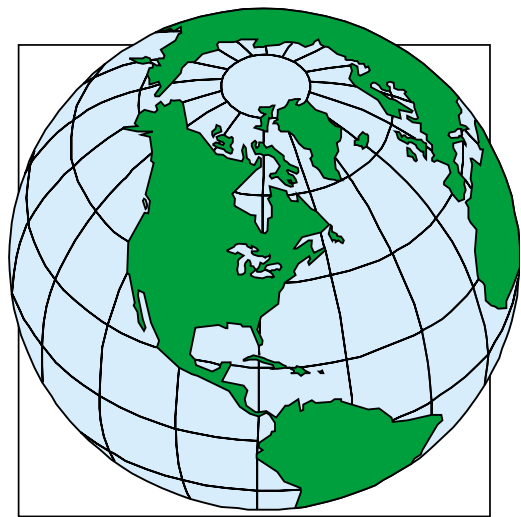


# Unit 11: Science and the Environment







## Vocabulary

*Study the vocabulary words and definitions below.*

**analogous system** ..... a research model that studies objects which are similar in function or design

**computer model** ..... a program that allows a computer to quickly and with detail mimic or predict the behavior of real objects or systems

**greenhouse gases** ..... chemicals emitted into the atmosphere that add to the overall increase in Earth's temperatures

**habitat fragmentation** ..... when roads cross a habitat; they expose animals within the habitat to death due to encounters with vehicles

**pollutants** ..... substances which lower the amount of life within a system

**runoff** ..... water that travels over the surface of the land during and after rain

**scale model** ..... a miniaturized but proportional version of an object

**technology** ..... the knowledge and tools we use to do difficult tasks





## Introduction

In Unit 10 we discussed ecosystems. We included some of the ways man may change ecosystems. In this unit we will expand on that topic and look at ways that man's tools impact ecosystems. Specifically, we will examine how science and **technology** affect the quality of our lives, our environments, and our future.

## Protecting the Environment

The environment is very delicate. Special care must be taken of the environment if it is going to continue to provide an atmosphere that will support life and all of the natural resources people

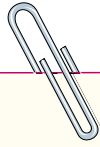


need to live. Some of these resources, such as minerals, ores, and fossil fuels, cannot be replaced. They are said to be nonrenewable. Others, such as the forests, soil, air, and water, are renewable and can be used over and over again. People must learn to use resources wisely and conserve or preserve natural resources for future use without inhibiting progress.

Pollution is a change in the air, water, or land that can be harmful or unpleasant to living things and the environment. Pollution upsets the balance of nature, and if not controlled, could cause severe environmental problems.

There are several measures society can take to help preserve the balance of nature and at the same time allow for technological advancement. One way is to make people aware of the problems of pollution and the need for conservation. Society can help create laws which protect the environment. Conducting scientific research to help keep nature in balance is another way to protect the environment. Some of the projects scientists are working on to accomplish this are as follows:





- finding new food sources
- looking for ways to get usable minerals and other natural resources from the ocean
- trying to find easier and less expensive ways to turn ocean water into fresh water
- looking for new energy sources
- looking for new ways to combat the harmful effects of pollution
- exploring space to possibly find new resources, answers to problems on Earth, and perhaps a new place for people to live

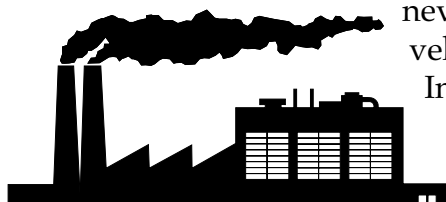
## Environmental Impact of Technology

Self-propelled vehicles have been around now for over 100 years and are a form of technology that most of us know well. Even if you don't know how a car works, its technology lets you use it to get around town. One of the goals of any technology is to solve problems or make life easier. Unfortunately, technology is not perfect. While vehicles make it easier for humans to travel great distances, they also can create problems. Let's look at just three of the problems: **runoff**, **greenhouse gases**, and **habitat fragmentation**.

### Runoff

Runoff is water that travels over the surface of the land during and after rain. It can carry **pollutants** and nutrients to waterways and disturb ecosystems.

Think about the many vehicles that are driven each day on a road. As the miles go by, the tires wear down, leaving rubber on the road. The next time it rains, that rubber, and all the spilled oil, gas, and other materials left on the highway wash downstream, causing water pollution. This problem can be traced back to a technology most of us take for granted,



never thinking of the devastating effect vehicles have on lakes, ponds, and wetlands. In response, scientists have been conducting research and looking for other energy sources. One of these is the electric vehicle.

One benefit of research is that you never know what you will learn. While we seek a solution to the problem of runoff and alternative energy sources, we may find solutions to other problems. Any effort to solve a problem advances science; that is, research increases our knowledge and understanding of the universe. In the case of runoff, there is much research being conducted. Because it is not possible or plausible to test all roads and conditions, scientists make some compromises. When a hypothesis is prepared and ready for testing, they may make use of a variety of models. Some models are like the **scale models** many people build as hobbies. They show a miniaturized version of objects and factors.

Some models may be **computer models**. These are programs that allow a computer to quickly and with detail mimic or predict the behavior of real objects or systems. For instance, we know that adding phosphate to water will increase the amount of algae. To predict how a large lake will be affected, we do not want to add the phosphate, motor oil, or other pollutants. Instead, we might create a computer program that would use known information to predict what could happen to the lake. This would be a far safer and faster way to examine the effects of runoff.

In researching runoff, we might look at another model, an **analogous system**. A small ditch in your yard is not the Apalachicola River. Still, there are similarities. Objects which are similar in function or design are analogs. We could determine how runoff effects the organisms that live in your ditch. From this, we might be able to reach conclusions about a stream, brook, or river. Runoff poses a threat to many Florida waters, so research is being conducted to determine ways to solve and prevent this problem.

### Greenhouse Effect

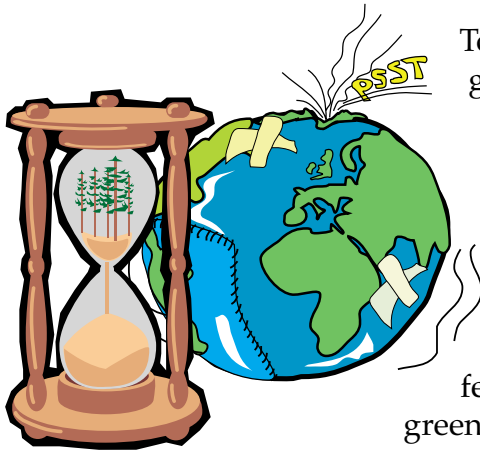
The greenhouse effect is a condition of increased heat resulting from the reflection of the sun's heat back to Earth from the atmosphere. Higher levels of carbon dioxide in the atmosphere cause an increase in the





ability of the atmosphere to trap heat. This trapped heat may cause an overall increase in Earth's temperatures. Chemicals called greenhouse gases are emitted into the atmosphere and add to the greenhouse effect. These gases are the result of burning fossil fuels in vehicles and using these fuels in homes and factories. Fossil fuels are created when living things die and form layers within the earth. Some of these organic materials do not fully decompose and so they maintain a high level of energy. Eventually, given great time and pressure, these energy-rich organic materials may turn into coal or oil deposits which are then burned by humans. This produces much-needed heat, but at the same time creates a variety of greenhouse gases such as carbon dioxide. These greenhouse gases coupled with the destruction of the world's rain forests have created a slow but steady increase in atmospheric carbon dioxide levels. This increase may have an adverse effect on life on Earth.

Burning fossil fuels releases carbon dioxide into the atmosphere. In order to remove these dangerous levels of carbon dioxide from the air, we rely on green plants to use carbon dioxide in photosynthesis. This process produces food for the plants and other organisms and at the same time releases oxygen. Without plants, our lives would not be possible. One effect of building roads and making the world accessible to vehicles, though, is a reduction in the amount of plant life. As the amount of plant life decreases and the quantity of greenhouse gases increases, Earth's climate may change. The result may be the loss of species or whole ecosystems.



To help solve the problem of greenhouse gases, scientists and engineers have recently made changes in vehicles by installing pollution-control devices. These changes have contributed to a reduction in the amount of greenhouse gases produced. The improvements may continue to come; however, they will be controlled by a few factors. If a vehicle produced no greenhouse gases but cost one million dollars, would many people buy it? This solution would not be practical. At the same time, it may not be practical to ask everyone to start walking. Some people would be unable and others unwilling.





The value one person places on something may be different from the value another person places on it. Think about the importance of plant life to different people. Persons who rely on herbal medicines may want to save the rain forests and improve their health and quality of life. Others may want cheap lumber and beef grown on land that used to be forest. The same is true for technology. One person may rely on a cellular phone or pager and see no way to do without them. Someone else though, when faced with the destruction of plants, trees, or an entire ecosystem to install a transmitter tower, may see that technology as unnecessary.

Every individual can do his or her part to help reduce the effect of greenhouse gases. Actions such as car pooling, using public transportation, riding bicycles, making sure that vehicles are in good working order, and planting trees and greenery can help solve this problem.

### **Habitat Fragmentation**



*Florida panther*

Habit fragmentation occurs when roads cross a habitat and expose animals within the habitat to fatal encounters with vehicles. Imagine a young Florida panther on a dark road who knows nothing of automobiles, trucks, or headlights. The panther is only concerned with getting across the road. Often, the panther would attempt to cross and would die. The resulting loss of life was caused by a culprit called habitat fragmentation.

Habitat fragmentation creates isolated pockets of creatures and most likely contributes to the threatened and endangered status of the Florida panther. The public has become concerned with the dwindling number of panthers in the wild. State and federal governments, private foundations, and industries all offer money for research to determine what can be done to save the panther. Scientists have begun to research the panther and its habitat and have discovered that panthers need large, unbroken habitats. A male panther will also need his home range to cross that of several females.



Scientists, however, cannot take away the roads. Instead, scientists have offered an experiment. A series of low, hidden tunnels have been built under roads. The tunnels are monitored for signs of use. The tunnels have reduced the number of panthers killed and have also provided crossings for other animals as well. In this case, a technological answer to a technological problem does seem to be producing some benefits. In order to learn this and other information about panthers, scientists perform research. Scientists have some information to offer and their insights point the way to the solution. The case is similar whenever scientists are asked to offer solutions or explanations of matters of public concern.

## Summary

There is an interconnectedness of Earth's systems and the quality of life. To improve their quality of life, many use technology. This technology allows humans to do many things but may adversely affect their environments. Such problems may create an opportunity for new technology, but the value of this technology differs for different people. No technology is successful if it is not practical for humans and does not meet their needs or values.

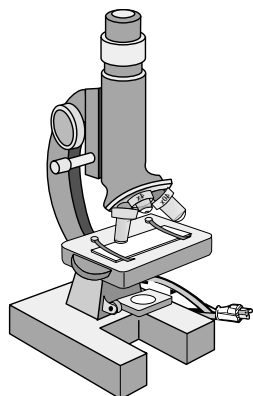
In testing technologies and other scientific situations, scientists use a variety of models. These include scale models, computers models, and analogous systems. The research conducted allows scientists to address areas of public research and offer knowledge and insight. Money for such research comes from a variety of sources including state and federal governments as well as private industry and foundations. This money can control the areas of research.

Florida is threatened by a variety of technological problems. These include runoff into lakes and wetlands, the greenhouse effect, and habitat fragmentation. One culprit in these threats is vehicles. Vehicles contribute to the production of greenhouse gases through the burning of fossil fuels. Scientists are currently seeking the technological solutions to these technological problems. Protecting our environment, while at the same time allowing for technological progress, is an extremely important and difficult task. Controlling the pollution of air, land, and water is one way to help solve this problem.



## Careers in Biology

### Environmental Engineer



**Environmental engineers** apply knowledge of ecology and engineering to promote a safe environment for humans and other organisms. The work done by individual engineers varies widely. Some work in laboratories or offices while others inspect building sites and structures. Environmental engineers usually seek to prevent humans from damaging environmental systems or find ways to minimize such damage. Many engineers work on protecting clean drinking water. A bachelor's degree is the minimum college work needed and most environmental engineers have higher degrees.



## Practice

*Answer the following using complete sentences.*

1. Give an example of a situation or problem that would be difficult to test without a model and describe the model you would use.

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2. Describe a situation from the news or recent history where scientists were called upon to provide explanations of events and offer possible solutions to problems.

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3. Choose an industry or business. Decide what areas of scientific study they should support and state why you think so.

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4. Describe one way in which the quality of human life is based on the quality of a natural ecosystem.

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5. Give an example of a technology or problem that has recently become widespread. Discuss the impact of this technology or problem and contrast that to the way you think others may view the technology or problem.

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## Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

<b>Florida panther</b>	<b>rain</b>	<b>temperature</b>
<b>fossils</b>	<b>runoff</b>	<b>tunnels</b>
<b>pollutants</b>	<b>technology</b>	<b>vehicles</b>
<b>radios</b>	<b>telephones</b>	<b>wetlands</b>

- \_\_\_\_\_ is the knowledge and tools we use to do difficult tasks.
- \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are all examples of technology we use daily.
- \_\_\_\_\_ is water that travels over the surface of the land during and after rain. It can carry \_\_\_\_\_ and nutrients to waterways and disturb ecosystems.
- When vehicles roll down the roads, the rubber that wears off the tires may run downhill during the next \_\_\_\_\_.
- Oil, gas, and other pollutants may pose a threat to Florida's lakes and \_\_\_\_\_.
- Greenhouse gases are chemicals emitted into the atmosphere that add to the overall increase in Earth's \_\_\_\_\_.



7. Greenhouse gases are produced by burning \_\_\_\_\_ fuels, which are the remains of living organisms.
8. When roads cross a habitat, they expose animals within the habitat to increased rates of death due to encounters with \_\_\_\_\_ .
9. It is believed that the creation of isolated pockets of animals has likely contributed to the endangerment of the \_\_\_\_\_ .
10. By creating \_\_\_\_\_ under roads, the number of panthers struck and killed seems to have been reduced.



## Lab Activity: Carbon Dioxide in the Atmosphere

### Facts:

- Oxygen is used by many organisms to release energy from food.
- Carbon dioxide is a product of combustion as well as the metabolism of food.
- Without oxygen, many organisms cannot survive.
- Flames will not burn without the presence of oxygen.

### Investigate:

- You will use a burning candle to model a living system and show how its production of carbon dioxide can be used to extinguish the flame.

### Materials:

- 1 candle
- 2 beakers or jars to cover the candle, 1 smaller and 1 larger
- matches or lighter
- a stopwatch

1. Place the candle in the center of your workspace. Light the candle and allow it to burn until the flame is steady. Did you see any smoke or other material given off by the flame?  

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2. Set the stopwatch to zero. Set the smaller beaker down over the flame. Record the time before the flame extinguishes. What happened to the flame before it went out?  

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3. Remove the smaller beaker. Light the candle and allow it to burn until the flame is steady. Set the larger beaker down over the flame. Record the time before the flame extinguishes.  

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4. What accounts for the difference (if any) in the times between the larger and smaller beakers?

\_\_\_\_\_

5. What gas was produced by the candle that caused it to go out?

\_\_\_\_\_

6. What gas was used by the candle before it went out? \_\_\_\_\_

7. What does the candle represent in this experiment? \_\_\_\_\_

8. What type of model is the candle? \_\_\_\_\_

Why? \_\_\_\_\_

9. If it were possible to put living plants within the beakers that used the carbon dioxide for photosynthesis, what might happen to the flame?

\_\_\_\_\_

10. Describe a real-life situation that is similar to that described in question #3.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

11. What implication does this experiment have for the burning of fossil fuels?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



## Practice

Use the list below to write the correct term for each definition on the line provided.

**analagous system**  
**computer model**  
**greenhouse gases**

**habitat fragmentation**  
**pollutants**  
**runoff**

**scale model**  
**technology**

- \_\_\_\_\_ 1. chemicals emitted into the atmosphere that add to the overall increase in Earth's temperatures
- \_\_\_\_\_ 2. when roads cross a habitat; they expose animals within the habitat to death due to encounters with vehicles
- \_\_\_\_\_ 3. substances which lower the amount of life within a system
- \_\_\_\_\_ 4. the knowledge and tools we use to do difficult tasks
- \_\_\_\_\_ 5. a research model that studies objects which are similar in function or design
- \_\_\_\_\_ 6. water that travels over the surface of the land during and after rain
- \_\_\_\_\_ 7. a miniaturized but proportional version of an object
- \_\_\_\_\_ 8. a program that allows a computer to quickly and with detail mimic or predict the behavior of real objects or systems