In flowering plants, the female reproductive organ is the pistil, and the male reproductive organ is the stamen.

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- **Stamen** – is the male reproductive part of a flower.
- ***Pistil*** - female reproductive part of the flower

## COLLECT EVIDENCE

How do plants, such as the purple tansy, reproduce? Record your evidence (A) in the chart at the beginning of the lesson.



**Seed plants: they reproduce by seeds.**

**There are two groups :**

**A. Flowering seed plants :**
**The female reproductive organ is the pistil.**
**The male reproductive organ is the stamen.**

**B. Flowerless seed plants:**
**The pollen is produced by the male cone.**
**The eggs are contained within the female cone.**

**Pollination occurs. when pollen grains land on a female plant structure of the same species.**

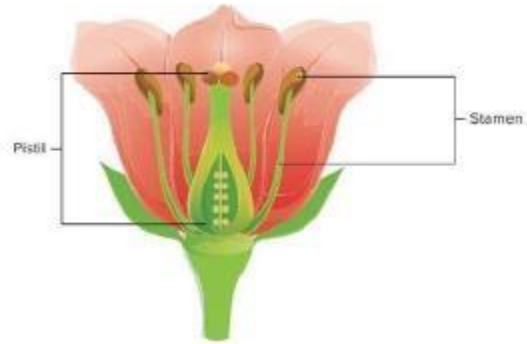
**If the pollen joins with an egg, fertilization occurs, and a seed develops.**

| 13 | Explore the parts of seed plants' flower and define fertilization and pollination | Textbook, figure | 72 |
|---|---|---|---|

**Which of the following is True regarding the apple trees shown below?**

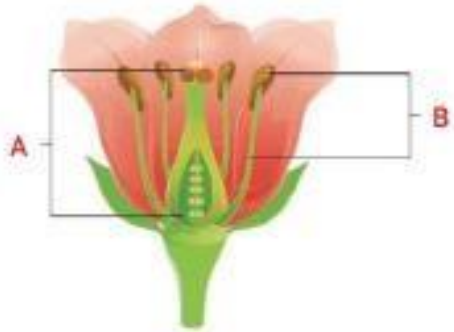
A. They reproduce asexually
B. They produce cones
C. They produce seeds
D. They produce spores

**Which of the following in Not true about the following diagram?**




A. It is a flowering plant
B. it reproduces sexually
C. the pistil is the male part in the flower
D. reproduction involves pollination

**What does the letter B refer to in the image bellow?**




A. stamen
B. Seed
C. Pistil
D. Spores

**The process of fertilizing flowers by transferring pollen from the male to female parts.**

answer choices

- Germination
- Pollination
- Reproduction
- Behavior

**The male structure of the flower; contains the anther.**

answer choices

- Stamen
- Anther
- Sepal
- Petals

| | | | |
|---|---|---|---|
| 14 | Interpret the factors that affect the growth of plants, and increases the probability of successful reproduction | textbook, figures, 3D | 78, 81 |

2. After analyzing and interpreting your data, construct an explanation in your Science Notebook on different factors that affect the growth of plants. Use evidence from the investigation to support your answer.

**THREE-DIMENSIONAL THINKING**

**Analyze and interpret the data** from the Investigation *Testing Plant Growth* to explain the **cause and effect** relationship between environmental factors and plant growth. Record your response in your Science Notebook.

In the investigation *Testing Plant Growth* you observed environmental factors that affect how plants grow. A tropism (TROH pih zum) is a response that results in plant growth toward or away from a stimulus. The growth of a plant toward or away from light is called **phototropism.** A plant has a light-sensing chemical that helps it detect light. The response of a plant to touch is called **thigmotropism** (thihg MAH truh pih zum). The vine growing up the fence in the photo clings to the fence in response to touching it. The response of a plant to gravity is called **gravitropism.** Stems grow away from the pull of gravity, while roots grow toward the pull of gravity.

Genetic factors also affect how plants grow. Plants inherit genes from their parents that determine traits, such as what color flowers they will have and where on the plant the flowers will bloom.

Johannes Hansen/Alamy

**GO ONLINE** for additional opportunities to explore!

Investigate factors that affect plant growth by performing one of the following activities.

☐ **Observe** phototropism and gravitropism in action in the **Lab** *How does an external stimulus affect the growth of a plant?*

**OR**

☐ **Determine** how light affects the growth of plants in the **Lab** *How important is light to the growth of plants?*

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## COLLECT EVIDENCE

What factors affect how plants, such as the purple tansy, grow? Record your evidence (C) in the chart at the beginning of the lesson.



➢ Plant growth towards or away from an external stimulus is called tropism .

Plant response to environmental stimuli such as light, gravity, and touch.

**Phototropism** — Response to too little light

**Gravitropism or Geotropism** — Response to gravity

**Thigmotropism** — Response to touch

**<u>Genetic factors</u>** also affect how plants grow.

Plants inherit genes from their parents that determine traits, such as what color flowers they will have

| | | | |
|---|---|---|---|
| 14 | Interpret the factors that affect the growth of plants, and increases the probability of successful reproduction | textbook, figures, 3D | 78, 81 |

## Three-Dimensional Thinking

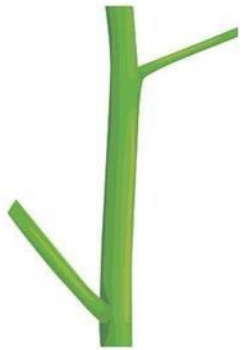
**2.** Which of the following is a plant structure that increases the probability of successful reproduction?

**A**

**B**

**C**

**D**



Mr. Blake is preparing to plant his yearly corn crop. In order to produce the best crop yield possible, he considers a variety of factors that can affect the growth of the corn.

**3.** Which of the following is not a factor that can affect the growth of the corn crops?

**A** gene for color of kernels

**B** amount of water given

**C** the space available for the plants to grow

**D** all of the above

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| 15 | List actions that help protect the land, and Describe the positive effect of recycling on land | Textbook, figures, investigation | 24, 25 |
|---|---|---|---|

**Resource Use** Resources such as wood, petroleum, and metals are important for making the products you use every day at home and in school. However, if these resources are not used carefully, the environment can be damaged. **Conservation** is the careful use of Earth's materials to reduce damage to the environment. Conservation can prevent future shortages of some materials. How can individuals help manage land resources wisely?

- Ways to conserve resources include :
- Reducing the use of materials
- Reusing materials
- Recycling materials

  - Reusing is to find another use for it instead of throwing it away.
  - Recycling waste can conserve earth's land resources
  - Compost: mix of decayed organic material, bacteria, other organisms and small amounts of water. (remains of food and is used as natural fertilizer)
  - Reducing is to limit the amount used

4. How did your rankings compare with those of your classmates?

Answers will vary; most students will discard more paper than anything else, but may vary in plastics, glass, metal, and food waste.

5. List two simple ways that you and your classmates can reduce your consumption of Earth's materials.

Students may suggest carrying their lunch to school in reusable containers; reusing old clothing as cleaning rags; or using both sides of notebook paper.

**Reduce, Reuse, Recycle** Developed countries such as the United States use more natural resources than other regions. Ways to conserve resources include reducing the use of materials, and reusing and recycling materials.

Reusing an item means finding another use for it instead of throwing it away. Using material again is called recycling. When you recycle wastes such as glass, paper, plastic, steel, or tires, you help conserve Earth's land resources. You can use yard waste and vegetable scraps to make rich compost for gardening, reducing the need for synthetic fertilizers. Compost is a mix of decayed organic material, bacteria, other organisms, and small amounts of water. Reducing means limiting the amount used initially.

The human population explosion already has had an effect on the environment and the organisms that inhabit Earth. It's unlikely that the population will begin to decline in the near future. To make up for this, resources must be used wisely. Conserving resources by reducing, reusing, and recycling is an important way that you can make a difference.

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| | | | |
|---|---|---|---|
| 15 | List actions that help protect the land, and Describe the positive effect of recycling on land | Textbook, figures, investigation | 24, 25 |

**Which of the following is an example of the "reduce" principle?**

- a) Throwing away plastic bottles after one use
- b) Buying single-use plastic utensils instead of reusable ones
- c) Using a refillable water bottle instead of buying disposable ones
- d) Purchasing new clothes frequently without considering the old ones

To reduce pollution in the environment, people should _____ materials.

answer choices

- recycle
- pollute
- throw away
- clean

**What does the "reuse" principle encourage?**

- a) Using items for a single purpose and then discarding them
- b) Repurposing or finding new uses for items to extend their lifespan
- c) Recycling materials to create new products
- d) Increasing consumption and buying more items than necessary

How could you reuse a can of soup to prevent it from ending up in the landfill?

answer choices

- You could recycle the can instead of throwing it away.
- You could clean it out, paint it, and use it as a pencil holder.
- You could throw it in the trash.
- You could put it outside for squirrels to eat out of.

**Which of the following is an example of the "recycle" principle?**

- a) Donating used clothes to a local charity
- b) Repairing a broken electronic device instead of buying a new one
- c) Sorting and separating waste into different recycling bins
- d) Throwing away plastic bottles in the regular trash bin

**Which of the following will increase the human negative impact on the environment?**

A. Recycling plastic drinking water bottles
B. Taking longer showers
C. Reducing the use of the resources
D. Properly disposing harmful chemicals

The careful use of Earth's materials to reduce damage to the environment is called what?

answer choices

- Reduce
- Conservation
- Cautious
- Reuse

| 16 | Illustrate how land resources can be managed and restored, and define reforestation and reclamation | Textbook | 26, 28 |
|---|---|---|---|

**Managing Land Resources** Because some land uses involve renewable resources while others do not, managing land resources is complex. In addition, the amount of land is limited, so there is competition for space. Landfills, for example, take up valuable space and often risk polluting the area. Those who manage land resources must balance all of these issues. Let's investigate how land resources can be managed and protected.

ENGINEERING

## LAB Lose the Leachate

**Safety**

### Materials

creative construction materials
paper towels
scissors
masking tape

### Procedure

1. Read and complete a lab safety form.
2. Read the information provided by your teacher about landfill requirements as set by the Environmental Protection Agency (EPA).
3. Plan and diagram your landfill design in your Science Notebook. Identify any materials used and note the inputs and outputs of the designed system.
4. Use the materials to build your landfill model. Add waste materials.
5. Pour 350 mL of water on your landfill to simulate rain. Observe the path the water takes.
6. Collect the leachate produced by your landfill. Leachate is the liquid that seeps out of your landfill. Record your data below.

Student answers will depend on their model. Answers might include that less than 350 mL water emerges from the landfill, and that it is discolored, or contains bits of the model's materials.

7. Follow your teacher's instructions for proper cleanup.

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### Analyze and Conclude, continued

12. Determine the similarities and differences among your design and the other groups'. In your evaluations, be sure to use data and/or digital tools and arguments to compare proposed solutions to your landfill. Identify the best characteristics of each that can be combined into a new solution to better address the effectiveness of the landfill. Redesign your landfill. Plan and diagram your new landfill in your Science Notebook. Retest your design.
13. How does your new designed solution better meet the needs of the landfill? Identify any limitations with your model in regards to representing the proposed solution.

Answers will vary. Students might make changes so that there is less leachate. Students should suggest that their new design is more efficient and produces less leachate.

14. Describe why it is important to test and modify solutions to designed systems, such as landfills.

Data generated by models, along with criteria and constraints that the proposed solution must meet, can be used to optimize the design solution through iterative testing and modification.

**Managing Land Resources** One way governments can manage forests and other unique ecosystems is by preserving them. On preserved land, logging and development is either banned or strictly controlled. Large areas of forests cannot be cut. Instead, loggers cut selected trees and then plant new trees to replace the ones they cut. **Reforestation** involves planting trees to replace ones that have been removed. Trees are renewable—they can be replanted and grown in a relatively short amount of time.

Land mined for mineral resources also must be preserved. On both public and private lands, mined land must be restored according to government regulations. **Reclamation** is the process of restoring land disturbed by mining. Mined areas can be reshaped, covered with soil, and then replanted with trees and other vegetation.

Land used for farming and grazing can be managed to conserve soil and improve crop yield. Farmers can leave crop stalks after harvesting to protect soil from erosion. They also can use organic farming techniques that do not use synthetic fertilizers.

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| 16 | Illustrate how land resources can be managed and restored, and define reforestation and reclamation | Textbook | 26, 28 |
|---|---|---|---|

✓ 1. Mined land can be made environmentally healthy through reclamation.

✓ **Reclamation:** is the process of restoring land disturbed by mining.

✓ In reclamation, mined areas are reshaped, covered with soil, and then replanted with trees and other vegetation.

Reclamation is ...

answer choices

- the process of getting rid of pollution in an area
- the process of replanting trees
- the process of restoring land disturbed by mining
- the process of changing an areas vegetation

2. Forest Land (Logging and development is banned or controlled on preserved land).

**Reforestation:** involves planting trees to replace ones that have been removed

Reforestation ...

answer choices

- involves planting trees to replace ones that have been removed
- involves cutting down trees in a select area
- involves monitoring the trees in an area
- involves control over trees in an endangered animal's habitat

3. Land used for farming and grazing can be managed to conserve soil and improve crop yield

✓ Farmers can use organic farming techniques.

✓ They can leave crop stalks on fields after harvesting to reduce soil erosion.

**Why is proper management of landfills important?**

- a) To prevent the formation of new landfills
- b) To maximize the production of renewable energy
- c) To minimize the release of harmful substances into the environment
- d) To promote the growth of plants and wildlife in landfill areas

| 17 | Explain the meaning of aquifer and groundwater and how humans activity impact them | Textbook, figures, investigation | 43 |
|---|---|---|---|

**Impacts on Groundwater** As you read, human activity has many impacts on the distribution and availability of surface water. Humans have an impact on groundwater as well. The water beneath Earth's surface is much more plentiful than the freshwater in lakes and streams. Recall that groundwater makes up the majority of Earth's freshwater. Groundwater is an important source of water for many streams, lakes, and wetlands. Some plant species absorb groundwater through long roots that grow deep underground. People in many areas of the world rely on groundwater for their water supply. In the United States, about 20 percent of the water people use daily comes from groundwater. People often bring groundwater to Earth's surface by drilling wells. Wells are usually drilled into an **aquifer**—an area of permeable sediment or rock that holds significant amounts of water. Groundwater then flows into the well from the aquifer and is pumped to the surface.

## INVESTIGATION

### Sinkholes

**GO ONLINE** Watch the animation *Groundwater and the Formation of Sinkholes* and answer the following question.

Explain the cause and effect of overdrawing ground water.

Answers may vary. Sample answer: If we overdraw the water from the ground for human use such as agriculture, the empty space could collapse under too much weight.

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**Groundwater** Precipitation helps replace groundwater drawn out of wells. During a drought, less groundwater is replaced, so the water level in a well drops. The same thing happens if water is removed from a well faster than it is replaced. If the water level drops too low, a well runs dry. The water in an aquifer supports the rocks and soil above it. In some parts of the world, water is being removed from aquifers faster than it can be replaced. This creates empty space underground. The empty space underground cannot support the weight of the overlying rock and soil. Sinkholes form where the ground collapses due to lack of sufficient support from below.

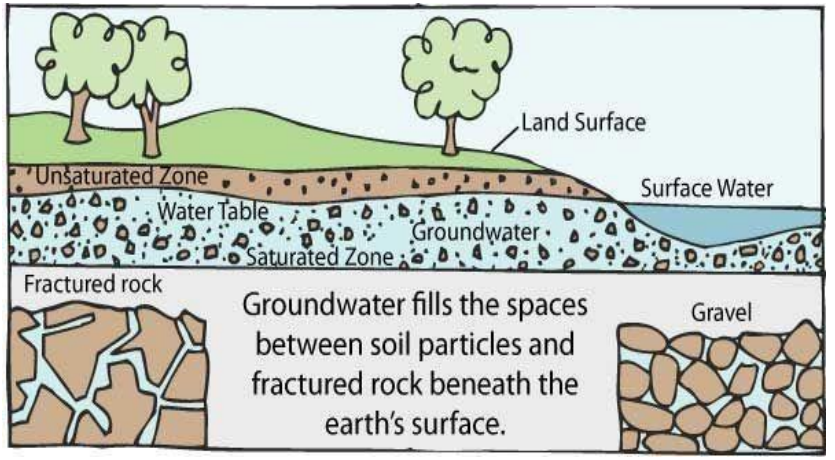
### COLLECT EVIDENCE

What evidence have you discovered to explain the impacts of water usage? Record your evidence (A) in the chart at the beginning of the lesson.



**An aquifer** is an area of permeable sediment or rock that holds significant amounts of water.

**Precipitation** helps replace groundwater that is drawn out of wells.




The water level in a well drops if people use the water faster than it can be replaced.

Overdraw of water due to human use lead to an empty space forms underground.

**Sinkholes** form where the ground collapses because of lack of support

| 18 | Describe humans impact on water distribution and availability and label it as positive and/or negative impact | Textbook, figures | 40, 41 |
|---|---|---|---|

# What impacts do humans have on water distribution and availability?

Most of the human activities that require water, require freshwater. Of all the water on Earth, freshwater makes up only 3 percent. Traditional sources of freshwater include ground water, lakes, rivers, and other surface water. As the human population increases, some natural systems are pushed beyond their limits. Let's examine one resource that couldn't keep up with human demand.

## INVESTIGATION

### Case Study: The Aral Sea

Read the text below then respond to the prompt.

**ENVIRONMENTAL Connection** Prior to the 1970s, the Aral Sea, which is located in central Asia, was the fourth largest lake in the world. The lake was supplied with freshwater from two major rivers, the Amu Darya and Syr Darya, and located in a basin where the only water loss was due to evaporation. Local economies were supported by the fisheries in the lake.

The Aral Sea is located in Kazakhstan and Uzbekistan (formerly the Soviet Union).

In the 1960s, the Soviet government, which had control of the Aral Sea at the time, diverted large amounts of water from the Amu Darya and Syr Darya rivers to grow cotton and other crops. The engineers behind this project knew this withdrawal would cause the sea to recede. They thought the benefits of an agricultural economy would outweigh the losses to the fishing industry supported by the lake.

Within 10 years, the Aral Sea was rapidly losing water as evaporation exceeded the amount of water still flowing into the lake. The shoreline began to shrink, causing fisherman to travel farther to the water. The lake's salinity, or how salty the water is, greatly increased. This destroyed the fisheries. By 1980 the fishing industry collapsed.

Not only did the lake dry up, but the two rivers carried fertilizer downstream. The salt left behind from evaporation mixed with these chemicals creating a layer of contaminated salt on the lake bed. This salt was carried by the wind and created less productive crop lands and human health problems.

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This is the Aral Sea in 2000.

Here is what the Aral Sea looked like in 2017.

Ultimately, the loss of the Aral Sea altered the regional climate and led to many health and economic problems. The human modifications to this natural system produced severe environmental consequences.

**WRITING Connection** In your Science Notebook, write an essay explaining how the expansion and operation of human communities influenced the Aral Sea natural system.

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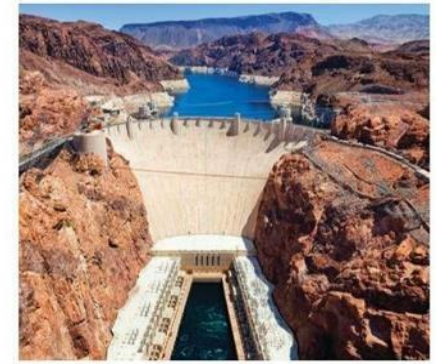
**Changing the Flow of Surface Water** People worldwide depend on sources of freshwater for their water supplies. Another method to obtain water is through dams. Streams and rivers are often dammed to create reservoirs that store water.

The large concrete structure shown to the right is the Hoover Dam in Nevada. The dam was built to control water flow and flooding along the Colorado River. Notice the large reservoir, Lake Mead, behind the dam. Freshwater from Lake Mead is used for recreational purposes, drinking water, irrigation, and hydroelectric power.



But dams can also have negative consequences on the environment and the biodiversity of ecosystems around the river. Dams can increase the rate of erosion along the banks of the streams. They also act as a geographic barrier for migratory fish. Because of dams, some rivers, such as the Colorado River, are nearly dry before they reach the ocean.

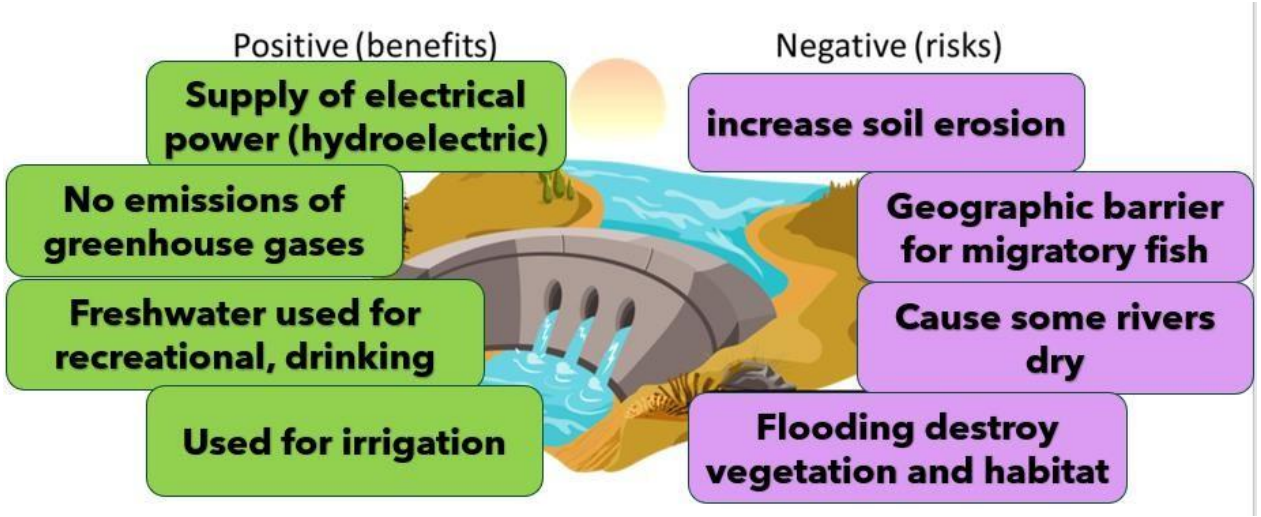
| 18 | Describe humans impact on water distribution and availability and label it as positive and/or negative impact | Textbook, figures | 40, 41 |
|---|---|---|---|

**5)** Which correctly describes something that can have both a positive and negative impact on the environment?

- **A)** building a dam
- **B)** picking up litter
- **C)** decreasing the use of chemical fertilizers
- **D)** using less water at home

## Correct Answer

**A)** building a dam




**which of the following is NOT true about Changing the Flow of Surface Water**

A. Dams can increase soil erosion along the banks of streams.
B. Dams interfere with the migration of fish such as salmon.
C. dams can slow the flow of a river
D. Dams will not affect aquatic life

**Which of the following is a negative impact on the environment as a result of building the darn shown in the image below?**

A. Creating a geographic barrier
B. Creating a continuous flow of the river
C. Increasing river flow
D. Decreasing the rate of erosion along the banks

| | | | |
|---|---|---|---|
| 18 | Describe humans impact on water distribution and availability and label it as positive and/or negative impact | Textbook, figures | 40, 41 |

**Which of the following is an example of human activities that can change the flow of surface water?**

- a) Planting trees along riverbanks
- b) Building dams and reservoirs
- c) Allowing natural wetlands to flourish
- d) Implementing water conservation practices

**How can changing the flow of surface water impact ecosystems?**

- a) By improving biodiversity and species habitats
- b) By reducing the risk of flooding and erosion
- c) By disrupting aquatic ecosystems and habitats
- d) By promoting the growth of native vegetation

| 19 | List and compare air pollutants and their effect on the atmosphere | textbook, investigations, figures, table, 3D | 64, 65, 66, 68, 70 |
|---|---|---|---|

# What is air pollution?

**ENVIRONMENTAL Connection** As the human population grows, people use more energy to heat and cool homes; to fuel cars, airplanes, and other forms of transportation; and to produce electricity. This energy use contributes to air pollution that affects the composition and viability of the atmosphere. The contamination of air by harmful substances including gases and smoke is called **air pollution.** Types of air pollution include smog, chlorofluorocarbons (CFCs), particulate matter, and acid precipitation. Let's take a closer look at each type of air pollution.

## INVESTIGATION

### In a Haze

Compare the atmosphere in the two images below.

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1. How would you describe the change from one image to the other?

Students should note that the air appears brown or hazy in the photograph on the right. Visibility is reduced.

2. What do you think causes this type of change? Write your response in your Science Notebook.

**Want more information?**
Go online to read more about the impact of human activities on Earth's atmosphere.

**FOLDABLES**
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.



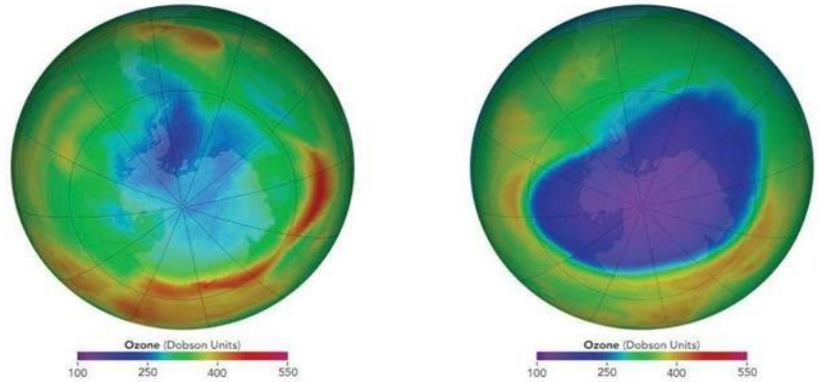
**Photochemical Smog** The brownish haze in the sky pictured in the right image on the previous page is photochemical smog. **Photochemical smog** is caused when nitrogen and carbon compounds in the air react in sunlight. Nitrogen and carbon compounds are released when fossil fuels are burned to provide energy for vehicles and power plants. These compounds react in sunlight and form other substances. One of these substances is ozone. Ozone close to Earth's surface makes air difficult to breathe. It can also damage the tissues of plants and animals.

While ozone in the lower atmosphere is harmful, ozone high in the atmosphere in the ozone layer helps protect living things from the Sun's ultraviolet (UV) radiation. Does air pollution impact the ozone layer?

## INVESTIGATION

### Oh Ozone

Compare the ozone layer in 1979 (left) to the ozone layer in 2016 (right).

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Which image shows a decrease in total ozone? What do you think caused the decrease in ozone?

The image from 2016 shows a decrease in ozone. Allow students to speculate. Some students might be aware that chlorofluorocarbons (CFCs) are strongly implicated in the ozone reduction in the upper atmosphere. Others may simply suggest air pollution.

**CFCs** In the 1970s, scientists suggested that CFCs could destroy ozone in the upper atmosphere. Studies revealed a thinning of the ozone layer, particularly over Antarctica.

All of the CFCs in the atmosphere are a result of human activity. CFCs are released from products such as old refrigerators and air conditioners, and propellants in aerosol cans. Ozone in the upper atmosphere absorbs harmful UV rays from the Sun. CFCs react with sunlight and destroy ozone molecules. As a result, the ozone layer thins and more UV rays reach Earth's surface. This, in turn, can harm the tissues of plants and animals.

While CFCs indirectly harm organisms, another form of pollution has a direct effect on Earth's biosphere. Let's explore.

## INVESTIGATION

### As a Matter of Fact

Compare areas along the Yangtze River in China.

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How would you describe the atmosphere in the above locations? What might cause the differences you observed?

The air appears clear in the photo on the left, and smoky in the photo on the right; dust and smoke from industrial processes.

**Particulate Matter** The mix of both solid and liquid particles in the air is called **particulate matter.** Solid particles include smoke, dust, and dirt. These particles enter the air from natural processes, such as volcanic eruptions and forest fires. Human activities, such as burning fossil fuels at power plants and in vehicles, also release particulate matter. Inhaling particulates can cause asthma, bronchitis, and lead to heart attacks. It can also interfere with the processes of cellular respiration and photosynthesis in plants.

## INVESTIGATION

The final major type of air pollution is acid precipitation. What are the effects of acidic rain on the biosphere? Let's take a look.

### Damaging Drizzle

Compare areas at the Great Smoky Mountains National Park in Tennessee.

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How would you describe the state of the trees in the two photos?

Students should note that the trees appear dead or in poor health in the photo on the right.

**Acid Precipitation** The trees you observed above were affected by acid precipitation. **Acid precipitation** is rain or snow that has a lower pH than that of normal rainwater. The pH of normal rainwater is about 5.6.

Acid precipitation forms when gases containing nitrogen and sulfur react with water, oxygen, and other chemicals in the atmosphere. Although volcanoes and marshes add sulfur gases to the atmosphere, burning fossil fuels is a major source of sulfur emissions. Acid rain can pollute soil and harm trees and other plants. When it falls into lakes and rivers, it can harm fish and other organisms. Many living things cannot survive if the pH of water or soil becomes too low.

Now that you understand the causes and effects of acid precipitation, see if your region experiences this type of air pollution. In the following lab, you will test the rainwater around your home.

| 19 | List and compare air pollutants and their effect on the atmosphere | textbook, investigations, figures, table, 3D | 64, 65, 66, 68, 70 |
|---|---|---|---|

**THREE-DIMENSIONAL THINKING**

Summarize your understanding of the cause-and-effect relationships between human activities and/or natural events and the environmental impacts on the atmosphere in the table below.

| Type | Causes | Effects |
|---|---|---|
| Smog | burning of fossil fuels to provide energy for vehicles and power plants | makes air difficult to breathe; damages the tissues of plants and animals |
| CFCs | products such as old air conditioners and refrigerators | destroy the ozone molecules that absorb harmful UV rays |
| Particulate matter | burning of fossil fuels; volcanic eruptions and forest fires | asthma, bronchitis, heart attacks; interferes with the processes of cellular respiration and photosynthesis in plants |
| Acid Precipitation | burning of fossil fuels; sulfur from volcanoes and marshes | pollutes soil; harms trees and other plants; harms fish and other organisms |

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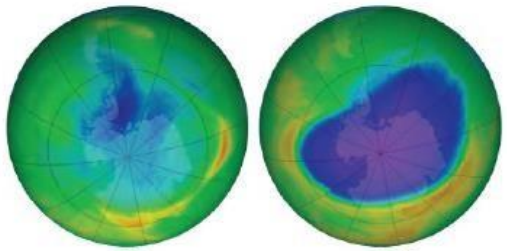
## COLLECT EVIDENCE

What are the causes and effects of air pollution? Record your evidence (A) in the chart at the beginning of the lesson.



**The image below represents the ozone layer in two different years.**

**Which of the following reduces the ozone layer in the upper atmosphere?**




A. Volcanic eruption
B. Acid precipitation
C. Photochemical smog
D. CFCs

**Which of the following statements about acid precipitation is False?**

A. It forms when nitrogen and sulfur gases react with water and oxygen in the atmosphere.
B. Acid precipitation can pollute soil and harm the trees
C. Acid precipitation can harm fish and other organisms
D. Acid precipitation has a higher PH than normal rainfalls

| 19 | List and compare air pollutants and their effect on the atmosphere | textbook, investigations, figures, table, 3D | 64, 65, 66, 68, 70 |
|---|---|---|---|

**How does acid precipitation affect the environment?**

- a) It improves soil fertility and promotes plant growth
- b) It enhances the biodiversity of aquatic ecosystems
- c) It damages forests, soils, and aquatic habitats
- d) It reduces air pollution and improves air quality

**What is the primary cause of acid precipitation?**

- a) Industrial emissions releasing sulfur dioxide and nitrogen oxides
- b) Natural volcanic activity
- c) Excessive deforestation
- d) Increased sunlight exposure

**What is acid precipitation?**

- a) Rainfall that is slightly acidic in nature
- b) Rainfall that contains high amounts of carbon dioxide
- c) Rainfall that is polluted by chemical emissions
- d) Rainfall that occurs in areas with high humidity

_____ is when nitrogen and carbon compounds in the air react in sunlight.

answer choices

- Particulate Matter
- CFC's
- Photochemical smog
- Solar Power

**What is particulate matter?**

- a) Tiny solid particles found in the air
- b) Chemical gases emitted from factories
- c) Microorganisms present in soil
- d) Sediments found in bodies of water

**How can particulate matter affect human health?**

- a) It has no impact on human health
- b) It can cause respiratory problems and lung damage
- c) It enhances the immune system and prevents diseases
- d) It promotes healthy skin and hair growth

**How do CFCs contribute to the depletion of the ozone layer?**

- a) By trapping heat in the atmosphere
- b) By releasing greenhouse gases
- c) By breaking down ozone molecules
- d) By causing deforestation

**What are some of the negative consequences of ozone layer depletion?**

- a) Increased risk of skin cancer and eye damage
- b) Improved air quality and reduced pollution
- c) Enhanced agricultural productivity
- d) Preservation of biodiversity

| 20 | List of measures and positive actions that can be taken to minimize and monitor impacts on the atmosphere | textbook, investigations, figures | 71, 73, 74 |
|---|---|---|---|

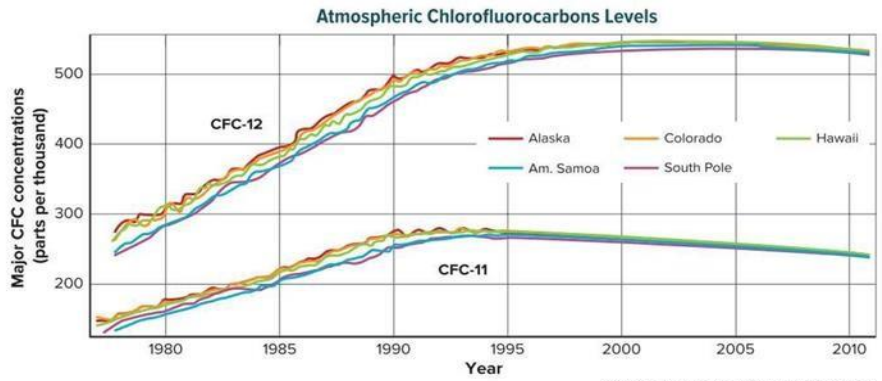
# How can we protect the atmosphere?

Preserving the quality of Earth's atmosphere requires the cooperation of government officials, scientists, and the public. Countries around the world are working together to reduce air pollution. For example, 197 countries, including the United States, have signed an international treaty called the Montreal Protocol to phase out the use of CFCs. In the United States, the Clean Air Act sets limits on the amount of certain pollutants that can be released into the air. Some states, such as California, have established their own emissions standards for motor vehicles. At least twelve other states have adopted or plan to adopt standards similar to California's in an attempt to reduce air pollution. Do initiatives such as these work? Let's investigate.

## INVESTIGATION

### International and National Initiatives

Examine the graph showing global CFC levels below.




**Source:** National Oceanic and Atmospheric Administration

**1.** What trends or patterns do you notice in the data?

Sample answer: The data show global levels of CFC-11 and CFC-12, major CFCs, increased in the 1970s and 1980s. CFC-12 continued to increase in the 1990s, while CFC-11 plateaued and began to decrease. In recent years, the data show both major CFC levels slowly decreasing.

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**Positive Actions** While international, national, and state legislation helps monitor and minimize impacts on the atmosphere, people can also make a difference. Do you turn off the lights when you leave a room? If so, you are helping reduce your impact on the environment. You can help protect Earth's atmosphere in other ways as well, such as educating others about environmental issues, analyzing the choices you make as a consumer, and following some of the suggestions you will read about next.

## INVESTIGATION

### It's Your Turn

Study the figure below.

**1.** Can you identify ways in which this community is helping reduce air pollution?

solar panels, recycling, planting trees, hybrid vehicle, public transportation

**2.** What other methods or technologies would you suggest?

Answers might include riding bicycles, utilizing alternative energy resources such as wind or geothermal power, and turning down thermostats in the winter and up in the summer.

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| | | | |
|---|---|---|---|
| 20 | List of measures and positive actions that can be taken to minimize and monitor impacts on the atmosphere | textbook, investigations, figures | 71, 73, 74 |

**Making a Difference** People have many options for reducing air pollution. You might be too young to own a house or a car, but you can perform simple activities such as planting trees to improve air quality, or turning off lights and electronic equipment when you are not using them to save energy. Walking, biking, or using public transportation also conserves energy. Recycling metal, paper, plastic, and glass reduces the amount of fuel required to manufacture these materials. Reducing energy use (both directly and indirectly) means that fewer pollutants are released into the air.

People also can invest in more energy-efficient technologies. Hybrid cars, for example, use both a battery and fossil fuels for power. Electric vehicles, such as the one shown below, use electric power alone.

Another way is to develop and use alternative sources of energy. Using renewable energy resources such as solar power, wind power, and geothermal energy to heat homes helps reduce air pollution. Recall that renewable resources are resources that can be replaced by natural processes in a relatively short amount of time.

**What Gives?** If solutions such as solar panels and wind turbines are engineered to help reduce air pollution caused by human activities, why aren't more individuals, towns, and countries relying solely on these types of technologies? In the following investigation, you will research and debate the advantages and disadvantages of Earth's energy resources.



## Ways to Reduce Air Pollution

Planting trees to improve air quality
Turn off lights and electrical equipment to save energy
Walk, ride a bike, use public transportation
Recycle
Invest in electric cars
Alternative ways to make electricity-water, wind, geothermal

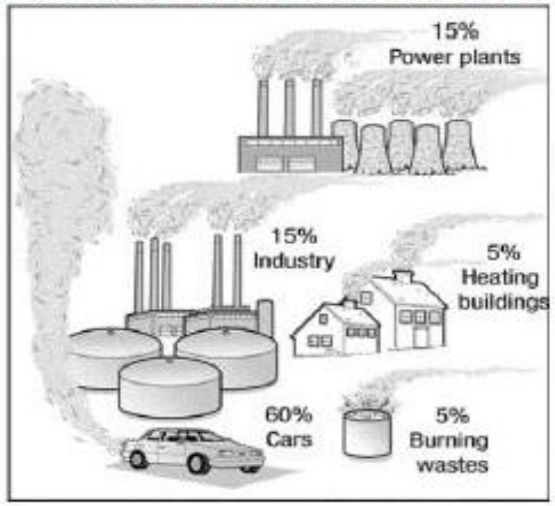
2) Which describes a way that people can minimize their impact on air pollution?

- A) decrease burning of oil and coal
- B) invent ways to remove particulate matter from the air
- C) decrease the size of the ozone layer
- D) invent ways to treat asthma

**Correct Answer**

A) decrease burning of oil and coal

5) The graphic shows where air pollution begins in a local community. Which would be the most effective way to reduce air pollution in this community?




- A) pass a law that states people cannot burn wastes
- B) help people to heat their homes more efficiently
- C) make traveling by bicycle easier and safer
- D) invent a way to trap particulate matter from industry

**Correct Answer**

C) make traveling by bicycle easier and safer