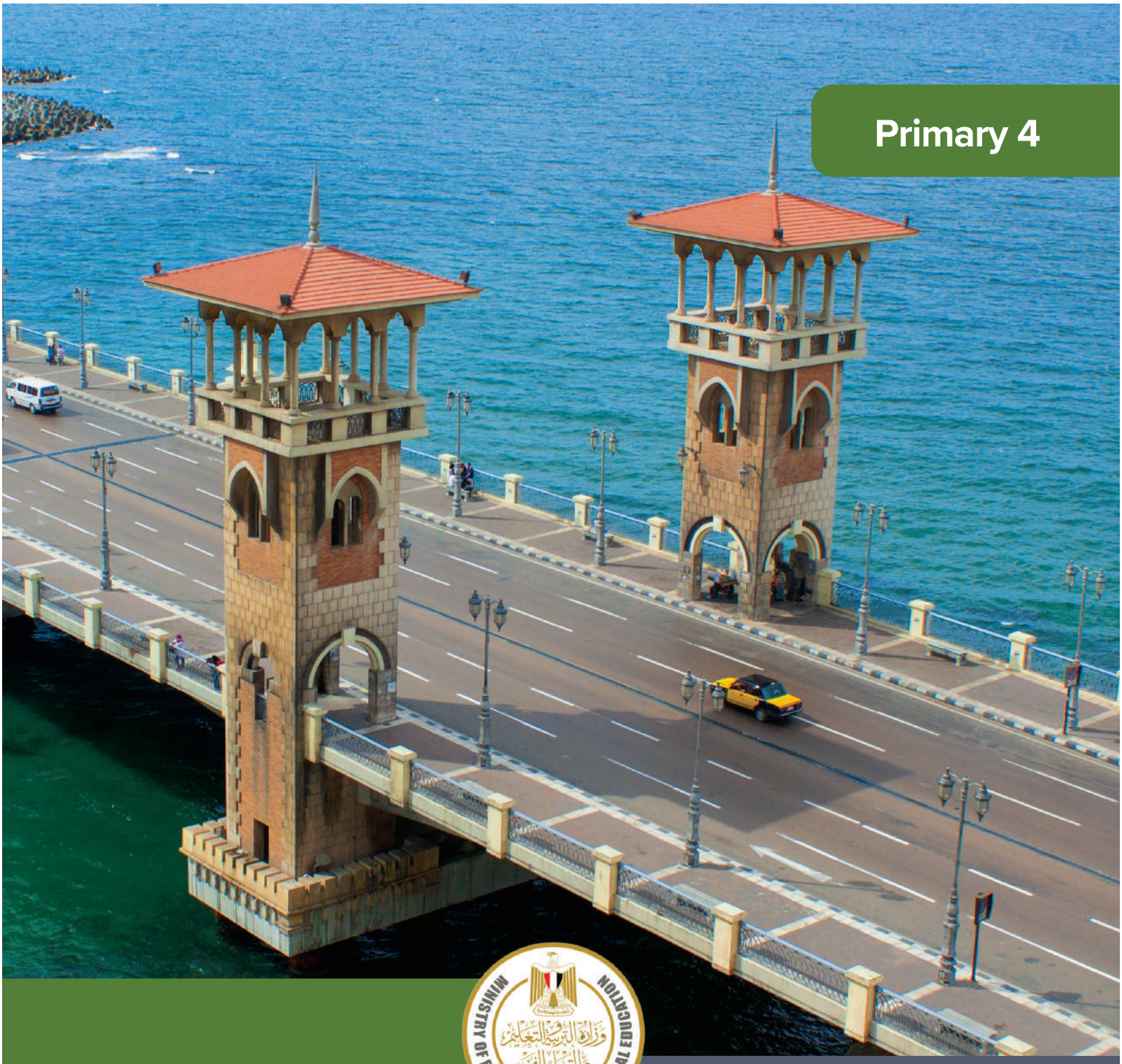

Primary 4

Science Term 2

Primary 4 Science

Name _____

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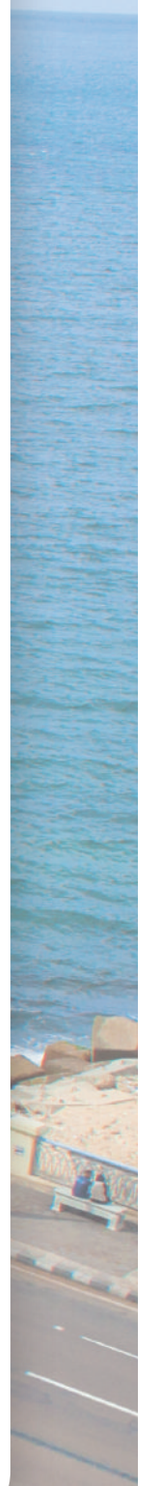

FOREWORD

The MOETE launched Egypt's reform vision for the development of education, and the process of developing curricula comes at the heart of this vision. The implementation of this vision was heralded in 2018, starting with the kindergarten stage in its first and second grades, with the aim of continuing until the end of the secondary stage.

This vision endeavored to make major transformations in the teaching and learning processes, where there is a transition from acquiring knowledge to producing it, and from learning skills to employing them both in specific learning situations and in the general life of the learner outside the classroom. Our curricula also integrate values that contribute to the establishment of our society—values which pose as a protective fort for our homeland. Egypt's reform vision for curriculum development also aims to take into account the specifications of pre-university education graduates, as well as the challenges Egypt faces locally, regionally, and globally. The developed curricula are intended to foster a citizen who is capable of engaging in civilized conversations and positive dialogues with the other, in addition to acquiring digital citizenship skills.

In this regard, the MOETE extends its gratitude and appreciation to the Central Administration for the Development of Curricula and Educational Materials. It also extends its thanks and gratitude to Discovery Education for their active participation in the preparation of this book. Gratefulness also goes to all the Ministry's experts who contributed to the enrichment of this work.

This transformation of Egypt's education system would not have been possible without the significant support of Egypt's current president, His Excellency President Abdel Fattah el-Sisi. Overhauling the education system is part of the President's vision of "rebuilding the Egyptian citizen" and it is closely coordinated with the Ministries of Higher Education and Scientific Research, Culture, and Youth and Sports. The new education system is only a part in a bigger national effort to propel Egypt to the ranks of developed countries, and to ensure a great future for all of its citizens.

WORDS FROM THE MINISTER OF EDUCATION & TECHNICAL EDUCATION

Dear students and fellow teachers,

It gives me great pleasure to celebrate this crucial stage of comprehensive and sustainable development, an epic in which all Egyptian people are taking part. This pivotal stage necessitates paving a foundation for a strong educational system which yields a generation that is not only capable of facing the major challenges the world is witnessing today, but one that also has complete possession of the skills of the future. For this reason, the Egyptian state is keen on empowering its citizens by establishing a top-notch educational system that invests in its children the expertise required to get them to compete at both a regional and global level, at a time when the world is witnessing successive industrial revolutions.

This dictates that our educational system has at its core an emphasis on skills development, deep understanding, and knowledge production. This can only be done through modern curricula that keep up with the changes taking place globally-- curricula which prioritize the development of skills and values, and the integration of knowledge. They are also curricula that focus on the provision of multiple learning sources, and integration of technology to enrich the educational process and to improve its outcomes, while addressing the most important contemporary issues.

To achieve this, we must all join hands to continue to revolutionize our education, and to support it with all that is required to transform it into a globally pioneering educational system.

My warmest regards to you, dear students, and my deepest gratitude to my fellow teachers.

Professor Reda Hegazy

Minister of Education and Technical Education

Dear Parent/Guardian,

This year, your student will be using Science book, a comprehensive science content developed to inspire students to act and think like scientists and engineers. Throughout the year, students will ask questions about the world around them and solve real-world problems through the application of critical thinking across the domains of science (Life Science, Earth and Space Science, Physical Science, Environmental Science, Engineering and Technology).

Theme 3: Protecting our Planet	
Unit 3: Energy and Fuels	
3.1	**Devices and Energy**
3.2	**About Fuels**
3.3	**Renewable Energy Resources**

Theme 4: Change and Stability	
Unit 4: Shifting Surfaces	
4.1	**Breaking Down and Moving Rocks**
4.2	**Changing Landscapes**

Science book has an innovative content that helps your student master key scientific concepts. Students engage with interactive science materials to analyze and interpret data, think critically, solve problems, and make connections across science disciplines. It includes QR codes, dynamic content, videos, hands on investigations,labs and game activities that inspire and motivate scientific learning and curiosity.

Science book is divided into units, and each unit is divided into concepts. Each concept has three sections: Wonder, Learn, and Share.

Units and Concepts Students begin to consider the connections across fields of science to understand, analyze, and describe real-world phenomena.

Wonder Students activate their curiosity and prior knowledge of a concept's essential ideas and begin making connections to a real-world situation.

Learn Students dive deeper into core scientific concepts through critical reading of texts and analysis of multimedia resources. Students also build their learning through investigations and interactives focused on the learning goals.

Share Students share what they are learning with their teacher and classmates using evidence they have gathered and analyzed during Learn. Students connect their learning with entrepreneurship, careers, and problem-solving skills.


Lesson 1

Activity 1

Can You Explain?

In the last term you learned about how objects in the world move around you by exploring the relationships between energy, work, and force. Now you will connect your learning about energy to explore how it can be transformed through devices.

What kinds of energy transfer must occur for light from the sun to power a cell phone?

Life Skills I can share ideas I am not yet sure about.

Concept 3.1: Devices and Energy | 5

Within this Student Edition, you will find QR codes and quick codes that take you and your student to a corresponding section of Science online.

We encourage you to support your student in using QR codes. Together, may you and your student enjoy a fantastic year of science and exploration.

Sincerely,

The Science Team

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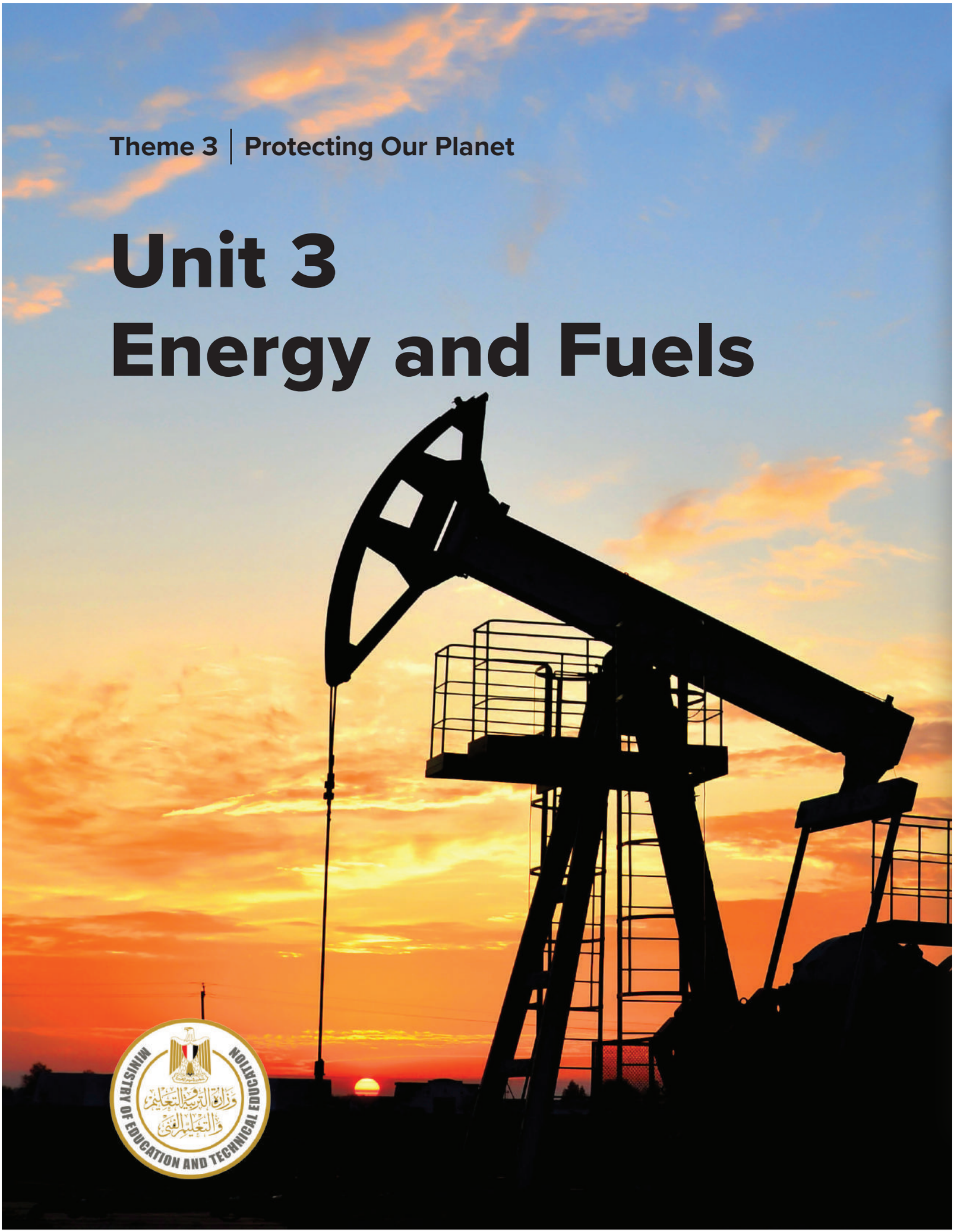
Unit Wrap-Up

Assess your learning

Theme 3 | Protecting Our Planet

Unit 3
Energy and Fuels

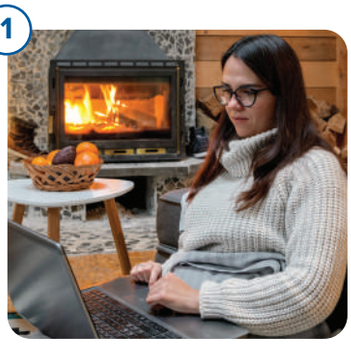


Get Started

What I Already Know

This unit is all about energy and fuels. **Think** about how humans use fuel for energy. **Look** at the first two images on this page. What types of fuels are shown? How is the energy from the fuel being used? Then, **look** at the third image. You can see the fire, but are there other examples of energy from fuel that you can see in the photo? **Write** some ideas you have about how humans use fuel and how we use energy that comes from fuel.

1



2

3

Talk Together Think about the items in your house that require energy or fuel. Where do you think that energy or fuel comes from? Share your ideas with a partner.

Now that you have learned about energy as it relates to work and motion, this unit will help you look at energy in a different way. During this unit, you will learn a lot more about how energy helps humans do everything from cook food to drive cars to power everyday devices. You will explore where this kind of energy comes from. You will explore different types of fuels and learn the difference between renewable and nonrenewable resources. You will investigate certain kinds of renewable energy that come from the sun, wind, or water. Finally, you will consider the impact on the environment when we use different kinds of resources for energy, whether they are renewable or nonrenewable.

Water for Energy

The sight of tremendous amounts of water flowing down a river and over a waterfall is impressive. All that water has a lot of kinetic energy. By the end of this unit, you will be able to describe how that energy can be turned into useful electricity. You will also be able to evaluate how obtaining that energy impacts the environment.

Water for Energy

Watermill

Did you ever think that we could use water as an energy resource? Have you ever felt the force of waves on the sea or ocean? Maybe you have observed a waterfall and heard the sound the rushing water makes. For years, people have used water to create energy by using the force of falling or moving water to move objects like a watermill. Water moves through the slats on the wheel and turns it, creating energy to move machinery and equipment. In modern times, scientists and engineers have developed a more sophisticated solution to harness the power of water. Dams are built to harness the flow of a river through a system that captures the power of the moving water. Hydroelectric power is the term we use to describe using the power of moving water to turn a large turbine to generate electricity. Dams can create lots of clean energy, but they also have an impact on the surrounding ecosystems by changing the path of water.

Solve Problems Like a Scientist

Unit Project: Dam Impacts

In this project, you will use what you know about energy and the environment to assess the positive and negative impacts of building a dam on the surrounding environment and community.

Questions

Did you visit the High Dam in Aswan in Egypt

- What do you notice about this image of the Kariba Dam in Southern Africa?
- How do you think dams can change the landscape?
- How do you think changing the landscape can affect plants, animals, and humans?

High Dam in Aswan, Egypt

Kariba Dam

Ask Questions About the Problem

You will research solutions to one of the negative impacts of building a dam. **Write** some questions you can ask to learn more about the problem. As you learn about how energy use affects the environment, **write** answers to your questions.

CONCEPT
3.1

Devices and Energy

Student Objectives

By the end of this concept:

- [ ] I can develop models based on observations that describe how everyday devices transform energy.
- [ ] I can use observations and evidence to explain how energy is transferred from place to place.

Key Vocabulary

- [ ] chemical energy
- [ ] Earth
- [ ] energy transfer
- [ ] energy source
- [ ] energy conservation
- [ ] sun

Activity 1

Can You Explain?

In the last term you learned about how objects in the world move around you by exploring the relationships between energy, work, and force. Now you will connect your learning about energy to explore how it can be transformed through devices.

What kinds of energy transfer must occur for light from the sun to power a cell phone?

Life Skills **I can share ideas I am not yet sure about.**

Activity 2

Ask Questions Like a Scientist

Energy in Remote-Controlled Cars

Every day you may use devices that need energy to work. Have you ever thought about where that energy comes from? **Read** the text and **look** at the image. Then, **complete** the activity that follows.

Many toys can be operated remotely. Remote-controlled cars, trucks, planes, boats, and robots are fun to use. All these devices need energy to make them move and do tasks such as turning corners, moving remote arms, or operating cameras.

Where do you think they get this energy from? All of these devices use electricity. Batteries are their onboard **energy source**. When the batteries are exhausted, they must be recharged or replaced with new ones. That is easy. Simply plug the device into the nearest charger or purchase new batteries at a store. But sometimes that is not possible. What other energy sources do you think devices use?

Think about the devices you use in your daily lives and the energy they use. **Write** questions you have in the chart below.

I wonder . . .

Life Skills **I can identify problems.**

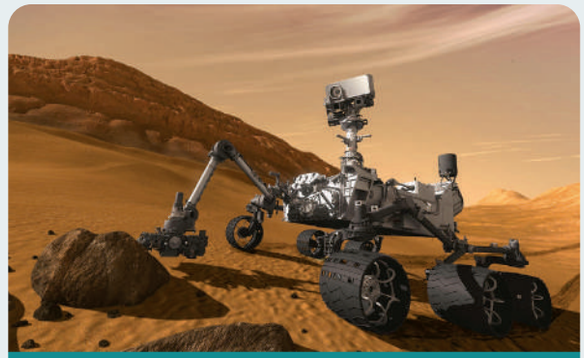
Activity 3

Analyze Like a Scientist

Mars Rover

Think about how the mars rover gets its energy. **Look** at the picture and **read** the text.

Mars never gets closer to **Earth** than about 54 million kilometers. That's a long way. It takes a spacecraft about six months, usually longer, to get there.



Mars Rover Curiosity

Over the past few decades, humans have sent many missions to Mars. None of these missions included people; they all used different types of remotely operated vehicles or robots. These robots have performed a variety of jobs. One of the most famous robots is the Mars rover Curiosity, which travels on the surface of the planet.

Like remote-controlled toys, these rovers need energy. They also use electricity. However, the rovers are too far from a local store or socket on Earth to use the same types of batteries as those found in toys. They can't just plug into the nearest Mars rock. What energy sources could they use?

List possible ways the Mars rover gets its energy.

_____

_____

_____

Life Skills **I can analyze a situation.**

Activity 4

Evaluate Like a Scientist

What Do You Already Know About Devices and Energy?

You have been thinking about how different devices get the energy they need to function. Now let's think about these devices when they are in use. How does the energy change? **Look** at the pictures. Then, **discuss** the questions with a partner.

Hair Dryer

Detergent bottle

Washing machine

Talk Together What is the source of energy, or energy input, for each device? What is the energy output?

Life Skills I can analyze a situation.

Where Does the Energy We Use Come From and Go To?

Activity 5

Analyze Like a Scientist

Energy Chains

Consider what you have learned about energy sources so far. How would you trace energy from its source to a device in use? **Read** the text and **look** at the diagrams of energy chains. **Share** your understanding with your partner.

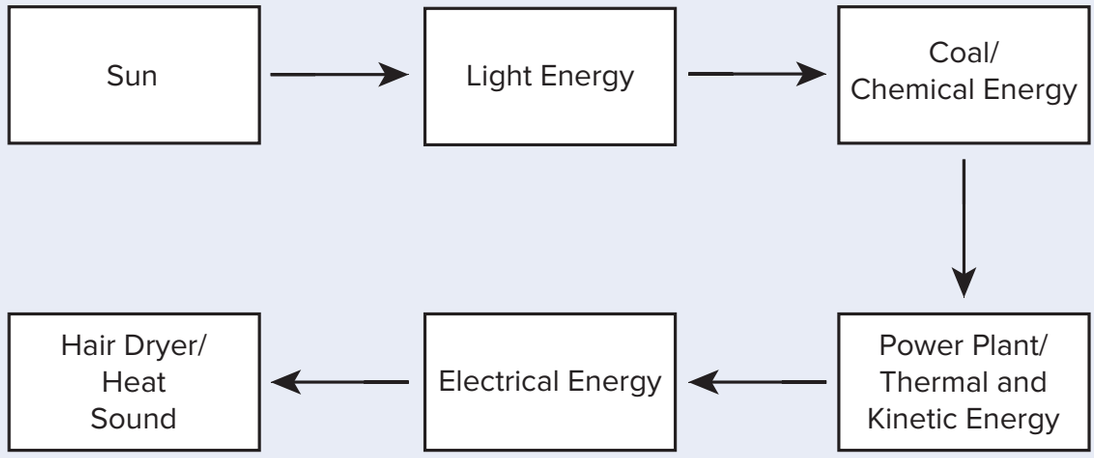
Most energy we use is made inside the **sun**. But how does that energy get inside the devices we use? We can draw energy chains that show the path of energy from the sun to different devices. A simple energy chain familiar to all of us is eating. This energy chain starts with energy from the sun hitting Earth as light. A plant, such as an orange tree, transforms that light energy into stored chemical energy as it makes sugars. When you eat the orange, your body uses **the chemical energy** that stored in the food to get the energy needed to do different activities such as movment.

How can an energy chain help us understand the energy of devices? Let's start with a simple example: heating a pan of water over a fire. The light energy of the sun helps a tree grow. The energy is stored in the tree as chemical energy. When the wood is burned, it releases thermal energy that heats the water.

The energy chain for a hair dryer is more difficult. The electrical energy that powers a hair dryer reaches it through an electric cord that is made of copper. The electrical energy comes from a power plant of some type. Perhaps it burned coal or gas to make this electrical energy. But where did this energy originally come from?

Energy Chains, *continued*

We already have many of the links. We have traced the energy backward to the power plant. If that power plant burned coal, a form of chemical energy, then we need the link to the sun. Coal was formed millions of years ago from dead trees. Where did the trees get their energy from? You guessed it: sunlight. So now we can diagram the energy chain for a hair dryer.



As you notice not all energy that enters an energy chain reaches the device and gets used as we intend. At each link in the chain, some energy escapes as other forms. It still exists, but it gets transformed into another energy form that is not used by the device. Most of this energy escapes in the form of heat.

Activity 6

Think Like a Scientist

Energy and Everyday Devices

In this investigation, you will use what you know about types of energy to describe the energy input and output of various devices. Before you begin your observations, review with your group some of the examples of energy input and output from previous activities. As you work, **discuss** your ideas and **record** your observations. When you finish, **reflect** on your experiences and **answer** the questions. As you investigate, record your observations in the table provided.

Energy of Everyday Devices

Device	Function	Form(s) of Energy In	Form(s) of Energy Out
Table lamp	Providing light	Electrical	Light, thermal

Does all of the energy that goes into each device come out as part of its function, or is some of the energy wasted? Support your answer with examples.

Life Skills **I can use information to solve a problem.**

Activity 7

Observe Like a Scientist

The Conservation of Energy

Think about what you already know about changes in energy. Do you think energy can disappear or be used up? **Read** the text to learn about **energy conservation**. Then, **answer** the questions that follow.

You already know that energy can change and that there are many types of energy. Energy is constantly converted from one form or type to another. Consider this example: If you have ever ridden a bike, you are part of a series of events that involve energy conversion.

You eat breakfast so that the chemical energy in your food will give your body energy. Where the chemical energy changes into kinetic energy as you push on the bike pedals with your legs, you cause the bike to move. The mechanical energy in the bike is also becoming heat energy as the tires rub on the Earth's surface.

Here is another example of a different type of energy conversion. When you turn on a light bulb, you are starting an energy transformation. Electrical energy that powers the light bulb is converted into light and heat energy. The room becomes brighter with the light from the bulb. If you hold your hand near some light bulbs, you can feel their heat.

While energy can change forms, it never goes away. Energy cannot be created nor destroyed. This is the Law of Conservation of Energy. It means that new energy cannot simply be made from nothing, and old energy does not disappear. Energy just changes types and forms.

What is the definition of the phrase *conservation of energy*?

What are the different forms of energy involved when a light bulb is turned on?

Life Skills **I can identify problems.**

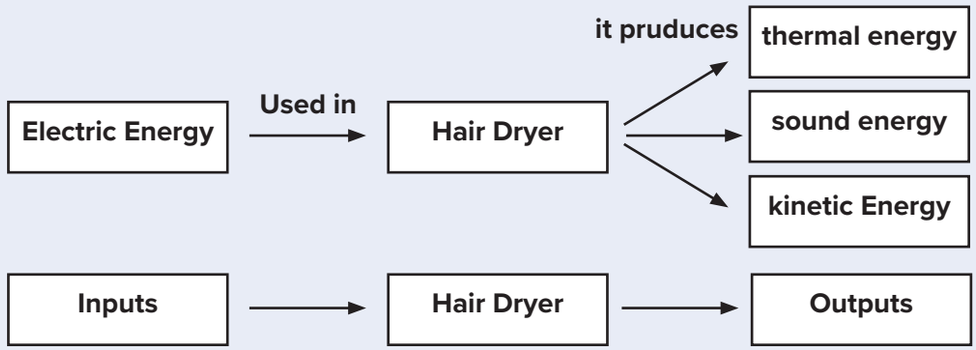
Activity 8

Analyze Like a Scientist

Follow the Flow

No one likes it when their cell phone battery dies. Why does this happen? Where does the energy go? **Read** the text and **look** at the diagram to find out how the energy that powers a device is converted into other types of energy and where it flows. Then, **answer** the question that follows.

Energy is conserved. It is neither created nor destroyed. What does this mean for how energy powers our devices? All the energy that goes into a device must eventually leave it, either in the same or a different form. Devices have energy that goes in and energy that goes out. We call these energy *inputs* and *outputs*.



When we trace the flow of energy, all energy must have a place to go. It might seem like a device "loses" energy. In fact, the energy has been converted into another type of energy. Sometimes this converted energy does not help do what the device is designed to do.

Think of a hair dryer. The energy input to the hair dryer comes through the cord as electrical energy. Inside the dryer, that energy is changed into other types. Thermal energy, sound, and kinetic energy (from the fan and moving air) leave the dryer. These are its energy outputs. The noise of the hair dryer can seem like "lost" energy because the sound energy is not contributing to the job of the device: to dry hair.

What kinds of energy transfer must occur for light from the sun to power a cell phone?

Sometimes, energy enters a device and is stored inside it for a while. A cell phone is one example. Energy enters the device as electrical energy. It is stored in the battery of the phone as chemical energy. When a phone is on or in use, the phone changes some of this stored energy. The chemical energy in the battery is converted into other types. Can you think of how the phone uses this stored energy in its battery?

List the different ways a cell phone uses its stored energy.

Activity 9

Think Like a Scientist

Build an Energy Chain

You have now seen a few energy chain examples. In this investigation, you will build your own energy chain. Your model should show **energy transfer** pathways from input to output. Do not forget to consider all the possible energy transfers, not just those that help the device do its job.

What Will You Do?

Use magazine pictures or illustrations to **construct** an energy chain for a common device. **Label** each picture with the form of energy and whether the energy is being transferred (as the same type) or transformed (into a different type).

Think About the Activity

How can these types of models be used to track energy pathways?

What are the limitations of these types of models?

Life Skills **I can try new things.**

Activity 10

Record Evidence Like a Scientist

Energy in Remote-Controlled Cars

Now that you have learned about energy transformations, look again at the image of a remote-controlled car. You first saw this in Wonder.

How can you describe the energy in a remote-controlled car now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the lesson.

Can You Explain?

What kinds of energy transfer must occur for light from the sun to power a cell phone?

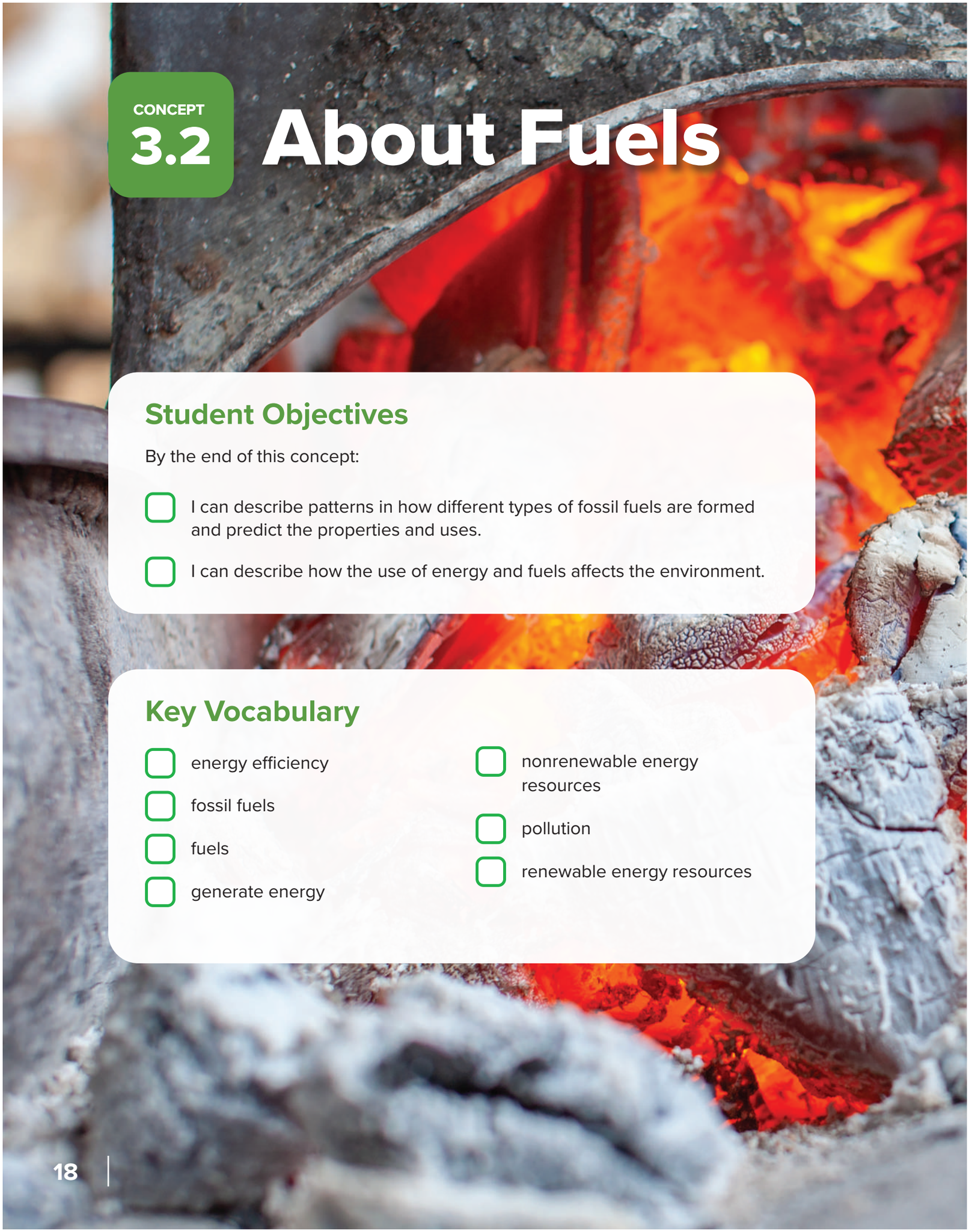
Now, use your new ideas to write a scientific explanation to answer this question. First, **write** your claim. Your claim is a one sentence answer to the Can You Explain? question. It should not start with a yes or no.

My claim:

Life Skills **I can review my progress toward a goal.**

Next, **record** the evidence that supports your claim. Then, **explain** your reasoning and your scientific explanation. The energy transformation that must accur for light from the sun to power a cell phone.

Evidence	Reasoning That Supports Claim	Scientefic Explenation



CONCEPT
3.2

About Fuels

Student Objectives

By the end of this concept:

- [ ] I can describe patterns in how different types of fossil fuels are formed and predict the properties and uses.
- [ ] I can describe how the use of energy and fuels affects the environment.

Key Vocabulary

- [ ] energy efficiency
- [ ] fossil fuels
- [ ] fuels
- [ ] generate energy
- [ ] nonrenewable energy resources
- [ ] pollution
- [ ] renewable energy resources

Activity 1

Can You Explain?

We previously learned about energy chains and how energy can be traced back to the sun. Now let's think about **fuels** such as gasoline, oil, and coal.

Where does the fuel we use every day come from?

Life Skills I can share ideas I am not yet sure about.

Activity 2

Ask Questions Like a Scientist

Fuels and Road Trips

Have you ever been on a road trip? Cars and trucks need energy to move. Where do you think this energy comes from? Think about a trip with your family using a car. Then, **write** questions you have about fuels.

What are fuels, and what are they used for? in your openion, is it possible to manufacture a car works with solar energy? Do you think that it is a good idea? the idea of working the cars with solar energy is a good idea. In this concept, you will learn about fuels and some other sources of energy that we use.

what questions would you like to investigate about different types of fuels, where they come from, and how we use them?

Life Skills **I can decide if a source is reliable.**

Activity 3

Evaluate Like a Scientist

What Do You Already Know About Fuels?

Fuels We Use

We use fuels in many different ways every day. Does your family need fuel to cook or heat your home? Let's think about different fuels, where they come from, and how they can be used as energy. **Choose** one of the fuels pictured here and be ready to share your ideas.

Cars fuels

Natural Gas

Coal

Wood

What Are the Different Types of Fuels?

Activity 4

Analyze Like a Scientist

Types of Fuel

Have you ever wondered about the different types of fuels we use? Read the text with a partner to learn about different types of fuels and where they come from. Then, classify the information on the graphic organizer and respond to the questions.

Fuels are substances that, when burned, release thermal energy. Wood is the most ancient fuel and is still widely used throughout the world. A wide variety of plant and other materials are used for fuels. Because they are made from living things, they are called biofuels. For example, charcoal, made from wood, is an important fuel.

Cooking Using Charcoal

Some plants can be turned into liquid fuels. For example, switch grass, wood chips, and corn all can be used to make a liquid fuel.

If we trace back to where the energy in these fuels comes from, we find that they started with light energy from the sun. These fuels are used around the world everyday, but the supply is also continually renewed as plants grow. For this reason, they are called **renewable** fuels.

Renewable fuels require careful management. For example, using wood as fuel requires cutting down trees. While some trees may grow to their full height in one person's lifetime, many trees only grow a few centimeters each year. This means that it would take many lifetimes for these trees to reach maturity. Cutting down trees at a faster rate than they can grow leads to deforestation, which has a variety of negative impacts on our environment.

Life Skills I can identify problems.

Types of Fuel, continued

Using wood at a rate that is sustainable means being careful not to use a resource faster than it can be replaced.

Fossil fuels are fuels that were formed from the remains of plants and animals that lived millions of years ago and buried rapidly away from the Earth's surface. Over a very long time, these remains built up and became buried under Earth's surface.

Coal Train

Eventually the broken-down plants were covered in hundreds of meters of mud and rock. Earth's heat and pressure turned these remains into coal. Coal are formed mainly from ancient plants, while oil and gas form mostly from ancient sea animals that buried rapidly away from the Earth's surface. Benzene is a fouel derived from oil.

Fossil fuels such as coal, oil, and gas form very slowly over millions of years. This means that we use them up much faster than they are formed. For life practical purposes, once we use fossil fuels, they are gone. They cannot be easily renewed. For this reason, fossil fuels are said to be **non-renewable sources of energy**.

	Biofuels	Fossil Fuels
Definition		
Examples		
Renewable or Nonrenewable energy resources		

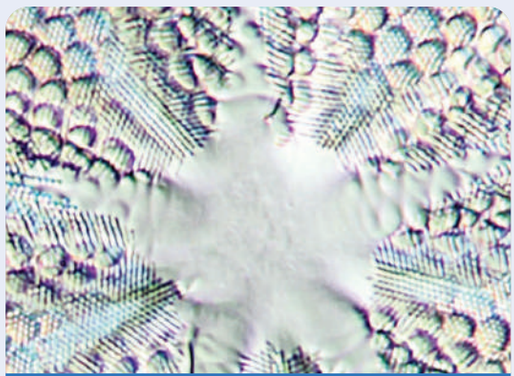
Activity 5

Analyze Like a Scientist

Oil and Water

Oil and water are two types of resources that humans can use to **generate energy**. However, these two energy resources have many differences. **Read** the text. Then, **answer** the questions that follow:

Oil comes from deep in the ground. Scientists think that oil formed as a result of the decomposition of sea creatures. As the sea creatures died, their remains settled on the ocean floor. They became rapidly covered with layers of sediment and rock.



Sea Creature under a Microscope

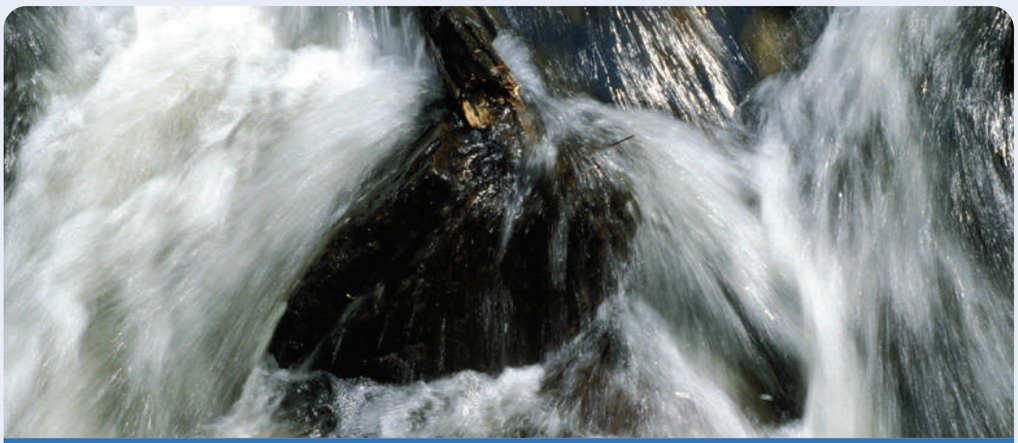
All of these layers pressed down. The layers created great pressure and heat. This pressure and heat slowly turned the remains into oil. Oil is a nonrenewable resource.

A nonrenewable resource is a natural material that is used faster than it can be replaced. We use oil faster than new oil can form. Therefore, we must use oil very wisely because we could run out of it.

offshore oil rig

Unlike oil, water is a **renewable resource**. A renewable resource is a natural material that can be renewed soon after it is used. Even though water is renewable, we still must be careful when we use it. We should not waste or pollute water. If we do, then water may not be replaced as quickly as we need it.

Oil and water are very different. However, we must use them both very wisely.



Moving Water

What are some ways we could conserve these resources?

Why is water considered a renewable resource?

Activity 6

Evaluate Like a Scientist

Fossil Fuel Formation

Let's see if you understand how fossil fuels form. The following are the steps involved in the formation of fossil fuels. **Write** them in the correct order.

Remains changed to become coal, oil, and natural gas.

Remains were buried.

Living things that lived a long time ago died.

Heat and pressure affected the remains.

Life Skills **I can decide on a solution to use.**

What Are Fossil Fuels Used For?

Activity 7

Think Like a Scientist

Living without Electricity

In many regions, nearly all electricity is generated by gas and oil, which are nonrenewable energy sources. Using renewable resources, such as hydropower and wind, is beginning to increase, but these energy sources are still very new. No matter which energy source is used, it is important for everyone to understand how much electricity they use and find ways to practice **energy efficiency**. In this activity, you will document your experience of spending some time without using electricity.

What Will You Do?

Choose a minimum of two hours to NOT use electricity. Write about your experience.

Think About the Activity

How long were you able to go without using electricity?

What types of devices would you normally have used during this period of time? What did you do instead?

How did you feel during and after this experience? Do you feel that you normally take electricity for granted?

What can you do at home to conserve fuels and avoid wasting electricity?

Activity 8

Analyze Like a Scientist

Using Fossil Fuels to Generate Electricity

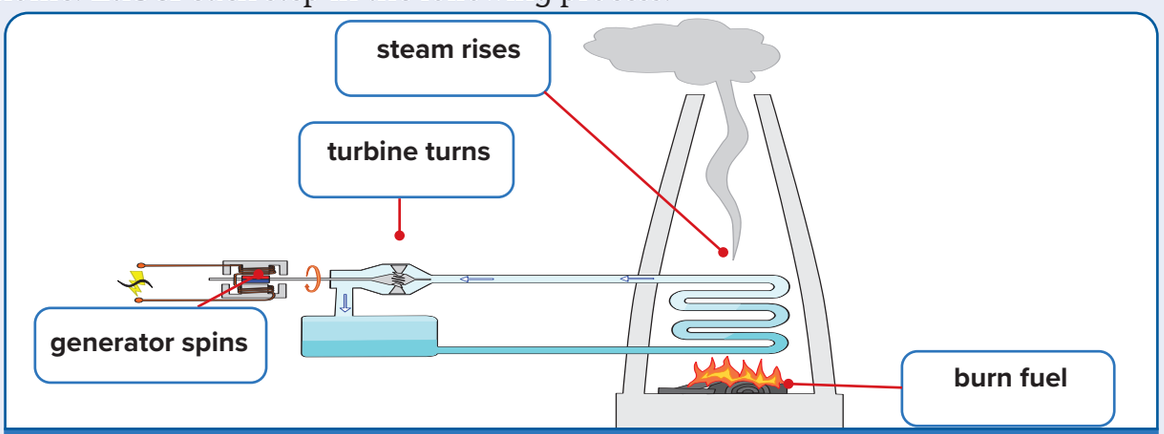
You already know that gasoline is used to provide energy to make cars move. But what about the electricity you use to power the lights in your home? Where does it come from? How are fuels involved in generating electricity? **Read** the text. .

Electricity is typically generated in a power plant. At the beginning of the process, a fuel is burned to release thermal energy. Common fuels include oil, coal, and natural gas. This thermal energy is used to heat water to make steam. The steam is directed through pipes and used to turn a device called a turbine. The kinetic energy of the turbine is used to spin a generator. A generator transforms kinetic energy into electrical energy. The electrical energy travels down wires to homes and businesses.

Coal Power Plant

It is likely that if you flip a light switch, the electricity you are using to make the bulb light up was generated from burning oil, coal, or natural gas to create steam that operates the turbines for generating electricity.

Observe the simple model of how a power plant works. First, **finish** the model by adding a sketch of how the electricity travels to your home or school. Then, use the text to **identify** each step in the flow of energy from a fuel to the lamps in your home. **Label** each step in the following process:



A model of a power station

Activity 9

Observe Like a Scientist

Big City Environmental problems

Using fossil fuels can have negative impacts on the environment. **Read** the text, and **look** for reasons why big cities have air pollution problems.

Population demands and increased industry and agriculture have resulted in pollution problems around the world. Burning fuels for energy can pollute the air. Pesticides used in farms can be carried into streams when it rains. The chemicals used at many factories can pollute the air as well as the soil nearby factories.

Pollution, in the form of smog, is especially severe in large cities. Environmental concerns are being addressed in large cities worldwide, where smog from automobile emissions causes widespread irritation to eyes and lungs. Medical researchers have found that smog is full of small particles that we breathe in. Because these pollutants are so small, they can irritate our lungs and damage the tissue of the respiratory system. Effort to make laws to prevent high smog levels in large cities are making slow progress.

Talk Together Now, talk together about the sources of air pollution in big cities. What is the potential impact of air pollution on the respiratory system?

Activity 10

Analyze Like a Scientist

Burning Fossil Fuels and Pollution

What happens when fossil fuels are burned to release energy? **Read** the text. As you read, complete the graphic organizer at the end of the passage to show how burning fossil fuels affects the environment.

In the 1800s, people began to need more energy than ever before. They needed energy to run factories, cars, trains, and ships.

Power Plant Emissions

Since then, the demand for energy has continued to rise. More energy is needed to supply electricity to homes, schools, businesses, and factories. The problem has always been finding a way to get all this energy.

The solution was fossil fuels. However, burning fossil fuels generates more than just energy. It also makes pollution. For example, burning coal and oil produces a gas called carbon dioxide. that form acidic rains with water exists in atmospheric air. Acid rain can kill trees. It can change the chemistry of lakes and kill fish. It can change the chemistry of soil. Acid rain can dissolve some rocks, including some used for building.

Carbon dioxide from burning fossil fuels can also cause another problem. Carbon dioxide gas can collect in the air. It forms a layer in the atmosphere that traps heat on Earth. As a result, Earth's temperatures slowly rise. Rising temperatures on Earth is called global warming.

At the moment, the only solution to stop acid rain and global warming is to conserve energy. The less energy we use, the fewer fossil fuels we burn. the less carbon dioxide and other pollutants we put in the air we need to breathe.

Conserving energy not only reduces pollution, but it also conserves the supply of nonrenewable fossil fuels. Conserving fossil fuels makes them last longer and keeps Earth cleaner from pollution.

Topic: The effect of burning fossil fuel on the environment

Cause	Effect
Burning fossil fuel (coal, oil, and natural gas) leads to increase in carbon dioxide percentage in the atmospheric air.	**Leads to form acidic rains and change the chemical nature of lakes**

Why Is It Important to Use Fossil Fuels Wisely?

Activity 11

Analyze Like a Scientist

Conserving Fossil Fuels

Read the following paragraph then, **underline** the main idea of the passage and **highlight** ways to conserve fossil fuels.

The supply of fossil fuels on Earth is limited. Eventually, fossil fuels will run out. Using fewer fossil fuels to meet our needs is the best way to conserve these resources. There are many ways to conserve fossil fuels. Some ideas are walking or biking instead of driving or turning off the lights when you are not in a room.

Public Transportation

Another problem with the use of fossil fuels is how they affect our planet. Burning fossil fuels to generate electricity and power vehicles releases gases into the air. These gases can cause pollution and also trap warm air in our atmosphere. You may have heard of global warming or climate change. The burning of fossils fuels is one of the most important causes of this problem.

Replacing fossil fuels with renewable sources of energy can greatly conserve fossil fuels. Solar, water, and wind are renewable sources of energy. Using renewable energy means that we will not run out of our energy sources nor overheat our planet. The main drawback has been that it currently costs more money to produce energy from renewable resources than from fossil fuels.

Talk Together What are the drawbacks to using fossil fuels to generate power? How do you think that people can benefit from conserving energy?

Activity 12

Evaluate Like a Scientist

Using Fuels

You have already learned a lot about the different types of fuels that we use in dfaily life. You know that fuels can either be classified as renewable or nonrenewable. In the word bank, you will find a list of some familiar fuels. Write the fuels in the correct category.

Once you have finished, your teacher will provide you with a list of other fuels. Although some of the fuels may seem unfamiliar, try to sort them using what you already know.

coal	gasoline	natural gas	oil
solar energy	wind power	wood	

Renewable	Nonrenewable

Activity 13

Record Evidence Like a Scientist

Fuels and Road Trips

Now that you have learned about how we use different types of fuel, **look** again at the image Fuels and Road Trips. If you need to, go back and **read** the text in Wonder. Then, **write** your answers to the questions that follow, using what you have learned in this concept.

How can you describe fuels and road trips now?

How is your explanation different from before?

Once scientists have asked questions and gathered information from multiple sources, they share what they have learned. Look at the Can You Explain? question. You first read this at the beginning of Wonder. Think about how you would answer this question now.

Can You Explain?

Where does the fuel we use every day come from?

Now, use your new ideas about where fuel comes from to write a scientific explanation to answer this question. First, **write** your claim. Your claim is a one sentence answer to the Can You Explain? question. It should not start with a yes or no.

My claim:

Next, **record** the evidence that supports your claim. Then, explain your reasoning.

Evidence	Reasoning That Supports Claim

Now, write your scientific explanation.

Fossil fuels are formed by . . .

CONCEPT
3.3

Renewable Energy Resources

Student Objectives

By the end of this concept:

- [ ] I can apply scientific ideas to design, test, and refine devices that convert energy from one form to another.
- [ ] I can explain the use of renewable resources in the generation of electricity.
- [ ] I can develop models based on observations and evidence that energy is transferred from place to place.

Key Vocabulary

- [ ] heat
- [ ] light
- [ ] radiation
- [ ] solar energy
- [ ] turbine
- [ ] watermills
- [ ] windmills

Activity 1

Can You Explain?

Solar panels

Solar panels are used to power the street lights on this city road.

What are the different ways we can use renewable energy to generate electricity?

Life Skills I can share ideas I am not yet sure about.

Activity 2

Ask Questions Like a Scientist

Windmills and Watermills

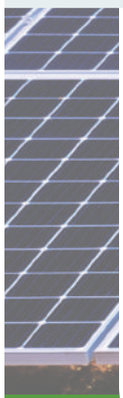
People have always used machines to make tasks easier, but we have not always had electricity to power these machines. How do you think machines worked when there was no electricity? **Read** the text and **look** at the pictures.

Imagine you were born 400 years ago. Life was hard. People needed machines to make their lives easier. One of the most common jobs of **windmills** and **watermills** was to crush grain to make flour. This took place at the mill.

Watermills

Modern Wind Turbines

Some mills used water, and other mills used wind. Can you think of some of the advantages these early mills had? What about disadvantages? Current wind and water **turbines** look both similar to and different from the windmills and watermills built hundreds of years ago. In your opinion why do you think they look different?



Windmill and Watermill Energy

Write wonder statements you have after observing the images of windmills and watermills.

Life Skills **I can ask questions in new situations.**

Activity 3

Analyze Like a Scientist

Using Energy from the Sun

Have you thought about how important the sun is to us? You already know that almost all plants and animals need the sun to survive. Now let's think about how the sun's energy reaches us on Earth and how we use that energy every day. Read the text. As you read, underline evidence in the text that energy is transformed from one type to another. Then, draw a diagram of the sun's energy and how it is transformed.

You see and feel sunlight. Even at night when you cannot see the sun in the sky, you feel the warmth of the sun's energy absorbed by the atmosphere. The land and water on Earth's surface also absorb the sun's energy, causing their temperatures to increase. Sunlight is radiant energy, or **radiation**.

Solar Water Heater

Energy received from the sun is called **solar energy**. We can use solar energy as a thermal energy source. Greenhouses allow in **light** and radiant energy from the sun. This energy converts to **heat** that warms the inside of the greenhouse. This helps farmers grow crops that would normally only grow in warm climates. Houses, too, can be built in a way that enables the energy from the sun to warm them. This is usually done by placing large glass windows on the wall that faces the sun for the longest part of the day.

Solar energy can also be used for cooking. Convergent (Concave) mirrors help in collecting and focusing sunlight to heat a metal pot and cook the food inside.

Solar energy can be used to heat water for other uses, too. Panels made of black pipes can be placed on the roof of a house. As water passes through the pipes, it heats up. It can then be stored in a hot water tank for use.

Draw a diagram of how the sun's energy is transformed in one of the examples given. Remember to include labels on your diagram.

Life Skills **I can identify problems.**

Activity 4

Observe Like a Scientist

Solar Energy

Have you seen solar panels in your community? Sometimes they are very small panels and supply energy to only one light. Other times they are very large or in sets that can supply energy to whole buildings or even towns. How might a farmer use solar panels? Look at the images. **Read** the text. Then, **answer** the questions that follow:

Most solar panels are used to generate electricity. Solar panels that generate electricity are made of many small solar cells. These cells catch the radiant energy of the sun and turn it directly into electricity.

Solar Panels

Solar-Powered Lights

The electricity can be used immediately, such as to turn on a streetlight. Or the electricity generated can be stored, such as in a battery. Solar-cell calculators run on batteries powered by small solar cells. Houses and other buildings may use electricity made from rooftop solar panels.

In some villages, solar power is being used to power irrigation equipment.

If the sun's energy is the input of the solar panel system, what is the output of the system?

Which form of energy enters the solar panels? Which form is the energy converted to?

Life Skills **I can identify problems.**

How can we capture the wind to provide useful energy?

Activity 5

Observe Like a Scientist

Harness the Wind

In your opinion, How do you think we can use wind as a source of energy? **Read** the text, **Look** for how wind turbines turn the kinetic energy of wind into electricity. Then, **complete** the activity that follows.

As the sun warms Earth, it warms the air. Different parts of the world get different amounts of this solar energy, which causes the air to move and wind to blow. We can use the energy in the wind to turn the blades of windmills. This kinetic energy can be used to generate electrical energy. The electricity from wind turbines is carried by big wires to places where it is needed.

Draw an energy chain showing the inputs and outputs of a turbine on a wind farm.

Talk Together Now, talk together about the locations you think are best for wind turbines.

How Can Energy from Falling Water Be Used to Generate Electricity?

Activity 6

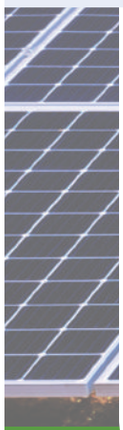
Analyze Like a Scientist

Falling Water

Did you know water can also be used to generate electricity? Read the text that follows. As you read, use the graphic organizer provided to record similarities and differences between using water and using wind to generate electricity.

Rivers run downhill. As they run, they change gravitational potential energy to kinetic energy. We can also control the flow of water to generate electricity. A hydroelectric dam holds back the flow of water to build up potential energy. When the water is released, it passes through turbines in the dam. The falling water makes the turbines turn. The turbines and generators in the dam generate electricity. The electricity can be sent along wires to cities where it is needed. This type of electricity is called hydroelectricity.

Hydroelectric Dam



compare the uses of water and wind to generate electricity?

Activity 7

Investigate Like a Scientist

Hands-On Investigation: Modeling a Turbine Generator

How similar do you think wind and water turbines are? In this investigation, you will use a pinwheel to model a spinning turbine in a hydroelectric dam. Use what you know about wind turbines to think about how the water system harnesses the flow of energy from water's movement.

What materials do you need? (per group)

- Large bin, at least 4L
- Water
- Pinwheel
- Plastic cup, 250 mL
- Large pitcher, at least 4L

HANDS-ON INVESTIGATION

What Will You Do?

1. Use the materials to model a turbine generator.
2. When the water runs out, use the cup in a way that will make the water a renewable resource within the system.

Think About the Activity

Explain the function of the pinwheel as a model of the hydroelectric power station. Draw a diagram of the model with labels.

Describe how you changed your model so it ran on renewable energy.

How does your solution for providing a renewable resource mimic what happens on Earth? (Hint: consider the water cycle.)

Which alternative energy resources come from forms of mechanical energy?

How can mechanical energy be used to generate electricity?

Activity 8

Record Evidence Like a Scientist

Windmills and Watermills

Now that you have learned about renewable energy sources, **look** again at the images you first saw in Wonder.

How can you describe windmills and watermills now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the lesson.

Can You Explain?

What are the different ways we can use renewable energy to generate electricity?

Life Skills **I can review my progress toward a goal.**

Now, use your new ideas to write a scientific explanation to answer this question. First, **write** your claim. Your claim is a one sentence answer to the Can You Explain? question. It should not start with a yes or no.

My claim:

Next, **record** the evidence that supports your claim. Then, **explain** your reasoning.

Evidence	Reasoning That Supports Claim

Now write your scientific explanation.

Solve Problems Like a Scientist

Unit Project: Dam Impacts

Throughout Energy and Fuels, you have learned about how humans use Earth's natural resources for getting energy. You know that there are advantages and disadvantages to using both renewable and nonrenewable sources of energy.

The image shown is a picture of a dam. You might have seen dams in Egypt, such as High Dam that considered the biggest water project in Egypt in modern time that have a big effect on Egyptian's life in all agricultural, economical, and industrial fields . In this project, you will learn about plans to build a dam, and infer its different effects such as the dam built on the Zambezi River of Zimbabwe, in the Batoka River Gorge. You will analyze the effects of building a dam for the purpose of generating hydroelectric power. You will be asked to consider how communities of people, ecosystems, and the landscape may be affected, both positively and negatively. **Read** the text and **complete** the activities that follow.

The high Dam in Aswan-Egypt

Life Skills **I can decide on a solution to use.**

Dam Impacts

Kariba Dam

One large dam, the Kariba Dam, is located on the border area between Zambia and Zimbabwe, in the southern part of Africa. This dam holds back the world's largest reservoir and has faced various challenges since the 1950s, when it was built.

The river the dam is built on is home to one of the world's largest waterfalls, called Victoria Falls. Victoria Falls is an incredibly powerful waterfall and provides a unique habitat for various living organisms.

Dams are designed to harness the kinetic energy of moving water and use this energy to spin the turbines to generate electricity. Kariba Dam was created to control the water flow at Victoria Falls and use it to generate electricity that can power homes and businesses. However, dams also affect the environment that surrounds them. How do dams change the landscape? How does building a dam affect humans and wildlife that depend on the river?

Let's get to know the impact of building dams through studying what happens as a result of building Kariba Dam. The Batoka River Gorge is a deep and narrow canyon that begins just below Victoria Falls. Tourists come to ride the whitewater rapids of the Zambezi River and admire the landscape. The gorge is a World Heritage Site because of its beauty, the fact that it is home to a variety of endangered animals, and the two million years of geology witnessed in the canyon walls. Normally, this designation means that a place cannot be disturbed.

So why do some support building a dam that would flood this area? Less than half of the people in Zimbabwe have access to electricity. Even those who have electric power sometimes face outages that can last for many days. Fewer and fewer people are able to pay for electricity. The limited supply of power means the price of energy has become more expensive. People who support construction of the dam say that hydroelectric power is the answer to these problems.

Unit Project

In this project, you will investigate both the positive and negative impacts of building a dam.

You will be asked to consider both advantages and drawbacks, as well as conduct research to come up with solutions to the problems associated with hydroelectric power plants.

Positive or Negative?

Think about the potential impacts of building a dam in the Batoka River Gorge. Which of the following effects of creating a dam are positive, and which are negative? **Complete** the graphic organizer with the effects listed.

- changing fish migration routes
- flooding a habitat area of an endangered living species
- producing hydroelectric power
- controlling the downstream river level
- providing a steady water supply

Positive	Negative

Energy Transfer at the Batoka River Gorge Dam

Create an energy model showing the energy transformations from water to electrical energy.

Advantages and Disadvantages

In the next two sections, you will be asked to conduct research on the construction of dams. **Decide** what you think is the greatest benefit of building a dam for hydroelectric power. Then, **think** about the major drawbacks. Be sure to **list** all sources you use to research your answers.

The Greatest Benefit

Choose the greatest benefit of building a hydroelectric power dam and research it. Then, explain why you chose that benefit as the best for communities of people, ecosystems, and the landscape surrounding a dam.

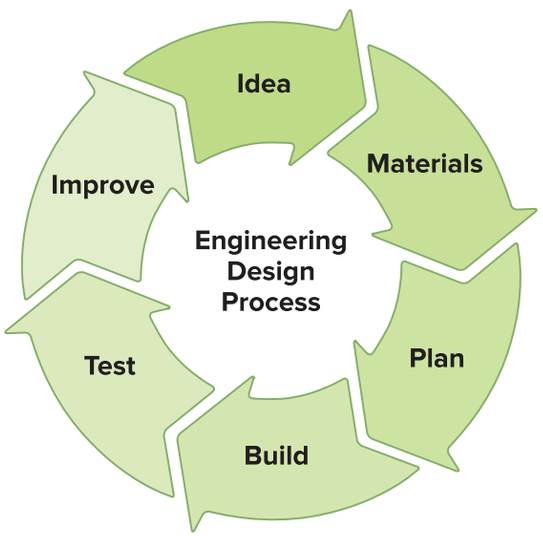
Disadvantages and Solutions

Choose one of the drawbacks of building a dam for hydroelectric power. Now, **research** possible solutions to that problem. **Write** a description of why it is important to address this problem, and then propose a solution.

Interdisciplinary Project:

Sunny Side Up

In this interdisciplinary project, you will use your science and math skills to find a solution to a real-world problem. First, you will read a story about a fictional group of characters, called the STEM Solution Seekers. Then, you will study some background information, and you will design, test, and refine a solution to the overall challenge. You will go through the steps of the Engineering Design Process, as shown in the diagram. You will also do some additional work in your math class related to this challenge.



The project Sunny Side Up challenges you to think about the impact of deforestation and how humans can use solar energy as a clean, renewable resource. In the story, you will read about a problem that a STEM Solution Seeker is having while trying to collect firewood to use as fuel for cooking. You will learn more about solar energy, and then you will design a solar cooker of your own to help find a solution of the problem.

Sunny Side Up

Jin, Claudia, Michael, and Hala are visiting Nadine, who lives in a village near Ngaoundere, Cameroon. They are all members of an international science fair team and usually work together over video calls. They are excited to be able to meet each other in person.

“Cameroon is so cool,” says Michael as they walk along a dirt road in Nadine’s village. “It is not like Washington, D.C., at all.”

says Hala, “and there is no sea nearby.”

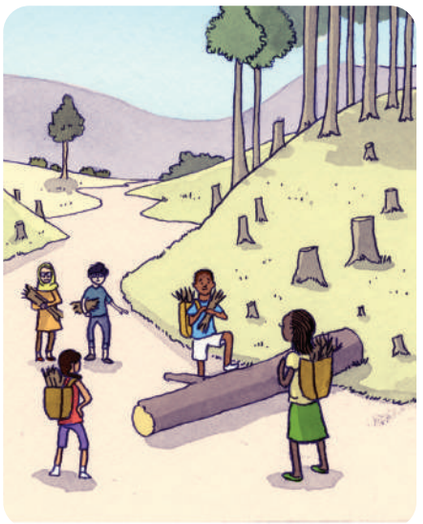
As the five continue to walk toward Nadine’s home, they begin to talk about their latest projects for the science fair. Claudia says, “Nadine, didn’t you say you wanted help with some kind of a robot?”

“Well, yes,” Nadine replies, “I want to create a robot to help me gather wood for my mom’s cooking fire.”

When they arrive at Nadine’s home, they are welcomed warmly and almost immediately served a traditional meal of meat sauce, millet, and vegetables, which they enjoy while getting to know Nadine’s family.

The next morning, Nadine and her friends go out to gather firewood for her family’s cooking fire. They have been walking a long time when Jin says, “Is it much farther? I am getting tired.”

Me too!" Michael, Claudia, and Hala all agree.



"Just a little farther, and then we can fill our baskets," Nadine encourages them. "You can see why a robot would be nice. I do this every day. The wood used to be closer, but people have been cutting more and more of the forest down and we have to walk farther and farther to find wood."

"That happens where I live in Peru too" Claudia says. "Not only is this tough on

people who rely on the lumber to survive, but it also harms the plants and animals that

make the forest their home. Deforestation could destroy the habitat of some species

for good," she adds.

After a few more minutes, Hala says, "I do not think you need a robot, Nadine. You would still be taking more wood out of the forest. I think you need a different kind of fuel for your fire."

Nadine considers and says, "People with more money sometimes use gas or kerosene for cooking, but they have to buy it at the store. Most families cannot afford that."

"I like the idea of finding another fuel for cooking, Nadine," Michael says. "It looks like your forest is not going to be here very long at this rate."

"I bet you could use a solar cooker here," Jin says excitedly. "It is nice and sunny."

Hala says, “Some people in the deserts of Egypt use them. I think they call them sun stoves.”

“I do not know how to make one, but I bet we could figure it out,” suggests Michael.

“Oooooh, I know what we can do!” Jin is so excited by his new idea that he drops all of his wood. “When we get back, I can draw a model of what I am thinking.”

They start planning as they load up their baskets and carry the wood back to Nadine’s house.

At dinner, Nadine’s mother likes the idea of a solar cooker since it would be far less messy than using fire, but worries that it would not cook the food enough. The next morning, the friends all work together on their plans for a solar cooker. They also begin to wonder, how could we figure out if there is enough sunlight to power a solar cooker?

Deforestation and Solar Energy

Cooking is one main reason that there is a demand for wood fuel and is a major cause of deforestation. Deforestation is not only a problem for Nadine's village in Cameroon; it affects many places all over the world.

There are many beautiful plants and unique animal species that can only be found in certain rain forests. Sadly, the deforestation of rainforests around the world for fuel is partly responsible for a decrease in animal habitats and loss of plants that could be used for medicines.

One alternative to using firewood for cooking fuel is the use of solar energy. Solar energy is energy from the sun. Most solar energy is reflected off or absorbed by Earth's surface and atmosphere.

Solar energy is free, renewable, clean, and saves trees, but there are some drawbacks to relying on this type of energy.

The equipment needed to collect and use solar energy can be expensive. Also, the amount of sunlight that hits Earth's surface is not the same all the time and varies widely from place to place.

One type of tool powered by solar energy is a solar cooker. Solar cookers absorb light energy like solar panels do, but they convert solar energy into thermal energy (instead of electricity) to create heat in the cooker. Solar cookers often have metal panels carefully positioned to collect as much light as possible and direct the light to one concentrated area. The heat generated through this process must be kept, or trapped, within the oven long enough for raw food to be cooked to a safe temperature for eating. Solar cookers come in a variety of shapes and designs.

Hands-On Investigation

Engineering Your Solution

Challenge

You have been asked to create a solar cooker that can heat food to a safe temperature (71°C). This activity will guide your team through the Engineering Design Process.

Objectives

In this activity, you will . . .

- Review the challenge requirements and assign roles to each member of your team.
- Create three or four sketches to brainstorm solutions.
- Agree on one final blueprint for your prototype.
- Build a solar cooker that uses energy from the sun to cook food to a temperature of at least 71°C.

A Solar Cooker

What materials do you need? (per group)

- Poster board or construction paper for final blueprint
- Building materials, such as a cardboard box, ruler, aluminum foil, plastic wrap, black paper
- Construction materials, such as tape, glue, scissors
- Testing materials, such as a thermometer, clock

HANDS-ON INVESTIGATION

Procedure

Follow these steps with your teammates:

1. **Review the Challenge** Study the challenge and design requirements for this project.

2. **Assign Group Roles** Decide the roles for the members of your group and record the names next to each role.
3. **Sketch Ideas** Review the materials data tables with your teammates and begin brainstorming. As a team, select three or four ideas to plan out in the Sketching Our Design boxes. Review your sketches and decide on one design to fully develop. Add more details to make it your blueprint that you will use to help you create your solution.
4. **Plan and Build** Gather materials and begin building your prototype. Make sure to keep track of your steps and process.
5. **Test** Once your prototype is finished, establish which materials you will need for testing. Discuss how you will measure the effectiveness of your design. Conduct your test according to your teacher's directions.
6. **Reflect and Present** When finished, review your product and your process. Identify ways you could improve. Prepare to share with your class.

Group Roles

Roles	Student name
Team Captain Provide encouragement and support; help other team members with their roles if needed; keep track of timeline	
Materials Manager Gather and organize materials; request additional materials if needed	
Chief Engineer Coordinate building the model; suggest when a test may be needed; make sure the team is building safely	
Team Reporter Record all steps of the process; share the process the team went through to complete the challenge	

Design Requirements

- [ ] Your solution must include a diagram and a prototype of your solar cooker, as well as a presentation sharing both your prototype (product) and how you worked together as a team (process).
- [ ] Your solution can only use materials your teacher has available and your design should be based on the data shared in the tables that follow.

Testing Data

In order to maximize energy from the sun, consider the following three tasks of your solar cooker: How could you best reflect and direct the sunlight, absorb its heat, and trap that heat inside the solar cooker?

Review the following data tables to study how different materials affected the temperature that a cup of water can be heated to in the sunlight. Consider this information when choosing the materials and the design of your solar cooker.

Test 1: Reflecting Sunlight

The following test was applied to investigate the best material for the reflecting panels of a solar cooker.

	Aluminum Foil Panel	Red Construction Paper Panel	Cardboard Panel
Temperature of water after 20 minutes in sunlight	42°C	22°C	20°C

Test 2: Converting Sunlight

The following test was applied to determine the best way to convert sunlight to heat through absorption.

	Cup covered in black construction paper	Cup covered in light colored fabric	Clear cup
Temperature of water after 20 minutes in sunlight	40°C	35°C	30°C

Test 3: Trapping Sunlight

The following test was applied to determine the best way to trap heat inside of a cup of water.

	Clear cup	Cup covered in fabric	Cup covered in plastic wrap
Temperature of water after 20 minutes in sunlight	22°C	23°C	25°C

Sketching Our Design

With your team, discuss these two questions for your ideas:

What do you like about these ideas? Where can you make improvements to the designs? Circle your final design to create.

Plan, Build, and Test

STEP 1 Now that you have selected one design idea, create a separate diagram with additional details that you will share during your presentation. This detailed diagram is the blueprint for your prototype. Identify any materials that you will use on the detailed diagram. Show what your solar cooker will look like from the side view, the top view, and any other views you think are needed. Color code your team's blueprint to make sure you have the necessary working parts of a solar cooker with the following:

- In yellow, outline the part that directs the sunlight.
- In orange, outline the part that absorbs the sunlight.
- In red, outline the part that traps the heat.

STEP 2 Gather the materials you identified in your blueprint. You may need to make adjustments to these materials as you are building. Keep track of what you actually use.

STEP 3 Begin building your prototype. As you build, you may run into problems or challenges. Focus on one problem at a time and use your group's creativity and collaboration skills to find solutions. Engineers use notebooks and documentation to troubleshoot when things go wrong so that they can look for places to make improvements.

STEP 4 Test your solar cooker prototype. Leave the solar cooker outside on a sunny day for 30 minutes, or longer if necessary. Place a thermometer inside the solar cooker to measure the temperature inside. Make sure your solar cooker reaches a temperature of at least 71°C. Record the temperature and the time it took for your solar cooker to reach the temperature in your notes.

STEP 5 Once your prototype is complete, work with your team to create a presentation to share both your product and your process. Be sure to explain the parts of your prototype that direct, absorb, and trap sunlight. Also, prepare to share how your team worked together, if you encountered any problems, and how you worked to make improvements.

Optional Extension: Writing Opportunity

Are you ready for a challenge? If time allows, write a set of directions for assembling your solar cooker and create an Assembly Instructions pamphlet. Add drawings with labels to clarify each step. Remember that your audience is people who have not used a solar cooker before and are accustomed to using wood as fuel.

Presentation Notes

Analysis and Conclusions

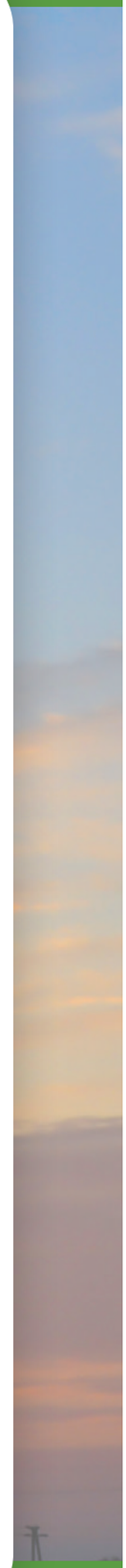
Reflect on the following questions:

1. Did you and your group encounter any problems as you assembled and used your solar cooker? If so, how did you solve those problems?

2. Did your solar cooker perform as well as you expected? If not, what might explain this?

3. What improvements would you make to the design process or to your final prototype?

4. What was your role on the team? What did you do well? What improvements could you make?



Assess your Learning

Answer the following questions.

1. Energy doesn't destroy, nor create from nothing, this is indicates .....
   a- The draining of energy resources.
   b- Conservation and transformation of energy.
   c- Resources of energy are numerous.
   d- Destroying the energy resources.

2. The produced energy from radio that reflects its main function is ..... energy.
   a- Electric. b- Sound.
   c- Light d- Chemical.

3. The idea of design and work of the Robot that explores the surface of Mars depends on the idea of transforming .....
   a- electric to kinetic energy b- potential to kinetic energy.
   c- light to electric energy. d- kinetic to electric energy.

4. In our daily life we use devices which depend on energy forms. Which of the following uses is true?
   a- Computer depends on kinetic and electric energy.
   b- Ceiling fan depends on electric energy.
   c- The function of television depends on the hydroelectric energy.
   d- Cell phones depend on potential and kinetic energy for operation.

5. Which of the following energy forms isn't produced from the Sun?
   a- Thermal energy b- Light energy
   c- Kinetic energy d- Radiation energy .

6. Rearrange the following steps to describe how coal is formed.
   a. The earth surface plants get old and died. ( )
   b. The remains of the plants were decomposed and covered with sand and clay layers. ( )
   c. Anciently, earth was containing with swamps where plants grow. ( )
   d. Several layers of clays and sands were deposited on the remains of died plants. ( )
   e. The buried plants were changed into coal due to the effect of heat and pressure. ( )

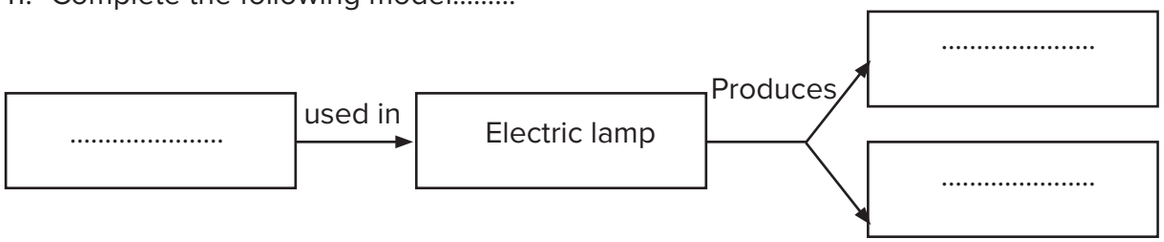
7. Which of the following is a preferred natural resource to generate clean energy?
   a- Ocean and river water b- Trees and dry herbs
   c- Water, coal, and oil d- Coal and natural gas.

8. ..... are used in converting light energy to electric energy.
   a- Wind turbines b- Water turbines
   c- Solar panels d- Windmills

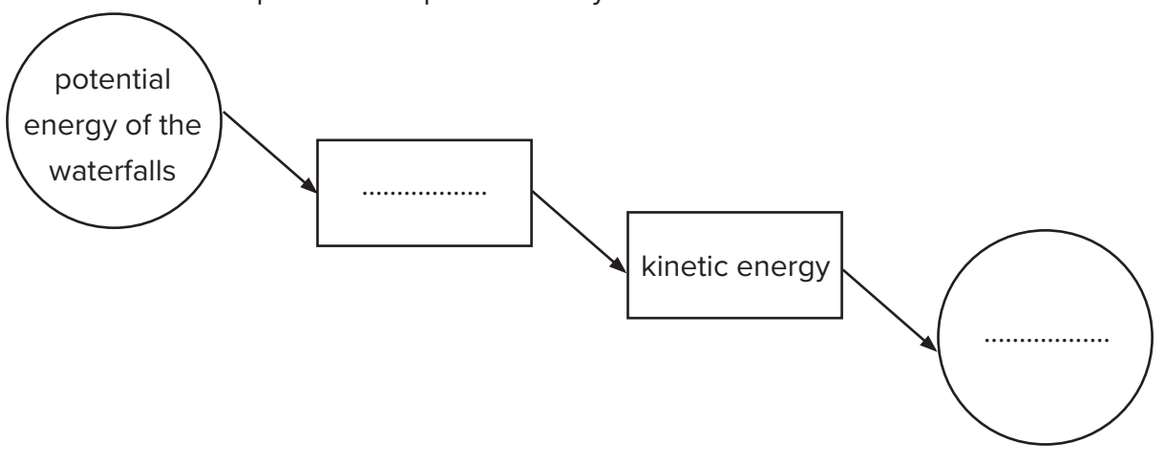
9. ..... is a renewable source of energy.
   a- Coal b- Natural gases
   c- Water d- Fossil fuel

10. The produced energy from flowing water from waterfalls and dams and turbines is called .....
   a- mechanical energy. b- hydroelectric energy.
   c- chemical energy. d- kinetic energy.

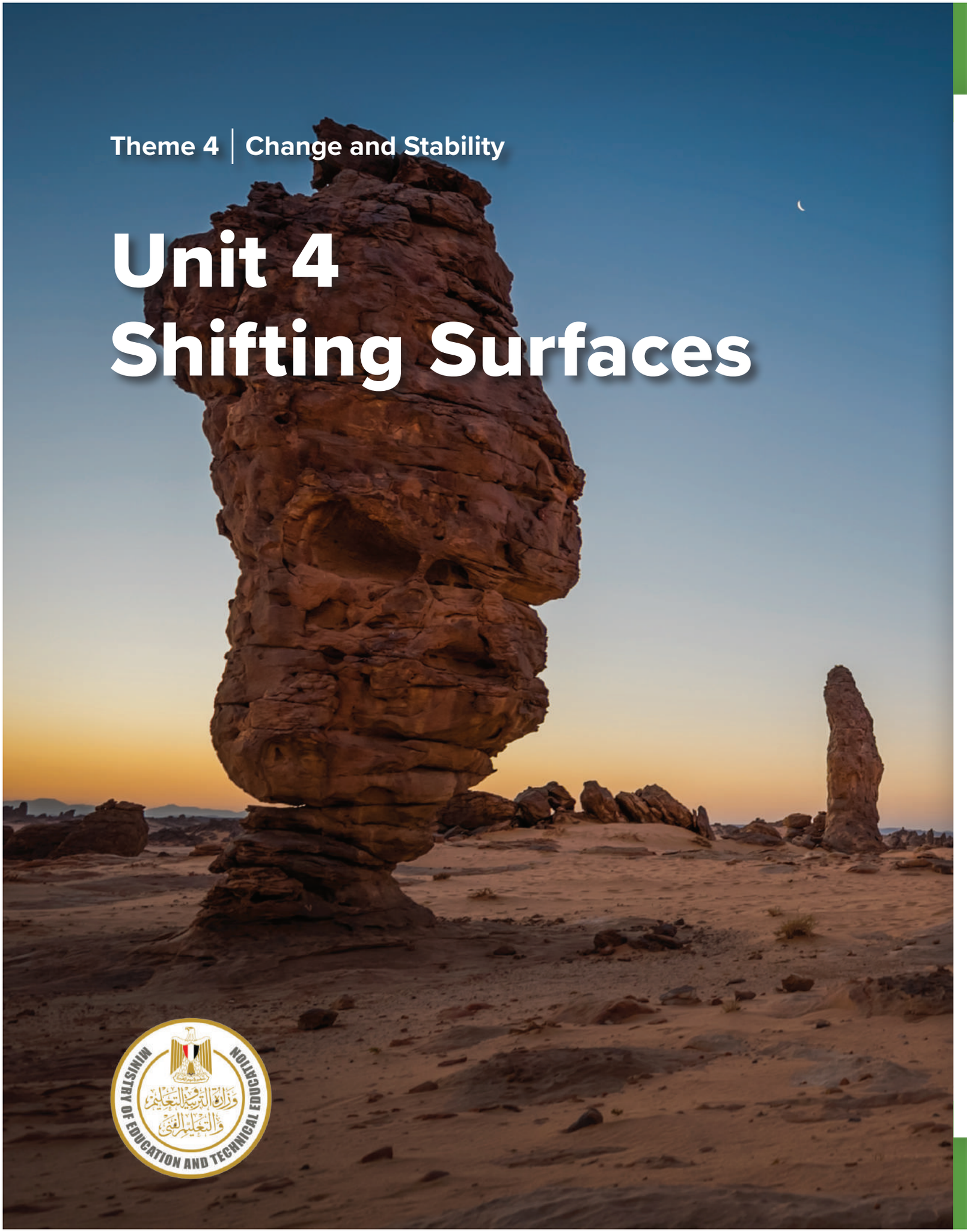
11. Complete the following model.....



12. Complete the following model to describe the hydroelectric energy, and then determine the inputs and outputs of this system?



13. ..... is considered one of the resources that we consume at faster rate then it is formed.
   a- The wind b- The water
   c- The solar energy d- The fossil fuels



Theme 4 | Change and Stability

Unit 4
Shifting Surfaces

MINISTRY OF EDUCATION AND TECHNICAL EDUCATION
وزارة التربية والتعليم والتعليم الفني

Get Started

What I Already Know

This unit is all about how our Earth's surface changes. You will learn more about what breaks down rocks, what might create rocks, and how our Earth's surface features are formed. **Think** about what you already know about factors that shape rocks, including water and wind. **Look** at the images shown here. How do you think the sand dunes were formed? What is the effect of the cracks in the large rocks? **Write** some ideas you have about what forces or factors can break down or change Earth's surface. Share what you know with your class.

1

2

3

Talk Together Think about different forces that shape of rocks. What do you think might cause the differences in shape of landforms ? Share your ideas with your partner.

Introduction:

In this final unit, you will consider what forces shape the surface of Earth. You will learn more about erosion and weathering. Over time, as rocks break down and move, the landscape of Earth changes. You will learn more about how water, and wind have produced many of Earth's landforms.

Wadi Nakhr: Landscape Under Construction

The image shown is of a large canyon called Wadi Nakhr in the country of Oman. Have you ever seen a canyon in Egypt before? What do you think could cause the different landforms shown in the photos? The wavy cliffsides and high peaks are clues to help us understand how those canyons were formed.

Aerial View of Wadi Nakhr

Sinai Colored Valley

Think About It

Look at the photograph. **Think** about the following questions.

- How do water, wind, and vegetation sculpt landscapes?
- What factors affect how quickly landscapes change?
- How are landscape changes recorded by layers of rocks and fossils?
- How can people protect themselves and the environment from the impact of changing landscapes?

Saint Catherine Mountains in Sainai- Egypt

Unit Project Preview

Solve Problems Like a Scientist

Unit Project: Forces That Shape the Earth

In this project, you will use what you know about the forces that shape Earth's surface to model how environmental factors shaped Wadi Nakhr.

Smooth, Steep Sides of a Mountain

Ask Questions About the Problem

You are going to design a model to explain how different environmental factors have affected the landscape of Wadi Nakhr over time. Write some questions you can ask to learn more about how landscapes change over time. As you learn about landforms and the forces that shape them in this unit, record the answers to your questions.

Life Skills **I can identify problems.**

CONCEPT
4.1

Breaking Down and Moving Rocks

Student Objectives

By the end of this concept:

- [ ] I can explain the roles of water, wind, and heat in weathering, erosion, and deposition.
- [ ] I can provide evidence that mechanical and chemical weathering change Earth's surface over time.

Key Vocabulary

- [ ] air
- [ ] chemical weathering
- [ ] deposition
- [ ] erosion
- [ ] heat
- [ ] mechanical weathering
- [ ] sediment
- [ ] soil
- [ ] water
- [ ] weathering

Activity 1

Can You Explain?

Earth's surface is always changing. Many things can change and break down Earth's surface features. What do you notice in this picture?

How do wind, water, and other weather factors change Earth's surface?

Life Skills **I can share ideas I am not yet sure about.**

Activity 2

Ask Questions Like a Scientist

Disappearing Sandcastles

Have you ever seen a sandcastle? What happened to it? If you walk along a beach or on a sand dune, will your footprints still be there the next day? Look at the images of a sandcastle and a beach.

Sandcastles

Beach Erosion

What do you wonder about these images? **Think** about how different agents break rocks and sediments and move them around. **Write** three questions you have and **share** them with the class.

I wonder . . .

Activity 3

Observe Like a Scientist

Sandcastles, Rocks, and Canyons

Some changes to Earth's surface happen quickly and some take hundreds of years. **Look** at the following different images. How do they help you determine what caused the changes? Then, **answer** the questions that follow.

Wrecked Sandcastle

Coastal Rocks

Canyon

Discuss with Your Class

Look at the image Wrecked Sandcastle. Are there any parts of the castle that remind you of other landscapes that you have seen before?

Compare the images Wrecked Sandcastles and Coastal Rocks. Can you see any similarities between the two images? Why do you think the coastal rocks is shaped this way? What factors do you think created these shapes?

Look at the image Canyon. How do you think the canyon was formed?

How was the shape of canyon looked like 20 minutes before the picture was taken. What did each scene look like 1 hour after the picture was taken? Predict what would each scene look like 10, and after 100 years from now?

Life Skills **I can analyze a situation.**

Activity 4

Evaluate Like a Scientist

What Do You Already Know About Breaking Down and Moving Rocks?

Shaping the Earth

You may have heard some of these terms. **Look** at the image and think about ways Earth's surface can be changed. **Write** each term from the left column in the correct place on the image. Then, **choose** the correct definition from the right column and write it next to the correct term.

Deposition	Breaking apart rocks
Erosion	sediment down
Weathering	Moving fragments of rocks or soil around

Life Skills **I can share ideas I am not sure about yet.**

How Are Rocks Broken Down?

Activity 5

Observe Like a Scientist

What Is Weathering?

Have you ever considered where tiny rocks come from? Little pebbles or grains of sand were once part of much bigger rocks. The process that broke them into tiny pieces is called **weathering**. **Read** the text to learn about how this process happens. Then, **discuss** what you learned.

What is the weather outside today? Is it sunny or rainy, windy or icy? All these factors are part of the weather. Weathering also involves these elements. Weathering is the process by which rocks are broken into smaller pieces. Have you ever noticed a statue crumbling or paint peeling on a building? Have you ever seen a wave crash on the shore, pulling the sand with it as it retreats? This is weathering at work.

Talk Together how weathering can change objects, landforms, and Earth's surface.

Activity 6

Analyze Like a Scientist

Types of Weathering

You already know that weathering is the process of breaking rocks into smaller pieces. There are two types of weathering that you will explore: **Mechanical and chemical weathering**. In the text that follows, you will learn how to tell the difference between mechanical and chemical weathering. **Read** the text and **look** at the images about weathering. As you read, **circle** the causes of each type of weathering and **underline** the effects of each.

The surface of Earth is always changing. One way that landforms change is by weathering. The enormous rocks that make up mountains can break into boulders. These boulders can further break down into smaller rocks, and the smaller rocks can continue to break apart to form sand. You have seen rocks of all different sizes—this is evidence of weathering.

Weathering has many factors. One of these factors is **Water**. As water runs over rocks, it can dissolve some of the substances in them. This makes the rocks fall apart. Sometimes it completely dissolves the rock. Sometimes the dissolved rock parts combine with other substances to form something new. Have you ever seen caves formed in the side of a mountain? Most caves are formed due to this type of Chemical Weathering. Have you ever left a metal toy outside where it is exposed to **Air** and rain? Chemical reactions between the toy and elements in the air cause the rust that you notice. Rocks that break down and appear red are also changed by similar chemical processes.

Chemical weathering changes what material a rock is actually made of. Mechanical weathering, on the other hand, breaks the rocks into smaller pieces that can be easily carried away.

Heat and cold also cause rocks to break. Water and cold temperatures often work together to mechanically weather rocks. Water can seep into tiny cracks in rocks and freeze when the temperature gets very cold. When water freezes, it expands. This makes the cracks even wider. If this process happens often enough, it can cause the rock to break apart.

Types of Weathering, continued

Wind and water can also be agents of another type of change. Sand and wind team up to wear down large rocks. As sand rushes across surfaces with the **Smoothing**, yet destructive, force of sandpaper on a piece of wood, small bits of rock are steadily broken off.

Rushing water works in much the same way. Flowing water, full of small bits of floating gravel and sand, **Scours** rough edges off boulders. Quickly moving currents cause rocks to tumble over one another, breaking off larger pieces when collisions occur.

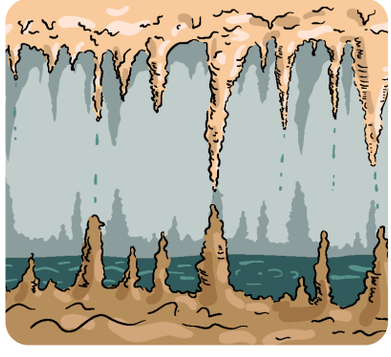
Did you know that trees can break rocks, too? The roots of trees and other plants often grow into the cracks in a rock. As the roots continue to grow, they can eventually break the rock into pieces. Since weathering happens over long periods of time, it is hard to see it in action. But you can see the effects of it all around you in the little rocks, pebbles, and sand that used to be part of much larger rocks.

Causes of Chemical Weathering

Oxygen

Oxygen in our atmosphere reacts with iron in rocks to create red-colored rust. This reaction also weakens iron-rich rocks, causing them to break more easily.

Water



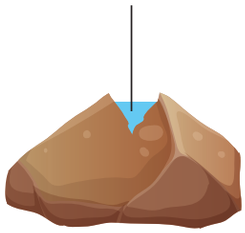
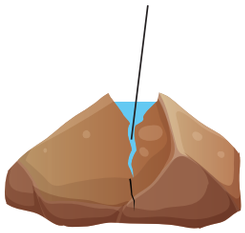
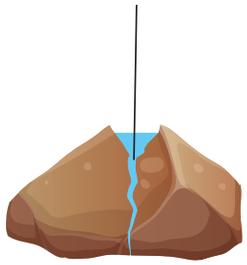
When water dissolves minerals in a rock, those minerals recombine into new substances. When water runs through limestone such as in this cave, dripping minerals form the shapes you see.

Living Organisms

Lichens, tiny plant-like organisms, produce acid as they grow. Over time, these acids can eat away at the rocks where they grow. Acid rain can also eat away at rocks.

How do wind, water, and other weather factors change Earth's surface?

Rock Going Through Mechanical Weathering

A	B	C	D
Water pools and finds its way into rock cracks	Water freezes when the temperature drops, expands, and causes crack to widen	Ice melts and water fills newly formed cracks	The cycle of melting and freezing continues until rock breaks
			

Now, **write** the factors and effects of chemical and mechanical weathering.

Chemical Weathering	Mechanical Weathering

Activity 7

Investigate Like a Scientist

Hands-On Investigation: Modeling Mechanical and Chemical Weathering

Weathering is a slow, natural process. It often takes years to see the effects of weathering on rock. In this investigation, you will speed up the process, and you will model and explore mechanical and chemical weathering to observe the similarities and differences between the two.

Make a Plan

Consider the following questions to plan how you will conduct the investigation.

Question	My Plan
Using the materials available, how will you model mechanical weathering?	
Using the materials available, how will you model chemical weathering?	

Life Skills **I can identify problems.**

What materials do you need? (per group)

- Crackers (per student), 2
- Transparent plastic cup, 250 mL
- Writing utensil (per student)
- Water, approximately 100 mL
- Antacid tablets
- Napkin (per student)

Make a Prediction

Which means of weathering do you think will produce the greatest changes?

What Will You Do?

1. Choose how you will model mechanical weathering.
2. Conduct your mechanical weathering procedure on one of your crackers.
3. Record the results.
4. Clean up the cracker crumbs.
5. Conduct your chemical weathering procedure on the other cracker.
6. Record the results.
7. Clean up the cracker paste.

Results

Record your observations.

Model	Observations
Mechanical weathering	
Chemical weathering	

Think About the Activity

Which means of weathering produced greater changes?

How were the chemical weathering and mechanical weathering similar?

How might the data you collected in the lab be useful in real-world applications?

Activity 8

Evaluate Like a Scientist

Weathering

You have learned about the different types of weathering. You have modeled how these factors can affect rock. Now it is your turn to apply what you know to a real situation. **Observe** the photograph. Then, **answer** the question that follows. Use evidence that you have collected from the previous activities to explain your answer.

Weathering

Is this landform the result of mechanical or chemical weathering?

Life Skills I can analyze a situation.

What Is Erosion, and How Does It Happen?

Activity 9

Analyze Like a Scientist

Erosion

You already know that when rocks are weathered, small pieces are broken off over time. Where do these pieces go? Do they stay in one place and pile up, or do they travel somewhere? **Read** the text about **Erosion** and **draw** an illustration of the process.

After rocks are weathered, they may erode. Erosion is the process that occurs when sand, **soil**, or rocks are moved from one place to another. Gravity pulls rocks down mountainsides. Rivers erode rocks and soil from their banks and carry them downstream. Waves pull sand away from beaches. Little by little, rain washes the soil on hilly farmland downhill.

The pieces of weathered rock that are moved by gravity, wind, water, and other transferring factors are called **sediment**.

Sometimes you can see erosion happening, such as during flash floods, hurricanes, or landslides. You may see sediments carried down gutters by water runoff after a big rainstorm. Or perhaps you have seen that sometimes the water in a nearby creek appears muddy. Grains of sand blown by a gentle wind may move only a meter or so at a time. Stronger winds will blow more sand and move it farther.

Draw a diagram for erosion process.

What Happens to Rock Once It Is Eroded?

Activity 10

Analyze Like a Scientist

Deposition

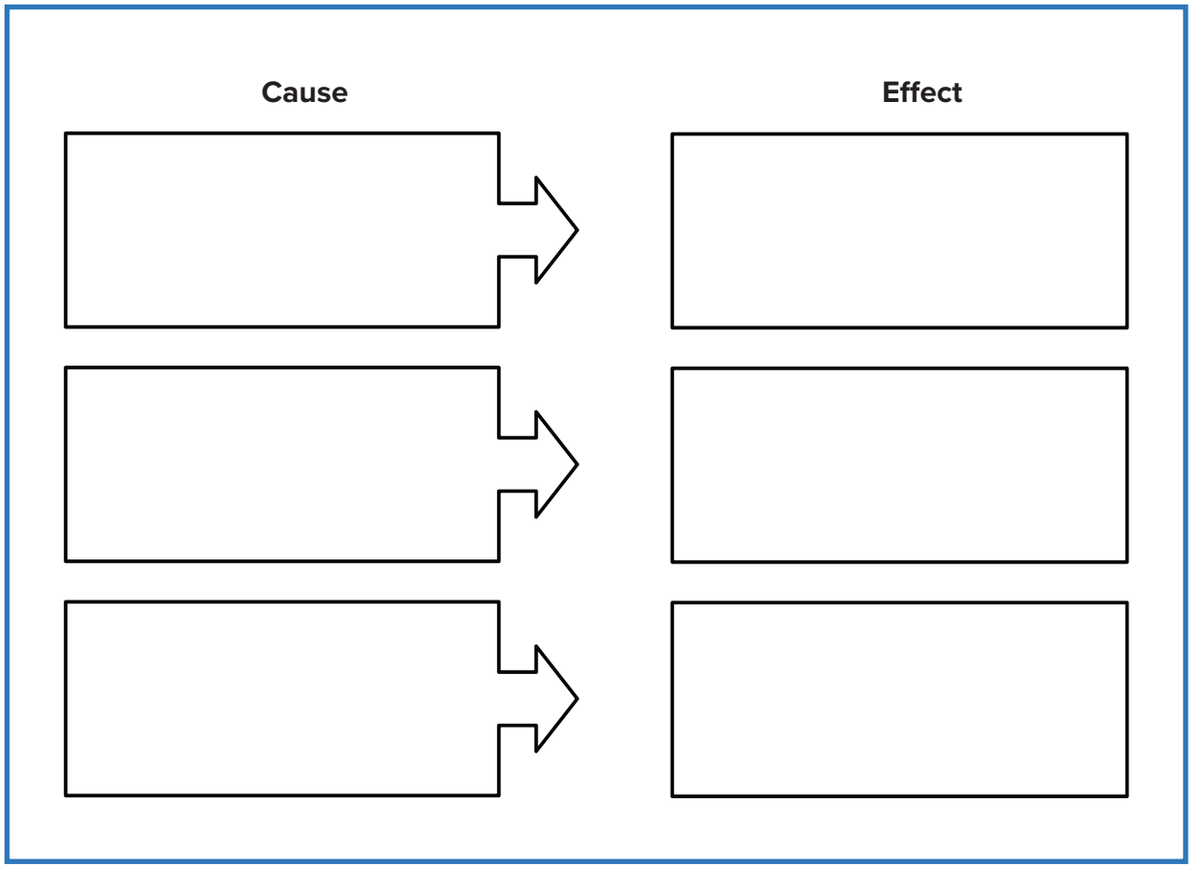
You have learned how rocks can be broken into much smaller pieces through the process of weathering. You know that these pieces are then carried away through erosion. Now, it is time to find out where these pieces of rock might end up. **Deposition** is the next stage of this journey. Sediments that were carried away are eventually precipitate.

Read the text about deposition three times. The first time, **discuss** with your partner what it reminds you of. The second time, **underline** the main idea of the text. After the third time, **discuss** with your partner the statement: "Erosion and deposition are connected." Use the chart to **explain** the cause-and-effect relationship between erosion and deposition.

Have you ever seen in a sandstorm? If you have, you know that as the wind blows, it picks up sand and tosses it around in the air. As the wind moves, the sand travels with it. But what happens when the wind stops blowing? The sand falls out of the air and onto the ground. The place where the sand ends up might be a different place than it started. When the sand is left in a new place, it has been deposited.

Erosion moves rocks and soil around. Deposition is the process that lays them back down. At some point, the wind, ice, or water will deposit the sediment it is carrying somewhere else. It will fall onto land that is already there or settle out on the bottom of a lake or the sea. If you see a deposit of sand, then you know it has already been eroded somewhere else. If rocks become eroded, then eventually they must be deposited. Erosion and deposition are connected. Sediments are the remains of weathered and eroded rock that have been deposited. Sediments build new landforms. A river may deposit a sandbar along its banks. A river could carry sediment. It may be deposited where the river meets the sea. This forms a delta

(such as Nile delta in Egypt). Waves may move sand from one spot to another. These piles make small dunes on a beach. Wind forms large sand dunes in places such as the Western Desert in Egypt or Rub' Al Khali in the Arabian Peninsula. Sediment may be deposited just a few centimeters or even many kilometers from where it was picked up.



Activity 11

Evaluate Like a Scientist

Evidence of Change

Look at the three images shown here and consider what you have learned about the processes of weathering, erosion, and deposition. How do these places in the world provide evidence of these processes at work? Write definitions of each term in the table provided.

Nile River Delta

Dunes

Weathering

Phenomenon	Definition
Weathering	
Erosion	
Deposition	

Activity 12

Record Evidence Like a Scientist

Disappearing Sandcastles

Water is the force that changes some of the earth's surface landforms. As water moves rocks pieces into new place. **Think** about what you have learned about break down and transport of rocks. **Look** at the image of wrecked sandcastle that you have seen before in wonder.

How can you describe disappearing sandcastles now?

How is your explanation different from before?

Look at the Can You Explain? question. You first read this question at the beginning of the lesson.

Can You Explain?

How do wind, water, and other weather factors change Earth's surface?

Now, you will use your new ideas about disappearing sandcastles to write a scientific explanation that answers the Can You Explain? question. To plan your scientific explanation, first write your claim:

Your claim:

Next, **record** the evidence that supports your claim. Then, **explain** your reasoning.

Evidence	Reasoning that Supports Claim

Now **write** your scientific explanation.

Life Skills **I can apply an idea in a new way.**

CONCEPT
4.2

Changing Landscapes

Student Objectives

By the end of this concept:

- [ ] I can ask questions about the causes and stability of landforms that change slowly and quickly.
- [ ] I can provide evidence that weathering and erosion by wind, and water, cause changes on Earth's surface over time.
- [ ] I can develop a model that describes patterns in the formation of deltas and predicts where deltas are likely to form.
- [ ] I can describe the interactions between water and landforms in a watershed and between wind and sand dunes at the beach.
- [ ] I can explain the changes that occur in the earth's surface over time using evidence from the rock formation patterns.

Key Vocabulary

- [ ] canyons
- [ ] delta
- [ ] dunes
- [ ] valleys

Activity 1

Can You Explain?

Canyon are a breathtaking sight to see. Many factors can change and break down Earth's surface features. What do you notice in this picture?

In your opinion, how are canyons formed?

Life Skills **I can apply an idea in a new way.**

Activity 2

Ask Questions Like a Scientist

Canyons

Have you ever spilled water on dirt or sand and saw the water move on the ground? When the water is moving over the dirt, it pushes some of the dirt out of the way. As the water moves the dirt, it leaves an impression where the water flowed. **Observe** the images. Then, **complete** the activity.

Wadi Nakhr, Oman

Wadi Rum, Jordan

Colored Canyon, Sinai

Small Canyon, Thailand

What do you wonder about canyons? Think about how canyons look alike and different. **Write** your questions about the similarities and differences. **Share** them with the class.

I wonder . . .

Activity 3

Evaluate Like a Scientist

What Do You Already Know About Changing Landscapes?

How Did It Form?

Scientist look for clues in the landscape to determine the cause of certain landforms. **Look** closely at the image of the canyon. What are some clues that a scientist might notice.

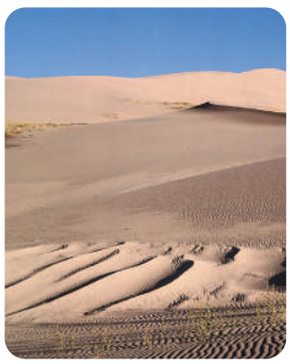
How do you think the canyon was formed? What clues or evidence do you see to support your answer? Write your answer to the following questions.

How can understanding the formation of landforms help predict future change?

Landforms

Look at the images of landforms. **Write** each of the following labels below the landform it describes.

Canyon	Dunes	Mountain	Valley



ACTIVITY 4

INVESTIGATE LIKE A SCIENTIST

Hands-On Investigation:

Landscapes in your Environment

In a previous activity, you looked for rocks that showed evidence of change. You may have found rocks with holes, rocks that were smooth, or rocks with layers. In this investigation, you will find and record evidence of change in local landscapes. You will use the evidence to create a map that shows different changes you found in the landscapes.

Make a Prediction

Brainstorm what evidence of weathering, erosion, and deposition you could find. **Record** the process and type of evidence you might see.

Process	Evidence

What materials do you need? (per group)

- Pitchers or bottles of water
- Paper
- Pencils
- Clipboard
- Camera (optional)

HANDS-ON INVESTIGATION

What Will You Do?

1. Visit a nearby landscape. Draw the main landscape areas in the provided space and label them.
2. Pour water on a sloping area of your landscape and observe what happens.
3. Mark the areas where you observe a change and describe this change.
4. If you have a camera, use it to collect images of these areas.
5. When you have finished the map, combine it with the photos.

Draw the Landscape

Think About the Activity

You may have observed mini-landforms such as streams or trickling water and hills or slightly uneven ground. How would evidence of weathering, erosion, and deposition look different for larger landforms like canyons or mountains?

Explain why it might be useful to recognize signs of weathering, erosion, and deposition.

Compare your map to another group's map. Did you see different evidence?

Is there anything they have that you would put on your map if you did it again?

Life Skills **I can think about how my team works together.**

What Sorts of Landforms Are Shaped by Water and Ice?

Activity 5

Analyze Like a Scientist

Canyon Formation

You know that the two processes of erosion and deposition can lead to the formation of some landforms. Now consider how **Canyons** form. **Read** the following statements and check the boxes to indicate if you agree or disagree with each statement.

Colored Canyon, Sinai

Agree	Disagree	Statement
		The greater the water flow, the greater the erosion.
		Larger streams or rivers produce greater change.
		Canyon walls are not very tall and have gentle slopes.
		A canyon is a type of valley.
		Rivers can change a landform very slowly.
		Fast-moving rivers can cause a lot of erosion.

Now, **read** the text. After you read, **review** your answers and change them if necessary.

Life Skills **I can review expectations.**

Canyon Formation

Gravity pulls rainwater downhill, where it gathers into small streams. These streams join one another and form bigger streams. Big streams or rivers cause more erosion than little streams. Rivers carve out **Valleys**. The shape of the valley formed depends upon several factors, including the types of rocks present and the speed, age, and size of the river.

As rivers drain, they create a variety of different landforms. Have you ever heard of or watched a canyon such as white canyons or colored canyons in Sinai or the Grand Canyon in the United States of America? It is very large and steep. Canyons are special types of valleys with steep sides.

You can probably guess how this canyon formed. Over a long period of time, the river eroded the rock and cut farther and farther down into the rock. Because the river was traveling down a steep slope, the water was moving quickly and had a lot of energy. The force of this rushing water eroded a lot of sediment and carried it away. This process took many millions of years.

Now look back at your responses in the previous table. Should any of your answers change? Write about how your thinking changed after reading the text.

Activity 6

Observe Like a Scientist

Canyons and Valleys

Read the text and **look** for patterns in how canyons form. **Compare** how canyons form to how valleys form. Then, **answer** the questions.

What makes the Grand Canyon so grand? In a previous activity, you learned that the Grand Canyon is a famous landform in North America. People travel from all over the world to visit this enormous canyon and they come to see the canyons and monuments in Sinai.

Grand Canyon in the United states of America

How is a canyon different from a valley? Valleys are lowland areas in between mountains. Valleys have gently sloped sides that usually surround a wide, flat plain. Valleys can be formed by rivers or streams. On the other hand, canyon walls are usually quite high, steep, and narrow. Both canyons and valleys often have rivers or streams that flow through the lowest point.

The Grand Canyon is the largest canyon in the world, and it is millions of years old. How was this landform created?

How were canyons formed?

Compare between the canyon and the valley in terms of characteristics of their formation.

Activity 7

Analyze Like a Scientist

Delta Formation

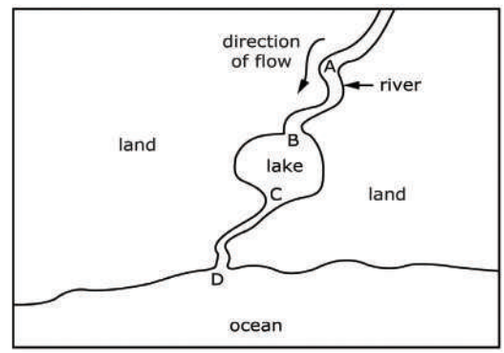
The Nile River **Delta** is the most famous delta in the world. The delta is characterized by the presence of fertile soil that allows the cultivation of different types of crops in Egypt. How does a delta form? You have already learned about erosion and deposition. **Read** the text to find out how these two processes work together to form the delta. Then, **complete** the activity that follows.

Unlike valleys and canyons, deltas are not formed by erosion, but rather by the process of deposition. Streams or rivers carry sediment, called silt, which is made of very fine bits of sand, clay, or rock materials. because rivers are so fast moving, such as River Nile, they carry these sediment easily. The Nile River Delta was formed in Egypt as a result of the rapid flow of the Nile River. Note that the map shows the Nile River Delta, which is triangular in shape and lies between Cairo and the northern coast of Egypt. The river water is full of sediment that it has collected along the journey.

Nile River Delta

Most deltas form where flowing water enters still water. This could be a large river entering the sea. The key is that deltas form where water speed slows or stops and drops the sediment it is carrying. Large wetlands form in deltas. The wetland plants are partly responsible for slowing down the water, and their roots help trap sediments, this increases deposition.

Now, **look** at the map that shows a river flowing through a lake and then into an ocean. Work with a partner to **draw** crosses on the map where you think deltas will form.



Explain why you marked these locations.

How Does Wind Shape Landforms?

Activity 8

Analyze Like a Scientist

Wind Erosion

Wind in the desert can be a powerful force of change of landscape. What makes moving air so destructive in this environment? Sand. **Read** the text and **look** at the image to find out what happens when wind and sand work together to both break down and build landforms.

When wind blows across the land, it picks up sand and other rock particles and carries it along. When this flying sediment hits a rock, it wears down that rock like a sandblaster. This carves the rock into strange shapes.

Some landforms are created by erosion and deposition processes at the same time. Have you ever been to a beach or a sandy desert? What landforms could these two very different environments have in common? Sand dunes, of course. As the name implies, these landforms are made of windblown sand. You usually see dunes in groups, and they may cover a large area. They can be hundreds of meters tall.

Wind Erosion Creates Landforms

Sand grains move away in the direction the wind blows. The grains bounce along, up the slope of the dune, carried by the wind. When they reach the top, the dune forms a barrier to the wind. The sand grains then roll down the other side. **Dunes** form because the wind is not strong enough to carry away the grains.

Draw the story of how wind and sand work together as forces of erosion and deposition. **Share** your ideas with your partner.

Activity 9

Investigate Like a Scientist

Hands-On Investigation: Sand Shifters

Wind and sand work together to erode rocks. When the wind stops blowing, the sand and small rocks are deposited in a new place. Have you ever seen sand dunes? Do you think that those dunes stay in one place forever, or will they be constantly shifting? In this investigation, you will create a model to explore this process in action. Consider what you already know about what causes sand dunes to form.

Make a Prediction

First, **write** your predictions in the chart.

Question	The Prediction
How do sand dunes form?	
Why do sand dunes form in some locations and not others?	

What materials do you need? (per group)

- Aluminum foil pans (approximately 33 x 23 x 5 cm)
- Broom and dustpan
- Copy paper box lids (for catching extra blowing sand if activity is done inside), 3
- Spray bottle of water
- Rocks or other small objects, 3
- Cooking oil spray (can be shared as a class)
- Colored pencils
- Safety goggles (per student)
- Sand
- Straws

HANDS-ON INVESTIGATION

Life Skills **I can use information to solve a problem.**

What Will You Do?

1. Fill three pans with sand. Place a small rock in each container.
2. Make a plan for how to produce a build up of sand in one place with the provided materials.
3. Record your predictions.
4. Explore what happens when you use the straw to blow sand.
5. Record your observations.

Observations

Think About the Activity

How does the wind affect the sand?

What shapes did you see that formed in the sand?

Compare your findings with other groups. Explain how they were similar or different.

Life Skills **I can review my progress toward a goal.**

Activity 10

Evaluate Like a Scientist

Describing Landforms

How are landforms formed? How is a landscape changed? Think about what you have read, watched, and investigated. Reflect on the processes that you have explored to complete each task.

Write the following words in the blanks to correctly identify each landform.

Canyons	Sand dunes	Rivers	Wind

_____ are deep valleys with steep sides.

_____ are hills that are made of sand.

_____ are often what causes the formation of both valleys and canyons.

_____ and sand work together as forces of erosion in the desert.

How Landforms Are Formed

In the columns, write how each landform is caused. There can be more than one cause for each landform.

Erosion	Water	Wind	

	Canyons and Valleys	Delta	Sand Dunes
Causes			

Solve Problems Like a Scientist

Unit Project: Forces That Shape the Earth

In this project, you will use what you know about how the surface of Earth changes to model how different environmental factors have affected the landscapes of the Wadi Nakhr valley over time.

Jebel Shams, Oman

The wadi Nakhr landscape has been shaped by weathering caused by wind and water. You can also find evidence of setimentary activity that occurred millions of years ago. As you complete the activity, remember what you have learned about how canyons, valleys have formed.

Look at the image that follows and the images of landforms in wadi Nakhr. **Think** about what you have learned about how different environmental factors can affect landscapes. **Answer** the questions to predict which factors affected the formation of each landform. Then, **complete** the modeling activity that follows.

Prediction

Look at the pictures of the valley.

Smooth, Steep Sides

Deep Canyon, Layers of Rock

Rippling Mountainside

Life Skills **I can apply an idea in a new way.**

Predict what factors (erosion, weathering, and so on) played a part in shaping this landform over time. **Explain** your reasoning.

Image	Which factors affected the formation of this landform?	Reasoning: Explain Your Thinking
Broken rocks in Wadi Nakhr		
Smooth, Steep Sides of mountain		
Layers of Rock		
Rippling Mountainside		

Model

Consider how any of the factors from the previous table will continue to shape the landscape of the wadi Nakhr over time. How will it look in the future? **Design** a model to represent the landform in the future and include at least one environmental factor that will change its surface.

How will you design the landform model? How will you design the environmental factor(s)? **Draw** a picture of your design.

Your teacher may ask you to **design** your model and **summarize** your findings. If so, **use** the summary frames to show what happened.

Assess your Learning

Choose the right answer.

1. When a rock's surface is eroded due to weather factors, this indicates the occurrence of ..... process.
   a. weathering
   b. deposition.
   c. transfer
   d. erosion

2. Dissolving metals forming rocks is an example for .....
   a. mechanical weathering.
   b. erosion by wind.
   c. deposition in rivers.
   d. chemical weathering.

3. Which of the following indicates the occurrence of chemical weathering process?
   a. Water freezes inside rocks.
   b. Mixing the acidic water with rocks.
   c. Trees' roots grow in rocks cracks.
   d. Rocks colliding with each other as a result of water current

4. What is the process in which the landforms change due to weathering factors?
   a. Expansion
   b. Weathering
   c. Erosion
   d. Evaporation

5. When rocks beak down into small pieces, this indicates the occurrence of ..... process
   a. mechanical weathering
   b. chemical weathering
   c. erosion by wind
   d. erosion by water

6. Which of the following is an evidence of erosion?
   a. Sand dunes formation
   b. Forming rock crumbs
   c. Nile delta formation
   d. Forming of sedimentary rock.

7. Forming red rust in sedimentary rocks is an evidence of occurring ..... process
   a. erosion of sedimentary rocks
   b. mechanical weathering
   c. chemical weathering
   d. transfer and deposit of crumbs

8. Steep valleys formed due to flowing water erosion are called .....
   a. canyons.
   b. sand dunes.
   c. hills.
   d. delta.

9. The formation of sand dunes in western Desert in Egypt is due to the movement of .....

a. floods.
b. winds.
c. waves.
d. torrents.

10. At the convergence of flowing river water that carries clay and sand sediments with the sea , landform is called.....is formed.

a. Delta
b. Sand dunes
c. Dams
d. Canyons

11. Which of the following landforms is steep and formed due to power of flowing water erosion is .....

a. plains
b. Valleys
c. Canyons
d. Mountains

12. The presence of sand dunes or the deposits in a region, tells us that they are.....

a. eroded in their place.
b. weathered in their place.
c. eroded in another place.
d. weathered and eroded in their place.

13. The following are photos for landforms. Each of them is an evidence of the occurrence of a geological process. Connect each process with its evidence of occurrence.

a. Erosion by water

b. Erosion and deposition due to wind

c. Deposits by water