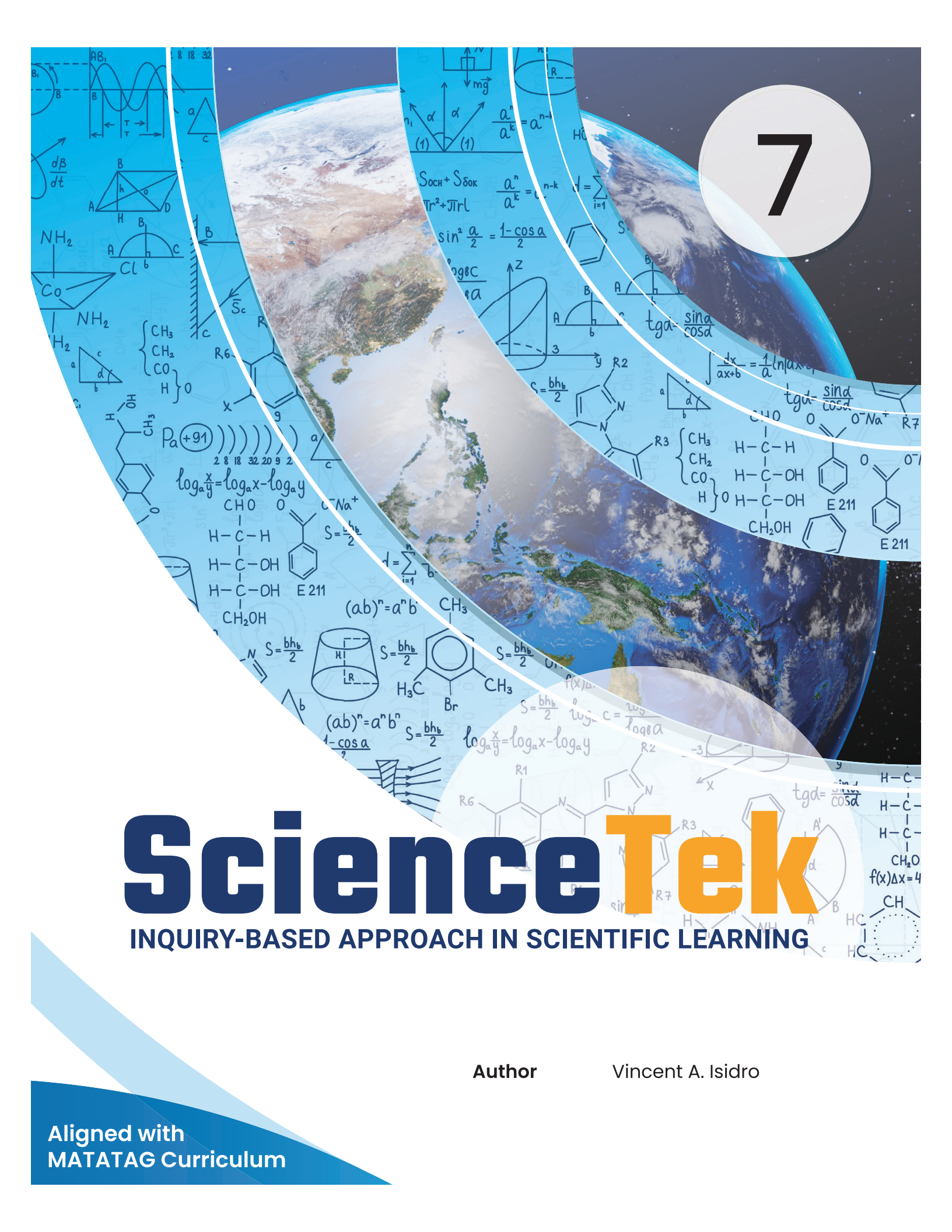




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ScienceTek

INQUIRY-BASED APPROACH IN SCIENTIFIC LEARNING

Author

Vincent A. Isidro

Aligned with
MATATAG Curriculum

ScienceTek7

INQUIRY-BASED APPROACH IN SCIENTIFIC LEARNING

Second Edition

Vincent A. Isidro



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FOREWORD

ScienceTek: Inquiry-Based Approach in Scientific Learning

In the ever-evolving landscape of education, ScienceTek emerges as a beacon of innovation and excellence, meticulously crafted to align with the new DepEd Matatag Curriculum. This courseware is more than just a repository of scientific knowledge; it is a dynamic tool designed to resonate with the modern learner. By embracing the principles of the DepEd Matatag Curriculum, ScienceTek ensures that its content is not only relevant and comprehensive but also culturally responsive and inclusive, promoting a holistic understanding of science in the context of our rapidly changing world. This alignment with the latest educational standards underscores our commitment to providing educators and students with resources that are both current and pedagogically sound.

At the heart of ScienceTek is its inquiry-based learning approach, a method that transforms the classroom into a laboratory of curiosity and discovery. This approach encourages students to ask questions, formulate hypotheses, and engage in critical thinking, mirroring the real-world process of scientific inquiry. Moreover, the textbook integrates science process skills and an engineering approach, providing a unique blend that fosters problem-solving and analytical skills. These features are complemented by digital interactives, seamlessly integrating technology into the learning experience. These digital components not only enhance understanding but also cater to diverse learning styles, making ScienceTek an indispensable tool in the modern science classroom. This courseware is not simply focused on teaching science; it is dedicated to transforming science learning into a great experience.

TechFactors Inc.

How To Use This Book

The descriptions of each lesson section in this courseware will serve as a guide in understanding its content and purpose for a fun and meaningful journey in science.



Target

States the learning objectives for the lesson.



Engage

Contains an image that would spark the interest of the students and poses engaging questions to stimulate inquiry in student.



Explore

Presents a digital interactive or simulation to allow students to use their science process skills and serve as springboard to the key concepts presented in the lesson.



Explain

Discusses the key concepts and includes illustrations and graphic organizers to aid students in developing mastery.



Elaborate

Comprises an individual or collaborative activity that enables students to apply the knowledge and skills they have learned in various situations.



Evaluate

Contains an assessment activity that will check what students have learned from the lesson.



Extend

Includes a performance task that requires students to demonstrate their knowledge and skills by creating an output or product in a real-world context.

What's New?

We are excited to share the latest enhancements in our ScienceTek courseware, meticulously designed to enrich your learning journey:

- **Alignment with DepEd Matatag Curriculum:** Our content is now fully aligned with the latest DepEd Matatag Curriculum, ensuring relevance and up-to-date educational standards.
- **Enhanced Conceptual Depth and Breadth:** Dive deeper into key scientific concepts with our improved content, offering a more comprehensive understanding of each topic.
- **Revamped DepEd Matatag Curriculum-Aligned Interactives:** Engage with our interactives, now fine-tuned to align with the DepEd Matatag Curriculum, for a more immersive and effective learning process.
- **Improved Assessment Tools:** Test your knowledge with our assessment tools, standardized for easy administration and specifically designed to stimulate higher-order thinking skills.
- **New Processing Activities:** To reinforce learning, we have included novel processing activities aimed at boosting mastery and retention.
- **Fresh Layout and Design:** Experience our content in a new light with a revamped layout and design, making learning not just educational but visually appealing.
- **Vibrant New Illustrations:** Bring learning to life with our vivid, newly added illustrations, making complex concepts easier and more enjoyable to grasp.

Embark on a dynamic educational journey with ScienceTek's latest offerings, where learning is made a great experience!

ABOUT THE AUTHOR

Vincent A. Isidro

Vincent graduated *magna cum laude* from the University of the Philippines-Diliman with a Bachelor in Elementary Education Major in Science and Health. He is currently completing his Master of Arts in Education Major in General Science from the same university. He previously worked as a science teacher and is currently a content developer in TechFactors, Inc.

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QUARTER 1

We are blessed with an abundance of materials around us. We use these materials in making our lives better and solving problems that we encounter. In this unit, you will learn how scientists identify and solve problems in a systematic way and how it changes our society. As you begin your journey, you will explore some laboratory equipment and demonstrate how it is properly used to measure quantity and gather data. You will also learn how to describe a solution quantitatively and the factors that affect its solubility. Finally, you will explore how to classify solutions whether it is an acid, base, or salt.

LESSON 1

The Scientific Method



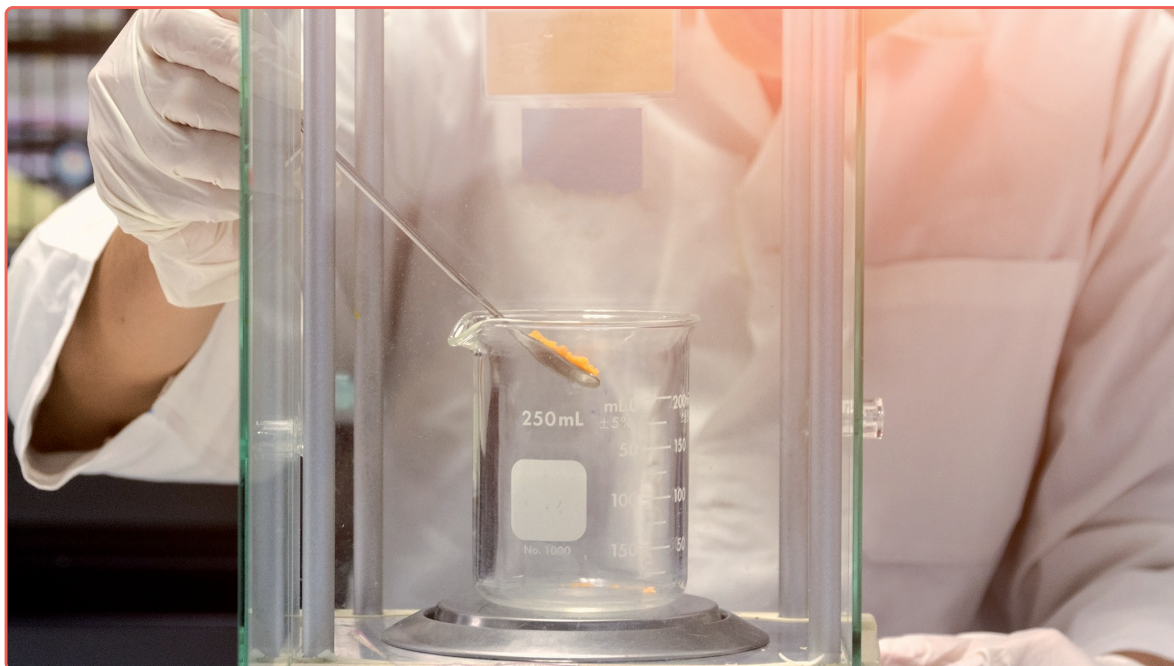
Target

At the end of this lesson, you will be able to:

- ◇ Identify the steps of the scientific method
- ◇ Apply the steps of the scientific method in an investigation.
- ◇ Solve problems using the scientific approach.



Engage



Is there a way for us to solve problem systematically?



Explore

Access the interactive
to perform the activity.



Mystery Branch

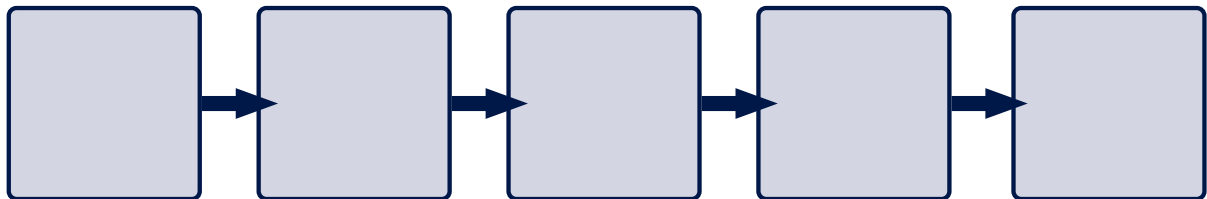
Objective

- ◇ To apply the scientific method in determining why the mystery branch broke.

Instruction from the Interactive

1. Click on the radio buttons to choose the valid observations.
2. Choose which of the two questions is more relevant to the problem.
3. Among the "suspects" shown, choose which one is responsible for why the branch broke based on the pieces of evidence that you have gathered so far.
4. You are going to test your hypothesis to see if the suspect you picked was POSSIBLY the one responsible for the incident. Shown on the Interactive screen are some tests that you can do to prove your hypothesis.
5. Complete the statement: *"Based on the circumstantial evidences and the tests conducted, I therefore conclude that the one responsible for why the branch broke was..."*
6. Arrange in a flowchart the specific steps you followed (based on scientific method) in solving the problem.

Data



The Mystery Branch

Guide Question:

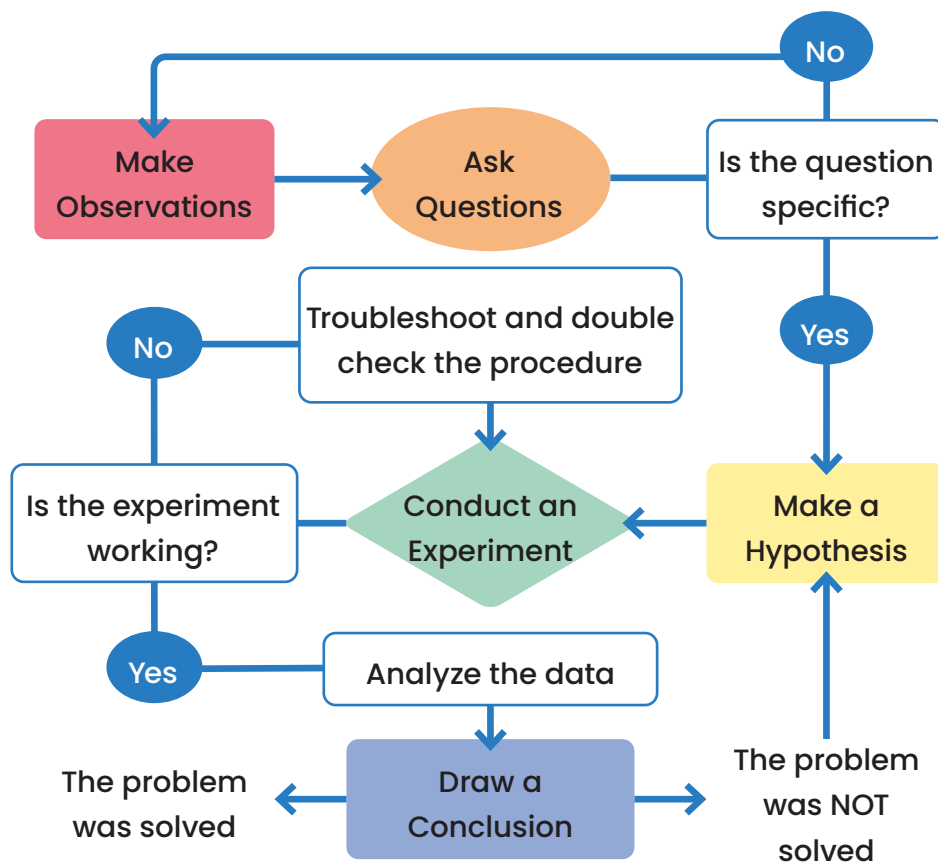
1. Write a short summary of the steps you performed in the interactive.



Explain

When we are faced with problems and challenges, it is important that we follow a systematic approach. This is called the **scientific method**.

Roger Bacon, a scientist during the Renaissance period, is generally considered the *Father of the Scientific Method*. He developed the idea of making observations, formulating a hypothesis, and then experimenting to prove his hypothesis. Furthermore, he documented his experiments so that scientists could repeat and verify the results of his experiments. His process can be summarized through the flowchart below.



The Scientific Method

Making Observations

Observations serve as the foundation of scientific inquiry, and they are essential for formulating questions, developing hypotheses, and conducting experiments. Our observations often stem from curiosity, or the need to understand phenomena. Observations in the scientific method occur when scientists use their senses or instruments to gather information about a specific phenomenon, event, or natural occurrence.



Observation perceives through senses: sight, hearing, smell, taste, and touch.

Identifying Problem

Observations may lead us to identify arising specific problems. This problem should be clear, concise, and focused on serving as the beginning point for scientific investigation.

Formulating a Hypothesis

Once we identified the problem, we will develop a hypothesis. A hypothesis is an educated/scientific guess or a tentative explanation of how to solve a problem or phenomenon. It often takes the form of an “if-then” statement, proposing a cause-and-effect relationship.

Conducting an Experiment

To test hypotheses and predictions, scientists design experiments. Experiments are controlled, systematic procedures that allow researchers to manipulate variables and collect data. Variables in the experimentation process can be identified as:

Independent variable: It is the variable that the researcher deliberately changes or manipulates to observe its effect on the dependent variable.

Dependent variable: It is the outcome or response that you measure or observe caused by the changes done with the independent variable.

Controlled variable: These are factors or elements in the experiment that you intentionally keep constant or unchanging.

Analysis of Data

After conducting experiments, data is collected and analyzed. Data analysis involves statistical and analytical methods to determine whether the results support or refute the hypothesis.

Making Conclusions

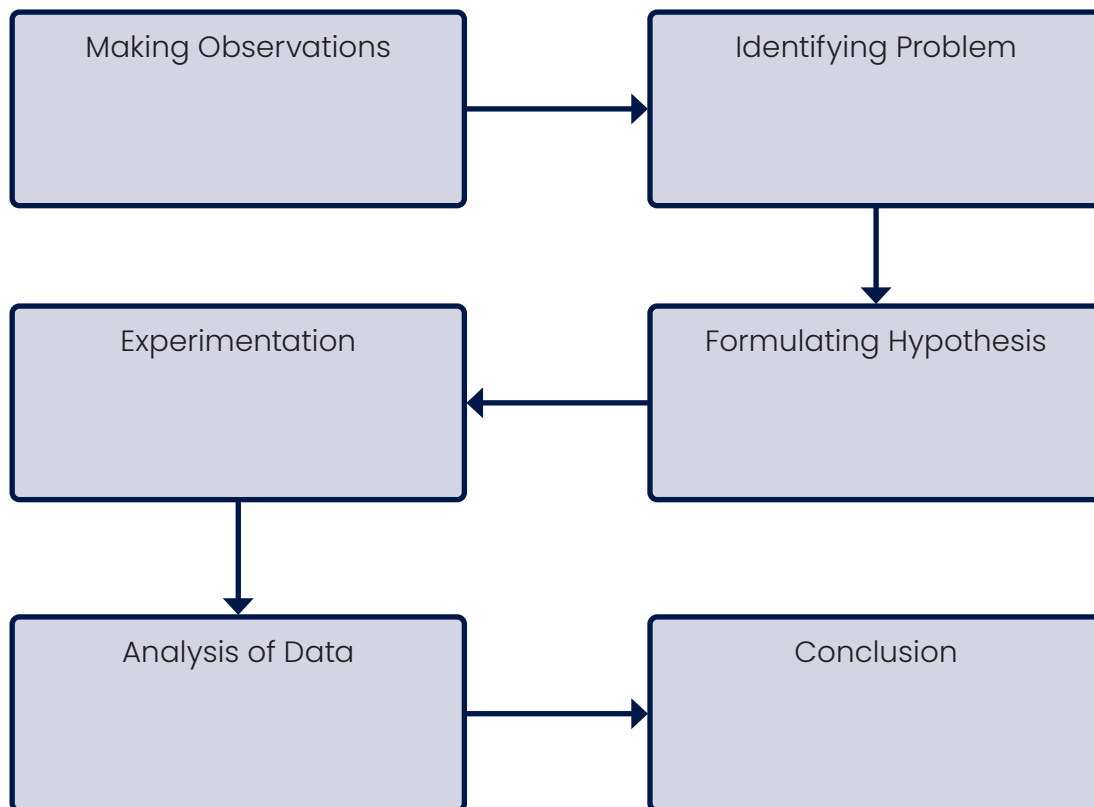
Based on the analysis of the data, scientists draw conclusions about the validity of the hypothesis. If the results support the hypothesis, it suggests that the proposed explanation is plausible. If not, it may indicate the need for alternative explanations or further investigation.



Elaborate

Form a group and identify an issue or problem you encounter at home or school. Below each step of the scientific method in the flowchart below, describe how you can apply each to address the issue you are dealing with. Then, explain your output in class.

Real-Life Application of Scientific Method





Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. What is the systematic approach of scientists or researchers in solving problems?
- a. Scientific Problem
 - b. Scientific Method
 - c. Scientific Equipment
 - d. Scientific Researches
- ____ 2. What step involves collecting data and analyzing the result if it supports the hypothesis?
- a. conclusion
 - b. gathering data
 - c. observation
 - d. hypothesis
- ____ 3. What step involves formulating questions based on his observations?
- a. conclusion
 - b. identifying problem
 - c. making observation
 - d. formulating hypothesis
- ____ 4. Which scientific question would require experimentation?
- a. Who made the first microscope?
 - b. How many giraffes live in Africa?
 - c. How long ago did dinosaurs live on the Earth?
 - d. Does the amount of salt in water affect the temperature at which it boils?
- ____ 5. Which of the following is NOT a characteristic of a good scientific hypothesis?
- a. It is testable.
 - b. It is falsifiable.
 - c. It is specific.
 - d. It is based on opinions

- _____ 6. Which step requires the researcher to draw conclusions based on the analysis of data and evidence?
- a.** Hypothesis
 - b.** Observation
 - c.** Experimentation
 - d.** Conclusion
- _____ 7. What is the variable that we measure in an experiment?
- a.** controlled variable
 - b.** conclusive variable
 - c.** independent variable
 - d.** dependent variable
- _____ 8. What is the variable that the experimenter manipulates or changes?
- a.** Constant variable
 - b.** Independent variable
 - c.** Dependent variable
 - d.** Controlled Variable
- _____ 9. What is the variable that does not change throughout the experiment?
- a.** Dependent variable
 - b.** Independent variable
 - c.** Controlled variable
 - d.** Unknown variable
- _____ 10. Suppose a scientist is conducting an experiment and obtains unexpected results contradicting the initial hypothesis. What should the scientist do next?
- a.** Disregard the results as anomalies.
 - b.** Modify the data to align with the hypothesis.
 - c.** Revise the hypothesis based on the new evidence.
 - d.** Repeat the experiment until the expected results are obtained.

LESSON 2

Science Equipment



Target

At the end of the lesson, you will be able to:

- ◇ Identify common science apparatus in the laboratory.
- ◇ Record accurate measurements using standard units for physical quantities.
- ◇ Organize collected data when carrying out a scientific investigation.



Engage



How can we measure the physical quantities of matter around us?



Measuring Matter

Objectives

1. Identify the proper science equipment to measure physical quantities of matter.
2. Measure physical quantities of matter such as mass, volume, and temperature.

Instructions from the Interactive

A. Mass of a Solid Object

1. From the equipment pane, click on the triple beam balance.
2. From the materials pane, click the metal block to place it in the triple beam balance.
3. Adjust the sliders on the arm until it is balanced and the arrow points to the center line.
4. Record the mass you have measured.

B. Mass of a Liquid Substance

1. From the equipment pane, click on the digital weighing scale.
2. From the materials pane, click the beaker to put it in the weighing scale and click "TARE". Observe the mass measured.
3. Click the bottle of water to pour its content into the beaker. Observe the mass measured.
4. Click "TARE" again and observe the mass measured.

C. Volume

1. From the equipment pane, click on the graduated cylinder.
2. From the materials pane, click the bottle of water to pour its content into the graduated cylinder.
3. Observe the line where the water level is. Record the volume measured in the graduated cylinder.

D. Temperature

1. From the materials pane, click on the beaker. Then, click the bottle of water to pour its content into the beaker.
2. From the equipment pane, click on the thermometer to put it in the beaker.
3. Record the temperature observed from the thermometer.

Observations

Table 1. Mass of a Solid Substance

	Mass (in grams)
Metal block	

Table 2. Mass of a Liquid Substance

	Mass (in grams)
Beaker	
Beaker with water	
Water	

Table 3. Volume

	Volume (in milliliters)
Water	

Table 4. Temperature

	Temperature (in degrees Celsius)
Water	

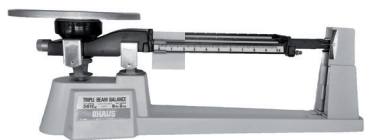
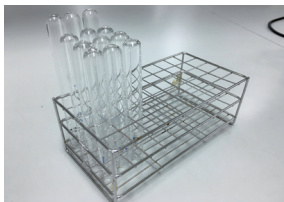
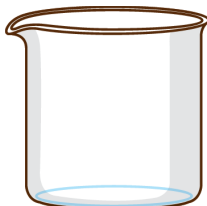
Guide Questions

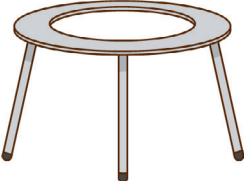
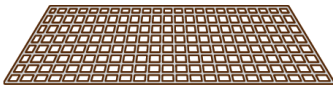
1. Why do we move the sliders in a triple balance beam?
2. Why is the mass of the water different when the TARE button was clicked?
3. Why is a graduated cylinder an effective tool in measuring volume?
4. Do you know of other units used to measure temperature other than degrees Celsius?



Explain

When performing a scientific investigation, it is important that we are familiar with the equipment in the laboratory. The following are common laboratory apparatus used.

		
Triple Beam Balance is used to measure the mass of an object.	Meter Stick is used to measure the length of an object.	Graduated Cylinder is used to measure the volume of an object.
		
Test Tube is used to hold, mix, or heat small quantities of solid or liquid chemicals.	Test Tube Rack is used to hold multiple test tubes upright at the same time.	Beaker is used for mixing, heating, and stirring liquids.

		
Alcohol Lamp is used for heating, sterilization, and combustion in a laboratory.	Tripod provides a stable and secure platform for holding equipment during experiments.	Wire Gauze is placed on a tripod to support beakers, flasks, or other glassware to protect it during heating.
		
A thermometer is used to measure the temperature of an object.	Erlenmeyer Flask is used to contain liquids and for mixing, heating, cooling, incubation, filtration, storage, and other liquid-handling processes.	A microscope is used to enlarge and observe smaller object that cannot be seen by our naked eye.

Physical Quantities

Physical quantities are considered as the building blocks of scientific understanding. It is essential that we have a structured way to describe and measure the natural world to help us create solutions to real-world problems. These quantities are measured using **standard units** or **SI units**. Length is measured in centimeters (cm), meters (m), or kilometers (km). Mass is measured in grams (g) or kilograms (kg). Volume is measured in cubic meter (m^3) but we often see it in bottles and other products to be measured in liters (L). Time is measured in seconds (s). Temperature is measured in Kelvin (K) but in everyday life, we often see it measured in degrees Celsius ($^{\circ}C$).

Presentation of Data

During scientific investigation, it is important to present your data properly to be easily understood. Now, we will learn some ways on how to present your data.

First you need to have a table, wherein data can be tabulated or presented in table format to show a comparison or contrast between two or more components. Also,

we use graphical presentation to show relationships and to guide us in interpreting our data.

1. Line Graph – it is commonly used to show trends, changes, or relationship in data over a continuous interval.
2. Bar Graph – it is commonly used to show comparisons, trends, and variation in data. It uses rectangular bars and columns.
3. Pie Graph – this graph is used to display the proportional distribution of a single data set or a whole into its constituent parts.



Elaborate

Form a group and measure some quantities of objects inside the classroom. Use the appropriate science equipment for each quantity. Record your observations in the table below. Then, present the data you have gathered using appropriate graphs.

	Science Equipment Used	Measurement
Mass of each member's backpack		
Member 1		
Member 2		
Member 3		
Volume of each member's water container		
Member 1		
Member 2		
Member 3		
Length of the different classrooms		
Room 1		
Room 2		
Room 3		

Temperature inside different classrooms		
Room 1		
Room 2		
Room 3		



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which instrument is best suited for measuring the mass of objects with high precision?
 - a. Meter stick
 - b. Thermometer
 - c. Measuring Tape
 - d. Triple Beam Balance
- ____ 2. What is the primary purpose of a meterstick?
 - a. Measuring mass
 - b. Measuring time
 - c. Measuring temperature
 - d. Measuring length or distance
- ____ 3. What is the main purpose of a thermometer in a laboratory setting?
 - a. Measuring weight
 - b. Measuring volume
 - c. Measuring length
 - d. Measuring temperature
- ____ 4. Which laboratory apparatus is primarily used for heating substances to high temperatures and is commonly found in chemistry laboratories?
 - a. Microscope
 - b. Alcohol lamp
 - c. Graduated cylinder
 - d. Triple beam balance
- ____ 5. Which of the following laboratory instruments is used for viewing objects that are too small to be seen with the naked eye and can magnify objects using lenses?
 - a. Petri dish
 - b. Centrifuge
 - c. Microscope
 - d. Erlenmeyer flask

- _____ 6. Which of the following laboratory tools is commonly used for holding and mixing small amounts of liquids or for conducting chemical reactions in a controlled environment?
- a. Beaker
 - b. Petri dish
 - c. Microscope
 - d. Alcohol Lamp
- _____ 7. When would you typically use a bar graph to represent data?
- a. When showing parts of a whole
 - b. When displaying trends in data over time
 - c. When comparing values across different categories
 - d. When showing the distribution of data within categories
- _____ 8. What does a pie chart (pie graph) primarily represent?
- a. Trends over time
 - b. Relationships between variables
 - c. The distribution of data within categories
 - d. Comparisons between different categories
- _____ 9. Which type of graph is best suited for showing trends in data over time?
- a. Pie chart
 - b. Bar graph
 - c. Line graph
 - d. Scatter plot
- _____ 10. Why is it important to use laboratory equipment correctly in scientific experiments?
- a. To impress peers and instructors
 - b. To save time and complete experiments quickly
 - c. To make the experiment look more professional
 - d. To ensure safety, accuracy, and reliability of results

LESSON 3

The Atomic Theory and Particle Model of Matter



Target

At the end of this lesson, you will be able to:

- ◇ Describe the significance of using scientific models in explaining phenomena.
- ◇ Explain the key points of the Atomic Theory and Particle Model of Matter.



Engage



How did early philosophers describe atoms?



Dividing Matter

Objective

- ◇ Determine how scientists thought matter can be further divided.

Instructions from the Interactive

A. Dividing Matter

1. On the screen is a piece of paper. Your goal is to cut the paper into its smallest piece possible using the scissors beside it.
2. Click the scissors to cut the paper.
3. Count the number of times you can cut the paper.

B. History of the Atom

Watch a virtual timeline of the theories and models of an atom.

Guide Questions

1. How many cuts were you able to make?
2. Do you think you could keep cutting the paper forever? Why or why not?
3. From the virtual timeline, give three statements about what an atom is.



Explain

Are you wondering how scientists can explain the world's smallest and biggest phenomena that might be challenging to comprehend? Such as how vast the universe is as it expands, and how cellular activity occurs inside the human body. Scientific models play a vital role for scientists to describe and make you understand such phenomena. These models can be mathematical, physical, or conceptual in nature and serve as tools to make complex or abstract ideas more understandable and testable.

Dalton's Atomic Theory

The concept of atom being the smallest indivisible particle is not new. Although, it is very difficult for early thinkers to imagine it without the use of models to visualize it. These models and theories laid the groundwork for our modern understanding of chemistry and the nature of matter.

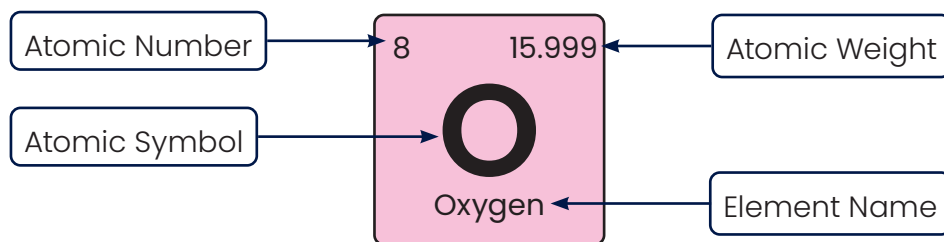
1. All matter is composed of extremely small particles called atoms.

The idea of the atom is rooted in the Greek Philosopher, Democritus. He proposed that all matter is composed of particles called *atomos* meaning indivisible. During the 19th century, John Dalton's discovery supported Democritus' idea suggesting that all substances in the universe, whether they are solids, liquids, or gases are ultimately made up of tiny, indivisible particles known as atoms.

2. Atoms of a given element are identical in size, mass, and other properties.

The Periodic Table of Elements is a chemist's guide to all the elements found on Earth. It also captures the important patterns in the behavior of the elements. Information about an element's structure, properties, and behavior in chemical reactions are indicated based on its position in the Periodic Table.

Each element in the table is usually displayed with the element's symbol and name, its atomic number, and atomic weight. Oxygen, for instance, carries the symbol O; has an atomic number of 8, and has an atomic weight of 15.999. All atoms of a particular element are identical to one another and distinct from atoms of other elements.



3. Atoms are composed of sub-atomic particles.

The Atomic Theory asserts that an atom is composed of sub-atomic particles: electron (negatively charged) as well as proton (positively charged) and neutron (neutral-charged) which are found inside the nucleus.

4. Atoms of different elements can combine in simple whole-number ratios to form chemical compounds.

For instance, water is formed when two hydrogen atoms combine with one oxygen atom, resulting in a ratio of 2:1. This principle of combining in fixed, simple ratios is fundamental to the nature of chemical reactions and compound formation.

5. In chemical reactions, atoms are combined, separated, or rearranged.



Photosynthesis is an example of a combination reaction that can create the complex molecules needed for plant growth.

When you chemically combine two or more elements together in a fixed proportion, you can make a substance out of it called compounds. Compounds have a specific chemical composition and can be represented by chemical formulas that indicate the types and numbers of atoms present.

Compound	Chemical Formula	Elements Combined
Water	H ₂ O	Hydrogen and Oxygen
Carbon Dioxide	CO ₂	Carbon and Oxygen
Salt	NaCl	Sodium and Chlorine
Baking Soda	C ₆ H ₁₂ O ₆	Carbon, Hydrogen and Oxygen
Sugar	NaHCO ₃	Sodium, Hydrogen, Carbon, and Oxygen

Particle Model of Matter

The Particle Model of Matter is a scientific concept that describes the fundamental nature of matter in terms of tiny particles. These particles are the building blocks of all substances and are in constant motion, even though they may be too small to see with the naked eye.

The Particle Model of Matter provides a framework for understanding the behavior and properties of different materials, helping scientists explain a wide range of physical phenomena observed in the natural world.



Elaborate

Find a partner and create a comic strip showing a conversation explaining Dalton's Atomic Theory. You may draw your output in a piece of paper or you may use digital image editing software. Present your output in class.





____ 1. Which ancient philosopher proposed that matter consists of indivisible particles called atomos?

- ____ 2. Which of the following is an example of an element?

- _____ 3. Which of the following represents a compound?

- _____ 4. Which statement is consistent with Dalton's Atomic Theory?

- a. Atoms of different elements are identical.
- b. Atoms can be divided into bigger particles.
- c. Atoms are composed of subatomic particles.
- d. Atoms combine in random ratios to form compounds.

- ____ 5. Which of the following is NOT a subatomic particle of an atom?

- a. proton c. neutron
b. electron d. neuron

- _____ 6. What particles are contained in the nucleus of an atom?

- a. electrons and protons
b. neutrons and protons
c. neutrons and electrons
d. pixels and electrons

- _____ 7. According to Dalton's Atomic Theory, what is the key characteristic of a chemical compound?
- a.** It consists of only one type of atom.
 - b.** It always contains hydrogen atoms.
 - c.** It can be broken down into simpler substances.
 - d.** It has a fixed ratio of atoms from different elements.
- _____ 8. According to Dalton's Atomic Theory, in a chemical reaction, atoms are _____.
- a.** Created and destroyed
 - b.** Divided into smaller particles
 - c.** Combined to form new elements
 - d.** Rearranged but not created or destroyed
- _____ 9. Which statement best reflects Dalton's Atomic Theory regarding the combination of atoms?
- a.** Atoms combine in random patterns to form compounds.
 - b.** Atoms of different elements always combine in varying ratios to form compounds.
 - c.** The ratio in which atoms combine depends on the temperature and pressure conditions.
 - d.** Atoms of different elements can combine in simple whole-number ratios to form compounds.
- _____ 10. Dalton's Atomic Theory was groundbreaking, but it had limitations. Which of the following limitations was addressed by the discovery of subatomic particles?
- a.** The existence of isotopes.
 - b.** The idea that atoms are indivisible.
 - c.** The concept of fixed ratios in compounds.
 - d.** The behavior of atoms in chemical reactions.

LESSON 4

States of Matter



Target

At the end of this lesson, you will be able to:

- ◇ Describe the structure and behavior of different states of matter.
- ◇ Explain the relative motion of the particles in each state of matter using diagrams and illustration.



Engage



How do states of matter differ from one another?



Explore

Access the interactive
to perform the activity.



States of Matter

Objective

- Describe how states of matter look like in the molecular level

Instructions from the Interactive

- Hover the magnifying glass on each object.
- Observe how the molecules behave in each object.

Data

Table 1. Description of the Different States of Matter

Description	Solid	Liquid	Gas
Particle arrangement			
Particle movement			
Shape			
Volume			
Density			
Compressibility			

Guide Question

How does knowing the molecular behavior and arrangement of matter help in distinguishing solid, liquid, and gas from each other?

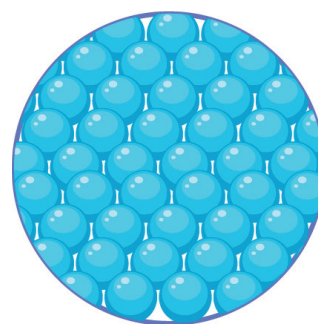


States of Matter

As you have observed in the interactive, matter exists in different states. The states of matter are greatly influenced by their intermolecular attractions and the motion of their molecules. Moreover, the molecule's temperature affects the motion of an object's molecule resulting to different phases of matter. The higher the temperature, the faster the molecules move.

Solid

Have you seen hollow blocks stacked on top of each other? Think of the particles of a solid like that, stacked neatly on top of each other, and they cannot move around too much. They are pressed together, but they can wiggle a little in their spots, like they are vibrating in place. Because they cannot move much, solids have a fixed shape, just like a bar of metal.

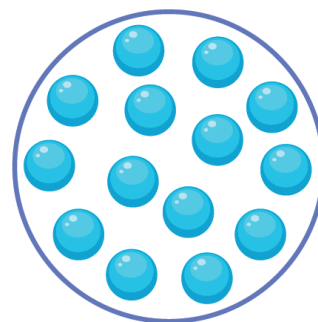


Tightly packed molecules of a solid

Observe your armchair. It is solid because it does not change its shape on its own. That is because its molecules are tightly packed. When you heat up a solid, like melting a chocolate bar, these molecules start to get more energy. They move faster and faster until they cannot stay together anymore. That is when a solid becomes a liquid.

Liquid

As you pour water in a glass, what do you notice? What makes liquids different from solids is that they can change their shape to fit into whatever container they are in. So, if you pour that water into a bottle, it takes the shape of the bottle. If you pour it into a cup, it takes the shape of the cup. This occurs because the molecules of liquid spread out and fill up any empty spaces they find.



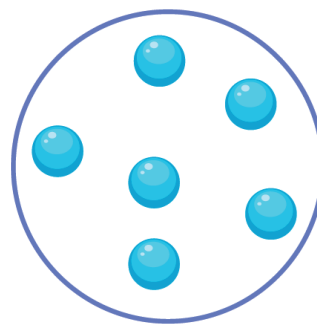
Molecules of a liquid which slides past each other.

The molecules of a liquid are still close together, but they can slide past each other. Imagine a group of fish swimming together in a pond. They are close, but they can move around and swim past each other. The molecules in a liquid behave in the same way.

When you heat up a liquid, like when you boil water, the water molecules get even more energy. They move very fast and spread out even more, and that is when a liquid turns into a gas.

Gas

The air that we breathe is a common example of gas. You cannot see air, but you can feel it when it is windy. Gas does not have a fixed shape nor volume. They can spread out and fill up any space they are in. So, if you have a balloon, and you inflate it, the gas inside the balloon spreads out to take the shape of the balloon. But if you let the air out, it goes back to filling up the room. The molecules of a gas move around very fast and can go anywhere they want.



Molecules of gas that are far away from each other.

Imagine a person pumping a bike tire. As you add more gas to the tire, gas gets more squeezed in there. When you let some air out, it expands and comes out. Gases can change their volume and shape very easily. When you heat up a gas, those molecules get even more energy and move even faster.

Particle Nature of Matter

The table below describes the different characteristics of solids, liquids, and gases based on the behavior and interaction of their particles.

Solid	Liquid	Gas
Has definite shape	No definite shape; takes the shape of its container	No definite shape; takes the shape of its container
Does not flow easily because the particles are closely packed together and are found in fixed positions. These particles only vibrate in place and they cannot slide past one another	Flows easily because the particles are not easily arranged nor found in fixed position. Particles can slide past one another.	Flows easily because the presence of large spaces in between particles and they can easily slide past one another.

____ 3. Which state of matter has particles that are slightly loose and slide past one another?

- a. Solid
- b. Liquid
- c. Gas
- d. Plasma

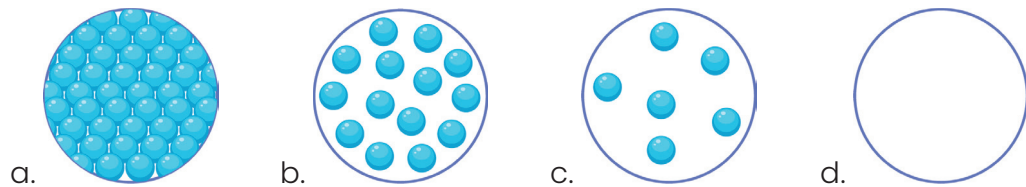
____ 4. In which state of matter do particles have the highest degree of organization and regularity in their arrangement?

- a. Solid
- b. Liquid
- c. Gas
- d. Plasma

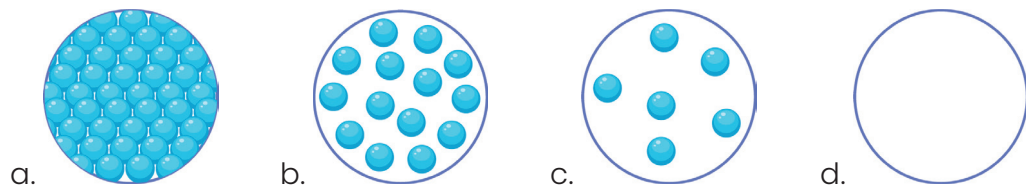
____ 5. When a liquid is cooled and turns into a solid, what happens to the arrangement of its particles?

- a. They remain the same.
- b. They become more disordered.
- c. They become more widely spaced.
- d. They become more tightly packed and ordered.

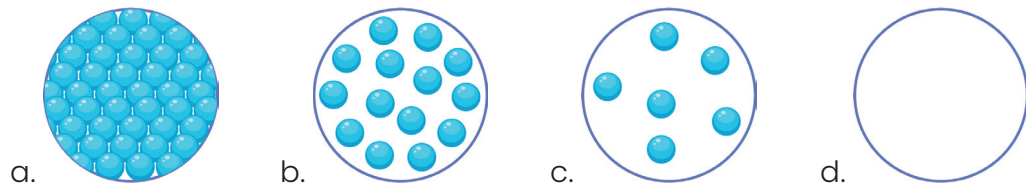
____ 6. Which of the following diagram represents water when exposed to a temperature higher than its boiling point?



____ 7. Which of the following diagram represents water a day after putting it in a freezer?



____ 8. Which of the following diagram represents an oil flowing on the floor?



- _____ 9. What is the primary difference in the appearance of molecules between a liquid and a gas?
- a.** In a liquid, molecules move slowly; in a gas, they move quickly.
 - b.** In a liquid, molecules are tightly packed; in a gas, they are widely spaced.
 - c.** There are no differences in the appearance of molecules between a liquid and a gas.
 - d.** In a liquid, molecules have high kinetic energy; in a gas, they have low kinetic energy.
- _____ 10. Which of the following statements accurately describes the particles found in a solid object?
- a.** It is tightly packed.
 - b.** It is not moving at all.
 - c.** It is sliding past each other.
 - d.** It is moving far apart each other.

LESSON 5

Changes in State of Matter



Target

At the end of this lesson, you will be able to:

- ◇ Explain how matter changes from one state to another due to energy changes.
- ◇ Describe the changes in particle arrangement when matter undergoes changes in state.



Engage



How does heat cause matter to change physically or chemically?



Phase Change Simulation

Objective

- Observe how phase change occurs.

Instructions from the Interactive

1. Choose the starting phase and the final phase of the water.
2. Click the play button to start the process of phase change.
3. Observe what happens to the water in the beaker.
4. Also, take note of the graph of temperature versus energy released/taken in by the ice/water.
5. Show a graph of temperature versus energy when:
 - a. Energy is released by ice
 - b. Energy taken in by water

Data

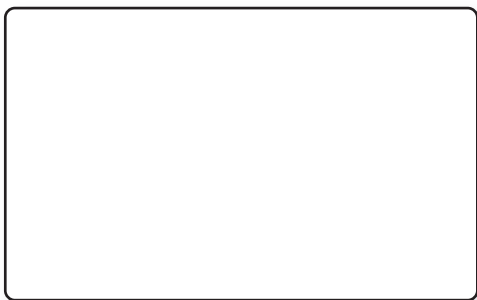


Figure 1. When energy is released by ice

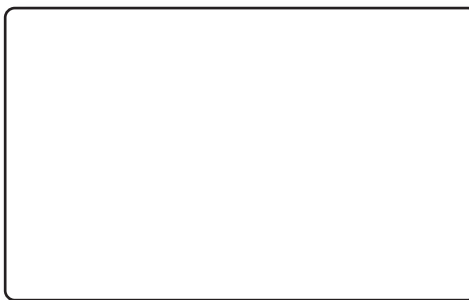


Figure 2. When energy is taken in by water

Guide Questions

1. Describe the behavior of molecules when matter changes from solid to liquid then to gas.

2. When does phase change occur?
3. What happens to temperature during phase change?



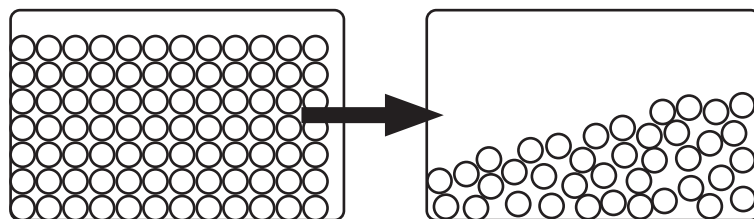
Explain

From the interactive, you witnessed how ice cubes turn into liquid water. We frequently observe this kind of change with water. At times, it becomes solid (ice) when it is cooled or turns into a gas (water vapor) when it is heated up. Water and other types of matter can change states. They can become solid, liquid, or gas. But have you wondered why a substance changes its state?

Changes of state are physical changes in matter. They are sometimes referred to as **phase change**. They are reversible changes and do not involve changes in matter's chemical properties. Matter changes its state when it loses or absorbs heat. Heat is a form of energy that flows between two substances due to temperature differences. When a substance absorbs heat, its temperature rises and particles spread out. On the other hand, when it loses heat, its temperature decreases and particles come together.

Solid to Liquid: Melting

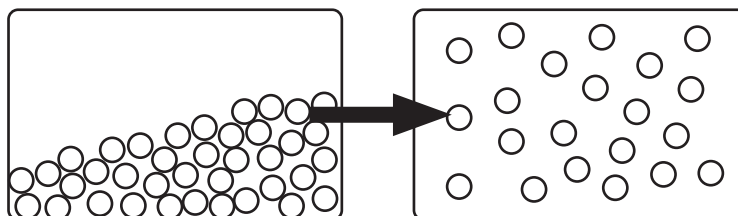
When a solid turns into a liquid, the process involved is melting. For examples, when ice cubes absorb the energy from the warmer air around it or when it was heated, the absorbed energy helps the particles overcome the force that holds them together. When the ice cubes reach the point where they become liquid already, it means it reached their **melting point**.



Change in particle arrangement from solid to liquid.

Liquid to Gas: Evaporation

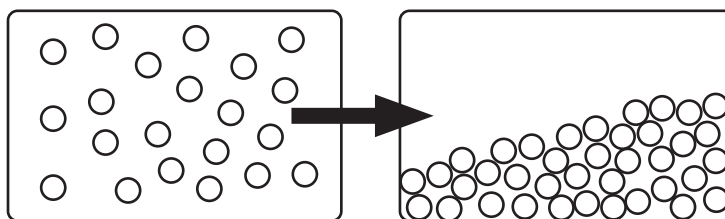
The process in which a liquid becomes a gas is called evaporation. This happens as the liquid absorbs enough energy to break the force that holds its particles together. Some call this process vaporization. Just like melting point, **boiling point** varies for different substances.



Change in particle arrangement from liquid to gas.

Gas to Liquid: Condensation

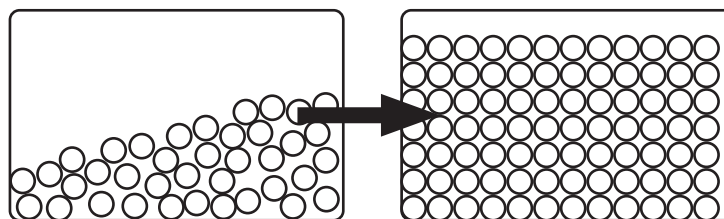
The process in which gas changes to liquid is called condensation. You may have noticed water droplets in your glass of ice-cold water on a sunny day. As the warm air around the glass encounters its cold surface, it cools and loses energy returning to liquid.



Change in particle arrangement from gas to liquid.

Liquid to Solid: Freezing

When you put water into a freezer, water loses energy to the colder air in the freezer. When this continues to happen, the particles do not have enough energy to freely move past each other. They will remain in fixed positions. In this case, the liquid water changes to solid. This process is called freezing. The temperature at which liquid becomes solid is called the **freezing point**.



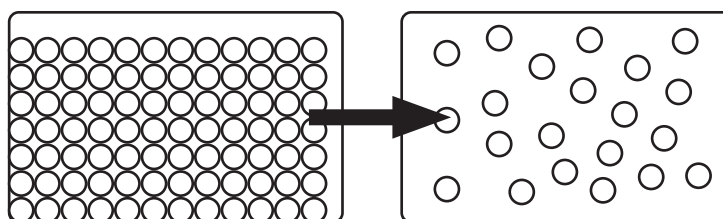
Change in particle arrangement from liquid to solid.

Solid to Gas: Sublimation

The process in which a solid turn into gas without passing the liquid state is called sublimation. This happens when the particles of a solid substance absorb enough energy to completely overcome the force that holds them together.



Mothballs undergo sublimation



Change in particle arrangement from solid to gas.

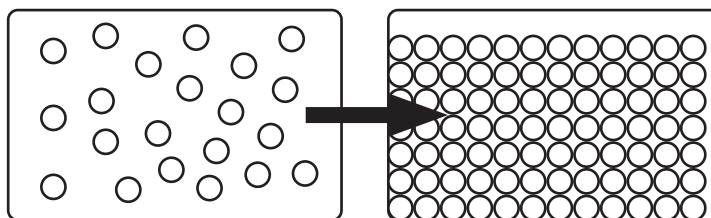
Gas to Solid: Deposition

The opposite of sublimation is deposition. This process happens when a gas turns into a solid. It happens when particles of a gas become very cold.

An example of deposition is the making of dry ice. Dry ice is commonly used to preserve food and other products upon transportation.



Dry ice.



Change in particle arrangement from gas to solid.

Endothermic vs. Exothermic

In general, there are two ways in which energy changes in matter – absorbing energy or losing it.

When energy is absorbed from the surroundings, the process is called endothermic. Melting, evaporation, and sublimation absorbed energy when heated. Thus, these processes are endothermic in nature.

On the other hand, when energy is released or lost to the surroundings, an exothermic process occurs. Freezing, condensation, and deposition are examples of exothermic processes.



Elaborate

Form a group. Go around the school and observe objects or situations that show change of state in matter. List down the objects or scenarios in the table below. Identify what kind of change of state occurs and classify it as endothermic or exothermic. Using a digital camera or your mobile device, take a photograph of these objects or scenarios. Present your observations in class.

Object or Scenario	Change of State	Endothermic or Exothermic	Photograph



____ 1. What phase change happens when a substance changes from a liquid to a gas?

- ____ 2. Which of the following is an example of a phase change that absorbs heat energy from the surroundings?

- ____ 3. During which phase change does a substance release energy into the surroundings?

- ____ 4. What happens to the particles of a substance when it changes from a liquid to a solid?

- ____ 5. On a cold morning, water vapor in the air turns into liquid droplets on a cold surface. This common weather phenomenon is called _____.

- _____ 6. During a scientific investigation, you noticed that a substance changes directly from a gas to a solid without becoming a liquid first. What is this process called?

- 37

c. Sublimation

d. Evaporation

____ 7. A puddle of water disappears after a sunny day. Which change of state best describes this process?

a. Condensation

c. Evaporation

b. Melting

d. Freezing

____ 8. During which phase change do the particles of a substance slow down and come closer together?

a. Melting

c. Evaporation

b. Freezing

d. Sublimation

____ 9. Sweating on a hot day is an example of a phase change. What specific change of state is involved?

a. Sublimation

c. Evaporation

b. Freezing

d. Condensation

____ 10. What happens to the tightly packed particles of a solid when it turns into a gas?

a. They stay close together.

c. They become more ordered.

b. They move farther apart.

d. They become solid.

LESSON 6

Solutions



Target

At the end of this lesson, you will be able to:

- ◇ Identify the role of the solute and solvent in a solution.
- ◇ Express quantitatively the amount of solute present in a volume of solvent.
- ◇ Demonstrate how different factors affect the solubility of a solute in a solvent.



Engage



What happens to salt particles when they dissolve in water?



Explore

Access the interactive
to perform the activity.



The Solvation Sphere

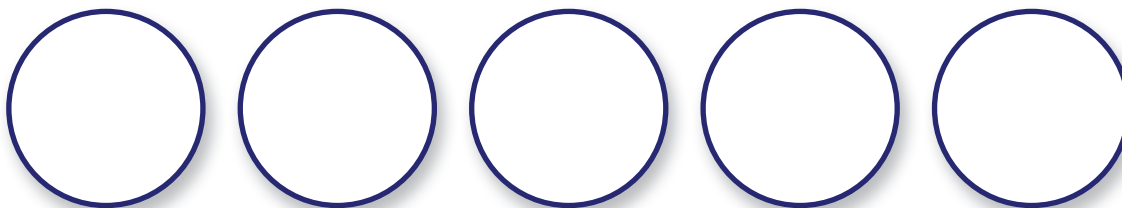
Objectives

1. To demonstrate how a solute dissolves in a solvent.
2. To determine why the phase of the solvent is the phase of the solution.

Instructions from the Interactive

1. Drop water on a watch glass with salt crystal. There will be a magnified image of the process that will take place. Observe what happens.
2. Keep on adding water until the salt crystal disappears.
3. Draw the five distinct changes that took place in the dissolution of the salt crystal after every drop of water was added in. Draw your observations in the circles under Data.

Data



Guide Questions

1. What happened to the solute when only a drop of water was added to it?
2. What happened to the salt crystal when you added more drops of water to it?



Explain

Solutions

Solutions are homogeneous mixtures. They are uniform in composition throughout and only one phase of matter is observed. They consist of two components – the solute and the solvent.

A **solute** is the component of the solution which dissolves in the solvent. A **solvent** is the component of a solution which dissolves the solute. It constitutes the larger component of the solution.

Solubility

There is a maximum amount of solute that can be dissolved in an amount of solvent at a certain temperature. This is called solubility of the solute. This is the property of a solution that helps the molecules of a substance to be dissolved.

A solution that contains the maximum amount of solute dissolved by a given amount of solvent is called a **saturated solution**. A solution is **unsaturated** when it contains less solute than the maximum amount it can dissolve at a given temperature. If you continue adding solute and reach the maximum amount that is capable of being dissolved in an amount of solvent at a given temperature, a **supersaturated solution** is achieved.

Concentration of Solutions

The concentration describes the relative amounts of solute and solvent in a solution. Quantitatively, you can express the amount of solute present in a given volume of solvent by stating the percentage of the solution that is composed of the solute. This percentage can be determined in one of three ways: (1) the mass of the solute divided by the mass of the solution, (2) the volume of the solute divided by the volume of the solution, or (3) the mass of the solute divided by the volume of the solution.

Percent by Mass

When the solute in a solution is a solid, a convenient way to express the concentration is a mass percent (mass/mass), which is the grams of solute per 100 g of solution.

$$\text{Percent by mass} = \frac{(\text{mass of solute})}{(\text{mass of solution}) \times 100\%}$$

Mass percentage can also be expressed in terms of the mass of the solute (in grams) per 100 mL of solution resulting in a mass-volume percentage. The mass-volume percentage is calculated by dividing the mass of the solute by the volume of the solution and expressing the result as a percent.

$$\text{Mass-volume concentration} = \frac{(\text{mass of solute})}{(\text{volume of solution}) \times 100\%}$$

Percent by Volume

The percentage of solute in a solution can more easily be determined by volume when the solute and solvent are both liquids. The volume of the solute divided by the volume of the solution expressed as a percentage, yields the percent by volume (volume/volume) of the solution.

$$\text{Percent by volume} = \frac{(\text{volume of solute})}{(\text{volume of solution}) \times 100\%}$$

Factors Affecting Solubility

Numerous factors affect solubility, or the capacity of a solute to dissolve in a solvent to produce a homogeneous solution.

1. Temperature

In most circumstances, a rise in temperature causes a rise in the solubility of solid solutes in liquid solvents. Although, solubility may decrease with increasing temperature for some solute-solvent combinations, especially for gases in liquids.

2. Stirring or Agitation

Stirring or agitating a solution is essential to maintain a concentration gradient and promote the mixing of solute and solvent molecules. This accelerates the rate of dissolution by bringing fresh solvent into contact with the solute.

3. Pressure

Pressure primarily affects the solubility of gases in liquids. According to Henry's Law, the solubility of a gas is directly proportional to the partial pressure of that gas above the liquid. Therefore, increasing pressure generally leads to higher gas solubility.

4. Surface Area

Finer particle sizes of solid solutes (greater surface area) dissolve more rapidly because more solute particles are exposed to the solvent. This increases the frequency of collisions between solute and solvent molecules, facilitating dissolution.



Elaborate

Find a partner and solve for the value asked in the following solutions. Show your answers in class.

1. What is the mass percentage of Iron in a piece of metal weighing 113 g containing 87.9 g of Iron?
2. What is the volume percentage of a solution made by taking 40.0 mL of ethanol and adding enough water to make 240.0 mL of solution?
3. A one-peso coin has a mass of 5.5 grams. How many grams of copper are in a one-peso coin containing 75% copper by mass?
4. How many mL of ethyl alcohol are present in a 50 mL bottle of 70% rubbing alcohol?



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. You are given a 40 mL solution in a beaker. You added solute to the beaker, and you observed some particles did not dissolve. What kind of solution is it?
- | | |
|----------------|-------------------|
| a. Saturated | c. Concentrated |
| b. Unsaturated | d. Supersaturated |
- _____ 2. What do you call a substance that dissolves in another substance of greater amount?
- | | |
|------------|-------------|
| a. Mixture | c. Solvent |
| b. Solute | d. Solution |

- ____ 3. What is the role of a solute in a solution?
- a.** To filter the solvent
 - b.** To dissolve the solvent
 - c.** To react with the solvent
 - d.** To be dissolved by the solvent
- ____ 4. To make a solute dissolve more quickly in a solvent, what should you do?
- a.** Stir it.
 - b.** Do not stir the solution.
 - c.** Let the solute settle down.
 - d.** Do nothing with the solute.
- ____ 5. Which best defines solubility?
- a.** Lack of polarity of molecules
 - b.** Amount of polarity of molecules
 - c.** Ability of a solvent to dissolve in a solute
 - d.** Ability of a solute to dissolve in a solvent
- ____ 6. If a solution has a high solute concentration relative to the solvent, it is considered ____.
- a.** Dilute
 - b.** Insoluble
 - c.** Saturated
 - d.** Concentrated
- ____ 7. How does the solubility of a solid change when the temperature of the liquid solvent is increased?
- a.** The solubility increases.
 - b.** The solubility decreases.
 - c.** There is no change in the solubility.
 - d.** The change in the solubility is unpredictable.

- _____ 8. If you dissolve 15 grams of salt (NaCl) in 85 grams of water (H₂O), what is the mass percent of salt in the solution?
- a. 10%
 - b. 15%
 - c. 85%
 - d. 100%
- _____ 9. You are conducting an experiment with a substance known to dissolve in water. As you continue adding the substance to the water, you notice that there are a few undissolved materials at the bottom. What term best describes this solution?
- a. Dilute
 - b. Saturated
 - c. Unsaturated
 - d. Concentrated
- _____ 10. If you want to prepare a supersaturated solution, what step would you likely take?
- a. Stir the solution vigorously until crystals form.
 - b. Heat the solvent until it reaches its boiling point.
 - c. Filter the solution and remove the undissolved solute.
 - d. Add more solute than the solvent can normally dissolve.

LESSON 7

Acids, Bases, and Salts



Target

At the end of this lesson, you will be able to:

- ◇ Identify solutions which can be found at home and in school as acids, bases, and salts.
- ◇ Investigate the reaction of acidic, basic, and saline solutions with a litmus indicator.



Engage



What causes changes in magnificent works of art such as ancient buildings and monuments?



Explore

Access the interactive
to perform the activity.



Sample Testers

Objective

- Differentiate the characteristics of two samples in terms of taste, feel and color change in litmus paper.

Instructions from the Interactive

- Drag the following testers and dip them in lemon juice:
 - taste tester
 - feel tester
 - litmus paper
- Drag the following testers and dip them in soapy water:
 - taste tester
 - feel tester
 - litmus paper
- Record your observations in Table 1.

Data

Table 1. Observations

Sample Tester	Lemon Juice	Soapy Water
Taste using Taste Tester		
Feel using Feel Tester		
Color using Litmus Paper		

Guide Questions

- What is the taste, feel and color of lemon juice? What about soapy water?
- Explain why the lemon juice tastes, feels, and looks the way it does according to your observation.
- Explain why the soapy water tastes, feels, and looks the way it does according to your observation.



Explain

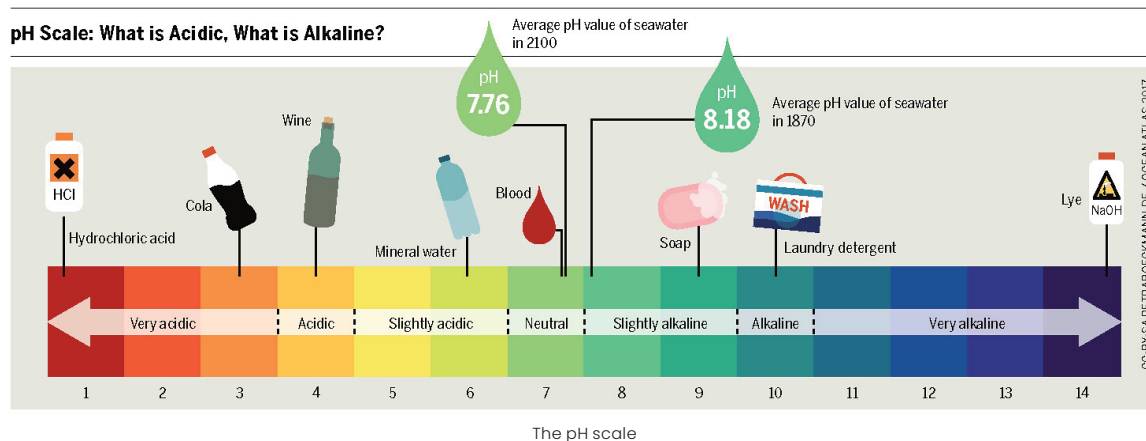
You have learned that there are substances that make the litmus paper turn red and blue. But how do we classify these substances?

Acids

You may have observed that lemon and orange juice, as well as vinegar, turn the blue litmus paper into red color while the red litmus paper remains the same. These substances are classified as acids. Acids are a fundamental class of chemical compounds with distinct properties.

Acids are substances that are sour in taste. You may have tasted it from fruits, such as citric acid in oranges and lemons. However, not all acids can be consumed as they can also be harmful, especially the concentrated ones. They can damage your skin and even structures such as buildings and statues.

Acids are known for their distinct pH levels. The pH value indicates how acidic or basic a substance is. Acids have a pH less than 7, with lower pH values indicating stronger acidity. A substance with a pH of 7 is neutral.



Some examples of acids are:

- Hydrochloric acid (HCl) in gastric juice
- Carbonic acid (H_2CO_3) in soft drinks
- Ascorbic acid (Vitamin C) in lemon and many fruits
- Acetic acid in vinegar
- Tannic acid in tea

Bases

Remember what happened to the litmus paper from the interactive when you dipped it in the soapy water? Yes, it turned the red litmus paper to blue while the blue litmus paper stayed blue. Soap and other substances that can do the same are called bases. Bases are also a fundamental class of chemical compounds with distinct properties.

Some bases are known for their bitterness and soapy feel. In its concentrated form, they cannot be ingested. These properties are the reasons why cleaning products contain bases.

Water-soluble bases are known as alkali. Alkalinity refers to the ability of a substance to neutralize acids and raise the pH of a solution. Bases are characterized by pH values greater than 7 on the pH scale. Higher pH values indicate stronger alkalinity.

Some examples of bases used in everyday life are:

- Sodium hydroxide or caustic soda used in soap and detergent production
- Potassium hydroxide or potash used in household cleaning products, refrigerant for refrigeration systems, and manufacturing fertilizers
- Calcium hydroxide or lime water used in construction, agriculture, and water treatment to adjust pH
- Magnesium hydroxide or milk of magnesia used to control stomach acidity
- Ammonium hydroxide used in hair dyes

When an acid and base react with each other to form salt, water, and heat, they undergo a neutralization reaction. In this reaction, the acidic and basic nature of the acid and base, respectively, are destroyed.

Salts possess several characteristics. Most salts have a crystalline structure, meaning their particles arrange themselves in a repeating, three-dimensional pattern called a crystal lattice. Salts can vary in their solubility in water. Some salts, like sodium chloride, are highly soluble in water and readily dissolve, while others are less soluble. Many salts are tasteless, while others, like sodium chloride, have a characteristic salty taste.

Some common examples of salts are:

- Sodium Chloride (NaCl) or common table salt used as a seasoning and preservative.
- Potassium Nitrate (KNO_3) used in fertilizers, fireworks, and food preservation.
- Calcium Carbonate (CaCO_3) found in limestone, chalk, and antacid medications.
- Sodium Bicarbonate (NaHCO_3) known as baking soda and is used in cooking and as an antacid.

Indicators

The substances used to determine the acidity or basicity of substances are known as indicators. They are weak acids or bases that have a different color from their original acid and base.

In the interactive, you used litmus paper. Litmus paper is a naturally occurring purple indicator extracted from lichens. It is available in the form of strips of paper, known as litmus paper, or a solution.



Litmus Paper Indicator

There are also natural indicators. These are from plants or plant parts containing useful chemicals that are used for testing an acidic or basic property of a solution. China Rose and turmeric are examples of natural indicators.



Elaborate

Form a group and observe your surroundings. On the tables below, list down two acids, bases, and salts that you can find in your home and in school. Write down what the substance is for and where they can be found. Examples are given for you.

Table 1. Acids

Acid	Location	Uses
Example: vinegar	Kitchen	Cooking

Table 2. Bases

Bases	Location	Uses
Example: shampoo	Bathroom	Cleaning your hair

Table 3. Salts

Salts	Location	Uses
Example: Epsom salt	Bathroom	For salt baths



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. Which of the following is a characteristic of acidic solutions?
- They taste bitter.
 - They turn blue litmus paper red.
 - They turn red litmus paper blue.
 - They have a pH greater than 7.
- _____ 2. When investigating the reaction of solutions with a litmus indicator, what will happen if a solution is basic?
- The litmus paper will turn red.
 - The litmus paper will turn blue.
 - The litmus paper will turn green.
 - There will be no change in the color of the litmus paper.

- _____ 3. Which of these solutions would typically be classified as a salt solution?
- a. Milk
 - b. Orange juice
 - c. Vinegar with water
 - d. Sodium chloride with water
- _____ 4. Which of the following is a strong acid?
- a. Milk
 - b. Vinegar
 - c. Lemon juice
 - d. Hydrochloric acid
- _____ 5. What happens to the numerical value in the pH scale as you move from acidic to alkaline (basic) solutions?
- a. It decreases.
 - b. It increases.
 - c. It remains constant.
 - d. It becomes unpredictable.
- _____ 6. Which substance is often used as a common household base?
- a. Vinegar
 - b. Lemon juice
 - c. Baking soda
 - d. Orange juice
- _____ 7. When a base reacts with an acid, what is typically produced?
- a. Heat
 - b. Light
 - c. Salt and water
 - d. Carbon dioxide gas
- _____ 8. What is the pH value of a neutral solution?
- a. 0
 - b. 7
 - c. 14
 - d. 10
- _____ 9. What does a pH value below 7 indicate on the pH scale?
- a. Acidic solution
 - b. Basic solution
 - c. Neutral solution
 - d. Highly concentrated solution
- _____ 10. Which of these is NOT a property of salts?
- a. They have a pH of 7.
 - b. They can be bitter or salty.
 - c. They are usually solids at room temperature.
 - d. They are typically formed by the reaction of an acid and a base.



Extend

Seawater is a naturally occurring salt solution. In this performance task, you will design an investigative activity to determine the amount of salt in a sample of seawater. You will also need to conduct it in the science laboratory as a group. Use the worksheet below to record your hypothesis, procedures, materials, or equipment needed, and the results and analysis of your investigation. Do not forget to wear protective gear.

Title of the Experiment

Define your Research Question

Notes:

Plan your Experiment

Notes:

Variables: _____

Hypotheses: _____

Materials/Equipment: _____

Procedure: _____

Conduct your Experiment

Analyze and Interpret your Results

Draw Conclusions

Reflection

Reflect whether your design meets the objective and the following criteria.

- ◇ Clarity and relevance of your research question and hypothesis.
- ◇ Thoroughness and thoughtfulness of your experimental design.
- ◇ Accuracy of your data collection and analysis.
- ◇ Quality of your conclusions and their alignment with your research question.

Rubric for Assessment

Criteria	4 (Exemplary)	3 (Proficient)	2 (Approaching Proficiency)	1 (Needs Improvement)
Research Question and Hypothesis	Clearly defined research question and a well-structured hypothesis that is logical, testable, and relevant to the topic.	Research question is defined, and the hypothesis is stated.	Research question is somewhat defined, and the hypothesis lacks clarity or is not well-structured.	Research question and hypothesis are vague or not adequately stated.
Experimental Design	A comprehensive and well-detailed experimental design that includes clear identification of the independent, dependent, and controlled variables. The procedure is logical, well-organized, and feasible within available resources.	An experimental design is presented with clear identification of most variables. The procedure is generally well-organized.	An experimental design is outlined but lacks clarity in variable identification, or the procedure is incomplete or unclear.	A poorly defined experimental design with significant gaps in variable identification or procedure.
Data Collection and Analysis	Thorough and accurate data collection with meticulous recording of measurements and observations. Comprehensive analysis of data includes appropriate use of tables, graphs, or charts.	Data collection is mostly accurate with minor errors. Analysis of data is mostly comprehensive.	Data collection is somewhat accurate, with noticeable errors or omissions. Analysis of data is limited or unclear.	Data collection is inaccurate or incomplete, with significant errors or omissions. Analysis of data is lacking or incorrect.

Conclusions and Interpretation	Clear and well-supported conclusions that directly address the research question. Comprehensive interpretation of results demonstrates a deep understanding of their significance.	Conclusions are stated and mostly relevant to the research question. Interpretation of results are reasonable.	Conclusions are somewhat relevant to the research question, with limited depth. Interpretation of results are minimal or unclear.	Conclusions are not relevant to the research question, or they are inaccurate. Interpretation of results are absent or erroneous.
Presentation	Engaging and well-organized presentation with clear communication of the research question, methods, results, and conclusions. Effective use of visual aids if applicable.	Presentation is organized and generally clear. Visual aids, if used, are somewhat effective.	Presentation is somewhat organized, but clarity and engagement is limited. Visual aids, if used, are not effectively integrated.	Presentation lacks organization and clarity, making it difficult to follow. Visual aids, if used, are ineffective or missing.

QUARTER 2

Learning how to value life and our connection to all living things fosters a sense of respect, responsibility, and stewardship for the environment and all its inhabitants, promoting empathy and care for others and our world. In this quarter, you will learn how the microscope helps us see things that are very small. You will also discover the tiny building block of life, the cell, and see how it performs mitosis and meiosis. You will also come across the levels of biological organization, and sum it up by understanding trophic levels and the food pyramid to see how nature's food chains work.

LESSON 1

The Microscope



Target

At the end of this lesson, you will be able to:

- ◇ Identify the parts and functions of a compound microscope.
- ◇ Demonstrate proper handling and storing of a compound microscope.



Engage



How do scientists observe microorganisms?



Explore

Access the interactive
to perform the activity.



Parts of a Microscope

Objective

- To discover the different parts of the microscope.

Instructions from the Interactive

1. Color each part of the microscope with the color assigned to them.
2. Once completed, place the pointer on top of each part to see how the microscope is used and manipulated.

Guide Question

What do you think is the importance of a microscope?



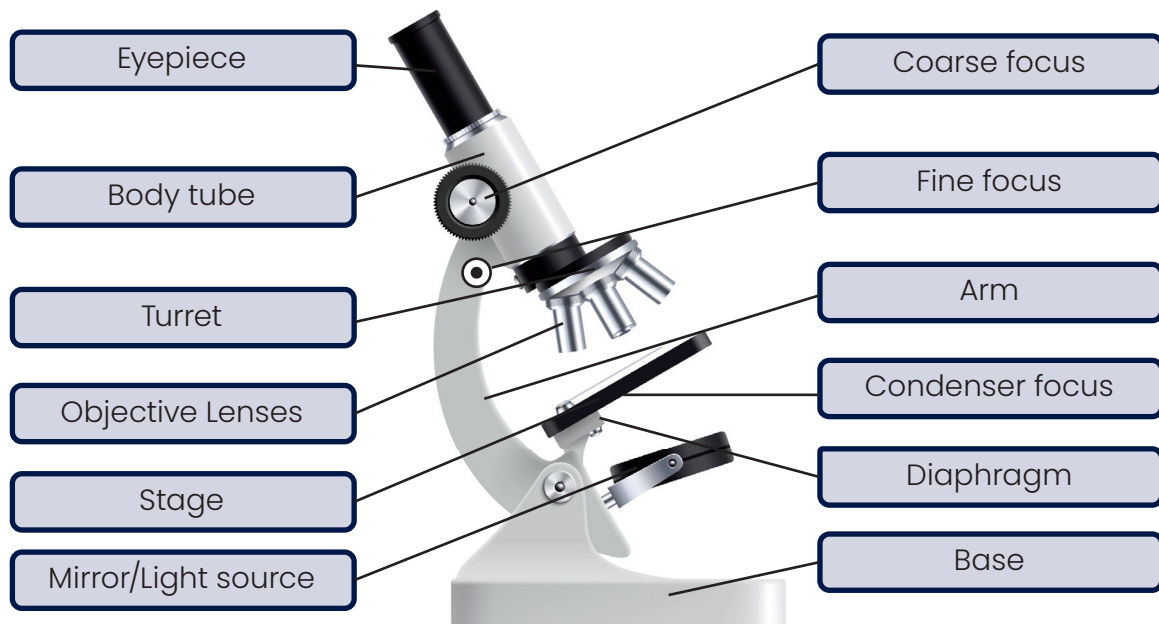
Explain

Have you ever wondered how scientists study microorganisms? They use an instrument called a microscope. A **microscope** is an instrument that magnifies an object allowing us to see and study things like bacteria, cells, and minerals in detail that are normally too small to be seen with the naked eye.

As you learn more about the microscope, you will encounter some important words that you should remember to understand the concepts better.

1. **Specimen** refers to the whole organism or a part of it that you view under the microscope.
2. **Magnification** refers to how much larger an object appears under a microscope than it truly is.
3. **Resolution** is defined as the shortest distance between two points on a specimen.
4. **Visible Light** refers to the portion of the electromagnetic spectrum that can be seen by the human eye.

Parts of the Microscope



1. The **eyepiece** is used to view the slide and magnify the image. You can find it at the top of the microscope.
2. **Coarse focus** is used to bring the image of the specimen into a rough focus. It is used for initial focusing.
3. **Fine focus** is used to bring the specimen into sharp focus using high-power lenses. It is best for you to use the coarse focus first to get close then move to the fine focus for fine tuning.
4. **Body tube** separates the eyepiece and objective.
5. The **base** holds up the entire microscope.
6. The **nosepiece** holds the objective lenses.
7. **Diaphragm** is the circular disk found below the stage that lets light pass through.
8. The **stage** is the platform that supports the prepared slides.
9. The **stage clip** is the one that holds the slide on the stage.
10. **Arm** is the part of the microscope that connects the tube to the base.

11. **Mirror (or light source)** is used to reflect light from an external light source up through the bottom of the stage.
12. **Objective lenses** gather light from the specimen, magnify the image of the specimen, and projects the magnified image into the body tube. Objective lenses have different names and magnifying power.

Objective Name	Objective Power
Scanning	4x
Low Power	10x
High Power	40x

13. **Revolving nosepiece** or turret is the ring that holds the objective lenses, and which allows one to rotate the lenses to a certain position.
14. **Condenser focus** is the part of the microscope that allows light to focus onto the specimen.

Proper Handling and Storing of a Compound Microscope

Properly handling and storing your compound microscope is crucial to ensure its longevity and maintain the quality of your scientific explorations.

Carrying

When handling the microscope, always use both hands. One hand should grip the arm of the microscope, while the other steadies the base. This prevents any wobbles or sudden jolts.

Table Placement

Set the microscope on a flat, solid support and in a position where it will not easily be knocked off.

Cleaning

Use only lens paper or gauze and cleaning solution. Never use your finger, handkerchief, or paper towels to clean the lenses. Do not remove any parts for cleaning; it only allows dust to enter the microscope.

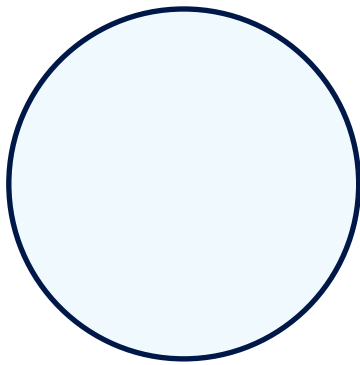
Storing the Microscope

Never leave a microscope exposed to dust and debris. A dust cover should be used to shield it from dust, dirt, and moisture. Store it in a clean, dry environment, away from direct sunlight and extreme temperatures.

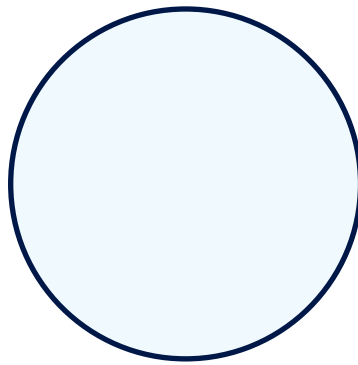


Elaborate

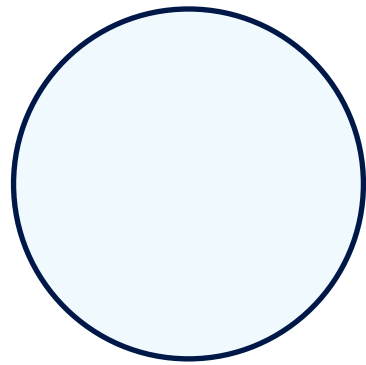
Form a group. Collect soil sample and mix it with water. Take a few drops from the mixture and make sure not to include any soil particles. Observe the drop of water at different levels of magnification and draw what you have observed in the circles below. Present and discuss your observations to the class.



4x



10x



40x

Guide Questions:

1. Based on the activity you have performed, describe the things you observed as you increase the magnification.
2. Why is it important to know the scale of magnification that a microscope is using?



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. What is the function of the eyepiece in a compound microscope?
- a. Connect the tube to the base
 - b. Hold the objective lenses
 - c. Magnify the image
 - d. Reflect light from the specimen
- _____ 2. Which part of the microscope is used to bring the image of the specimen into a rough focus?
- a. Body tube
 - b. Coarse focus
 - c. Fine focus
 - d. Stage
- _____ 3. Where is the diaphragm located in a compound microscope?
- a. Below the stage
 - b. On top of the eyepiece
 - c. Inside the body tube
 - d. Under the base
- _____ 4. What is the purpose of the base in a compound microscope?
- a. Hold the eyepiece
 - b. Support the prepared slides
 - c. Reflect light from an external source
 - d. Magnify the image
- _____ 5. Which part of the microscope connects the tube to the base?
- a. Arm
 - b. Eyepiece
 - c. Coarse focus
 - d. Body tube

- ____ 6. What does the mirror in a compound microscope do?
- a.** Magnify the image
 - b.** Hold the objective lenses
 - c.** Rotate the lenses
 - d.** Reflect light from an external source
- ____ 7. Where can you find the objective lenses in a compound microscope?
- a.** In the eyepiece
 - b.** Inside the body tube
 - c.** In the nosepiece
 - d.** On top of the stage
- ____ 8. What is the purpose of the condenser focus in a compound microscope?
- a.** Allow light to focus onto the specimen
 - b.** Magnify the image
 - c.** Rotate the lenses
 - d.** Reflect light from an external source
- ____ 9. How should you handle a compound microscope to prevent disruptions to focus?
- a.** Hold it by the stage.
 - b.** Shake it gently to clear dust.
 - c.** Use only one hand to grip the base.
 - d.** Use both hands, one on the arm and one on the base.
- ____ 10. How should you store a compound microscope?
- a.** Leave it uncovered to prevent condensation.
 - b.** Store it in direct sunlight for better visibility.
 - c.** Store it in extreme temperatures to prevent mold growth.
 - d.** Use a dust cover and store it in a clean, dry environment.

LESSON 2

The Cell



Target

At the end of this lesson, you will be able to:

- ◇ Classify organisms as unicellular and multicellular.
- ◇ Identify the different organelles of a cell and its function.
- ◇ Differentiate animal and plant cells based on their organelles.



Engage



What are all living things made of?



Explore

Access the interactive
to perform the activity.



Parts of a Plant Cell

Objective

- Discover the different parts of a plant cell.

Instructions from the Interactive

1. Plants need certain organelles to be able to carry out its role as the source of energy to many organisms. Label the parts of the plant cell by typing the name of the organelles on the space provided for them.
2. You may refer to the choices provided.
3. Once completed, click on each part to learn the function of each.

Guide Question

How do the different parts of the cell work together to function efficiently and effectively?

Parts of an Animal Cell

Objective

- Discover the different parts of an animal cell.

Instructions from the Interactive

1. Cardo is looking for his grandmother Charito's house but he cannot seem to find the right direction. The only way he can reach his destination is to answer the question in each station which will point him to his grandmother's house.
2. Help Cardo reach his destination by clicking "WALK" so he can get to the stations that will take him to his grandmother's house.
3. Once in front of a station, click the "Show Question" button and answer the question so that Cardo will be allowed to walk to the next station.

Guide Question

Briefly explain your observations.



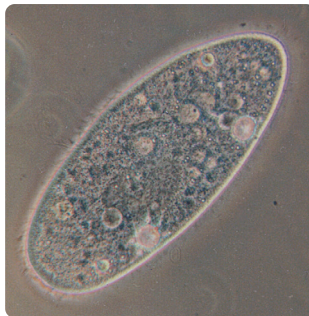
Explain

All living things are made of cells. **Cells** are the smallest unit of life.

Some living things are called unicellular organisms because they are just one cell doing all the work. On the other hand, plants, animals, and us humans are multicellular organisms.

Unicellular Organisms

Unicellular organisms are made up of a single cell. They are the oldest form of life, with fossil records dating back to about 3.8 billion years ago. These unicellular organisms are mostly invisible to the naked eye; hence, they are also referred to as microscopic organisms. Examples of these are amoeba, paramecium, and salmonella.



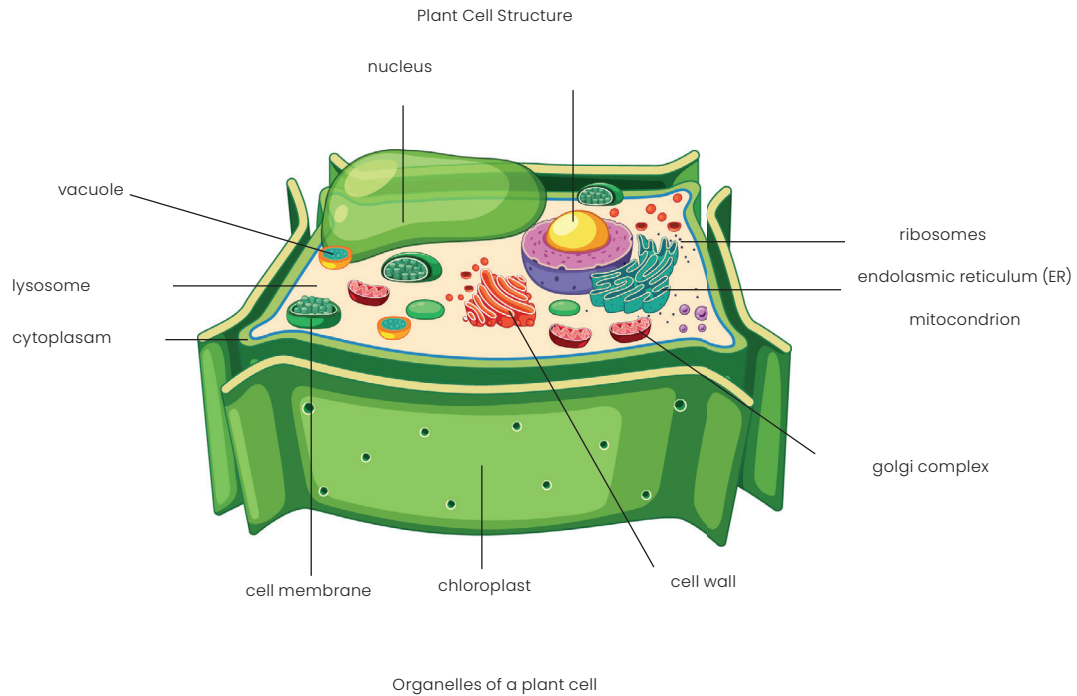
A paramecium is an example of a unicellular organism.

Multicellular Organisms

Organisms that are composed of more than one cell are called multicellular organisms. All animals and plants are multicellular but the cells of plants and animals differ in some of their structures.

Plant Cell

Plants are part of a group called eukaryotes because they have a nucleus and different organelles, all wrapped up in a protective layer called a plasma membrane. The structure of the plant cell is very suitable for their survival.



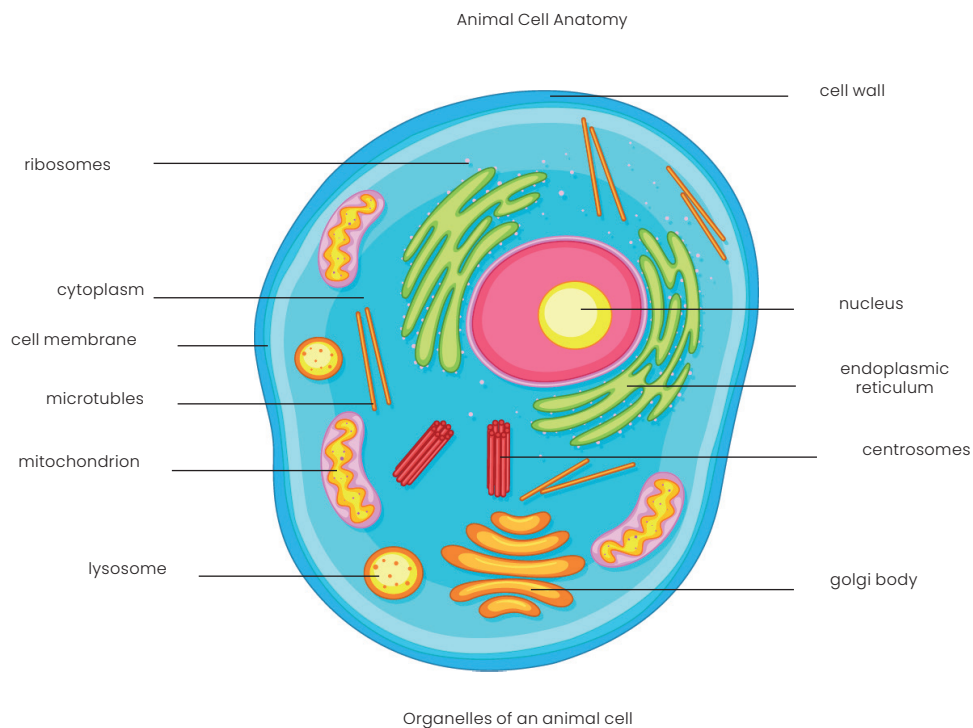
Organelles of a Plant Cell:

1. **Nucleus** is the part of the cell that controls all cellular activities.
2. **Nucleolus** plays an important role in protein synthesis.
3. The **endoplasmic reticulum** transports synthesized protein to the Golgi bodies.
4. **Ribosomes** are considered sites of protein synthesis.
5. **Mitochondrion** is the site of cellular respiration where the glucose molecule is converted to the energy currency of the cell, the ATP.
6. The **vacuole** stores water and waste materials in the cell.
7. **Chloroplast** is the organelle which houses the green pigment chlorophyll and the site of photosynthesis.
8. The **plasma membrane** regulates the entry and exit of molecules into and out of the cell.
9. The **cell wall** provides support, protection, and a definite shape for the cell.

The organelles that are unique to plant cells are the chloroplast and cell wall. The chloroplast is where the **chlorophyll** is found which gives most leaves its characteristic green color. This is where photosynthesis takes place, turning sunlight and other materials into energy. The cell wall is made of a strong material called **cellulose**. It protects the plant cell and gives it structure.

Animal Cell

The animal cell is a eukaryotic cell complete with nucleus, cytoplasm, and cell membrane. Unlike a plant cell, it does not have a tough cell wall, so it does not have a rigid, fixed shape.



Organelles of an Animal Cell:

1. The **nucleus** is considered as the control center of the cell.
2. **Lysosome** is a part of the cell that is responsible for autolysis which destroys old organelles or the cell itself.
3. The **endoplasmic reticulum** is the organelle that transports and modifies proteins.

4. **Ribosomes** are responsible for the production of protein.
5. **Cell Membrane** is the part that surrounds the entire animal cell.
6. **Cytoplasm** is the gel-like fluid in the animal cell where all the organelles are suspended.
7. **Golgi Bodies** are organelles in charge of sorting and packaging proteins.
8. The **vacuole** is the organelle responsible for water and minerals storage.
9. **Centrioles** is the organelle in the animal cell that organizes microtubules during cell division.
10. The **mitochondria** are the organelle in the cell that converts energy stored in glucose.

Some organelles that are exclusively found in animal cells are lysosomes and centrioles. Lysosomes function by destroying old organelles or the cell itself. On the other hand, the centrioles are cylinder-like structures which control the spindle fibers during cell division.



Elaborate

Form a group. Create a model of an animal and a plant cell using edible materials such as jelly, marshmallow, candies, among others. Present your edible models and explain what organelle each ingredient represents. Explain the function of each organelle as well.



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which of the following statements is true regarding unicellular organisms?
- a. They are always visible to the naked eye.
 - b. They are composed of more than one cell.
 - c. They date back to about 3.8 billion years ago.
 - d. They do not have specialized organelles.
- ____ 2. What is the primary function of the nucleus in both plant and animal cells?
- a. To convert sunlight into energy
 - b. To control cellular activities
 - c. To store water and minerals
 - d. To transport and modify proteins
- ____ 3. Why are plant cells described as eukaryotic cells?
- a. Because they have a nucleus
 - b. Because they have a tough cell wall
 - c. Because they can convert sunlight into energy
 - d. Because they lack a plasma membrane
- ____ 4. Which organelle is unique to plant cells and not found in animal cells?
- a. Chloroplast
 - b. Endoplasmic Reticulum
 - c. Lysosome
 - d. Nucleus
- ____ 5. How do plant cells use chlorophyll in the chloroplast?
- a. To convert glucose into energy
 - b. To convert sunlight into energy
 - c. To destroy old organelles
 - d. To transport and modify proteins

- _____ 6. Which organelle is responsible for sorting and packaging proteins in animal cells?
- a.** Centrioles
 - b.** Cytoplasm
 - c.** Golgi Bodies
 - d.** Mitochondria
- _____ 7. What is the primary function of the cell wall in plant cells?
- a.** To convert sunlight into energy
 - b.** To control cellular activities
 - c.** To protect the cell and provide structure
 - d.** To store and transport water and minerals
- _____ 8. How are multicellular organisms different from unicellular organisms in terms of cell composition?
- a.** Multicellular organisms have more organelles than unicellular organisms.
 - b.** Multicellular organisms are always big, while unicellular organisms are always small.
 - c.** Multicellular organisms have a single type of cell which performs the same function.
 - d.** Multicellular organisms have different cells that perform different function.
- _____ 9. Which organelle is responsible for converting glucose into energy in both plant and animal cells?
- a.** Chloroplast
 - b.** Mitochondria
 - c.** Nucleus
 - d.** Ribosomes
- _____ 10. Why are animal cells described as lacking a fixed shape?
- a.** Because they have a nucleus
 - b.** Because they lack a cell wall
 - c.** Because they lack a plasma membrane
 - d.** Because they can convert sunlight into energy

LESSON 3

Mitosis



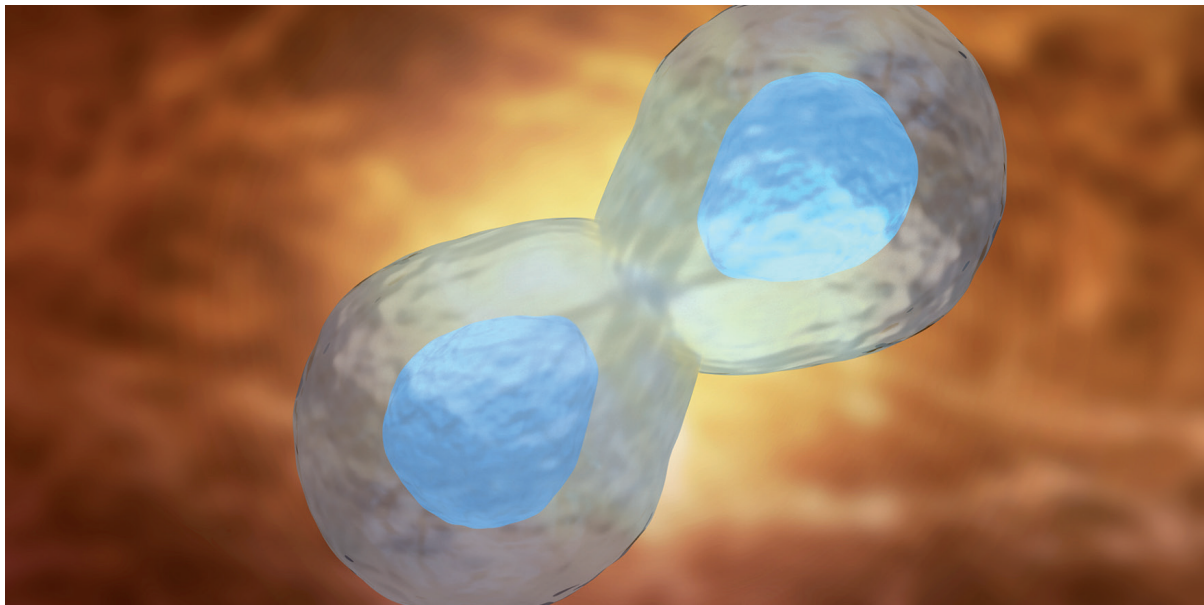
Target

At the end of this lesson, you will be able to:

- ◇ Describe mitosis as a type of cell division.
- ◇ Enumerate the step-by-step process of mitosis.
- ◇ Explain the importance of mitosis for growth and repair.



Engage



Which body process helps us grow and heal our damaged cells?



Explore

Access the interactive
to perform the activity.



Stages of Mitosis

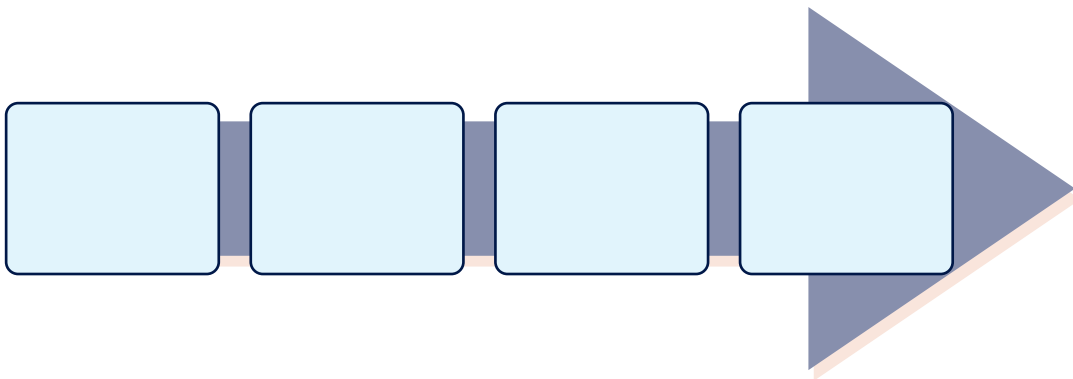
Objective

- Determine the stages of mitosis.

Instructions from the Interactive

1. Play the simulation of the stages of mitosis.
2. Summarize the events in each of the four stages of mitosis.
3. Show this information under Data.

Data



Guide Question

1. What is the number of cell/s before mitosis happened?
2. Do these cell/s have nucleus, genetic material, and centrioles?
3. What happened to the cell after mitosis?
4. What is the number of cell/s after undergoing mitosis?
5. Do the cell/s have nucleus, genetic material, and centrioles?



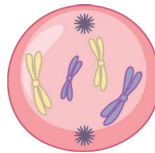
Explain

Mitosis is a fundamental process of cell division that takes place in all multicellular organisms. It is the way our body creates new cells, and it plays a vital role in growth, repair, and maintenance. Imagine you have a scratch or a cut on your skin; mitosis is the process responsible for healing it by producing new skin cells.

The Stages of Mitosis

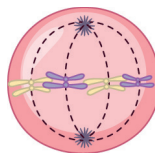
Mitosis can be broken down into four main stages: prophase, metaphase, anaphase, and telophase. Each stage has a specific role in ensuring that the two new cells created are identical to the parent cell.

Prophase: In this stage, the cell's DNA, which is usually spread out as thin threads called chromatin, condenses into visible structures known as chromosomes.



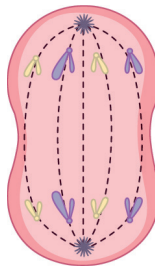
Prophase

Metaphase: In this stage, the chromosomes line up neatly at the center of the cell. This alignment is critical to ensure that each new cell gets the right number of chromosomes.



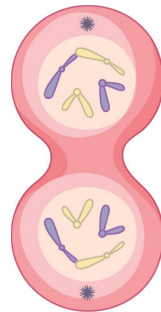
Metaphase

Anaphase: The sister chromatids, which are two identical copies of each chromosome, are separated and pulled towards opposite ends of the cell.



Anaphase

Telophase: New nuclear envelopes form around the separated chromosomes, creating two distinct nuclei within the cell. Soon, the cell will split into two new daughter cells.



Telophase

Mitosis is important because it ensures that our body's cells have the same genetic information. It helps in growth, as new cells are constantly being produced. Additionally, when we get injured, mitosis creates new cells to repair damaged tissues. Without mitosis, our bodies could not heal, and we would not grow.



Elaborate

Form a group. Using the microscopes set up by your teacher, identify if the cell you see through each microscope is in prophase, metaphase, anaphase, or telophase. Draw what you see on each microscope. Write your answers on the table below.

Microscope	Stage of Mitosis	Drawing
Example: Microscope 1	Example: Prophase	
Microscope 1		
Microscope 2		

Microscope 3		
Microscope 4		



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which process is mitosis responsible for?
 - a. Producing sperm and eggs
 - b. Growth and repair of body cells
 - c. Mixing genetic information
 - d. Controlling body temperature

- ____ 2. During which stage of mitosis do chromosomes line up in the center of the cell?
 - a. Prophase
 - b. Metaphase
 - c. Anaphase
 - d. Telophase

- ____ 3. What happens to the nuclear membrane during mitosis?
 - a. It breaks down in prophase.
 - b. It forms a new nucleus in telophase.
 - c. It stays the same throughout mitosis.
 - d. It shrinks during anaphase.

- ____ 4. How many daughter cells are produced in mitosis?
 - a. One
 - b. Two
 - c. Four
 - d. Eight

- ____ 5. What is the result of mitosis in terms of genetic information in daughter cells?
- a.** The genetic information is identical to the parent cell.
 - b.** The genetic information is halved compared to the parent cell.
 - c.** The genetic information is shuffled and mixed.
 - d.** The genetic information is lost which results to deformities.
- ____ 6. What is the correct order of the phases of mitosis?
- a.** Anaphase, Prophase, Metaphase, Telophase
 - b.** Prophase, Metaphase, Anaphase, Telophase
 - c.** Metaphase, Telophase, Prophase, Anaphase
 - d.** Telophase, Metaphase, Anaphase, Prophase
- ____ 7. What type of cells are produced by mitosis?
- a.** Sperm and egg cells
 - b.** Identical daughter cells
 - c.** Genetically modified cells
 - d.** Microscopic cells
- ____ 8. Which is NOT a function of mitosis in the human body?
- a.** Growing taller
 - b.** Healing a wound
 - c.** Replacing old skin cells
 - d.** Producing sperm and egg
- ____ 9. Which phase of mitosis involves the separation of sister chromatids?
- a.** Prophase
 - b.** Metaphase
 - c.** Anaphase
 - d.** Telophase
- ____ 10. During which phase of mitosis do the nuclear envelopes reform around the separated chromosomes?
- a.** Prophase
 - b.** Metaphase
 - c.** Anaphase
 - d.** Telophase

LESSON 4

Meiosis



Target

At the end of this lesson, you will be able to:

- ◇ Describe meiosis as a type of cell division.
- ◇ Enumerate the step-by-step process of meiosis.
- ◇ Explain the importance of meiosis in fertilization.



Engage



Why don't siblings look exactly alike?



Explore

Access the interactive
to perform the activity.



Stages of Meiosis

Objective

- Determine what happens to the cell in meiosis

Instructions from the Interactive

1. Play the simulation of the stages of meiosis.
2. Summarize the stages of meiosis.
3. Write this information under Data.

Data

Table 1. Stages of Meiosis

Stages	Description

Guide Question

What does the simulation tell you about the importance of meiosis?



Explain

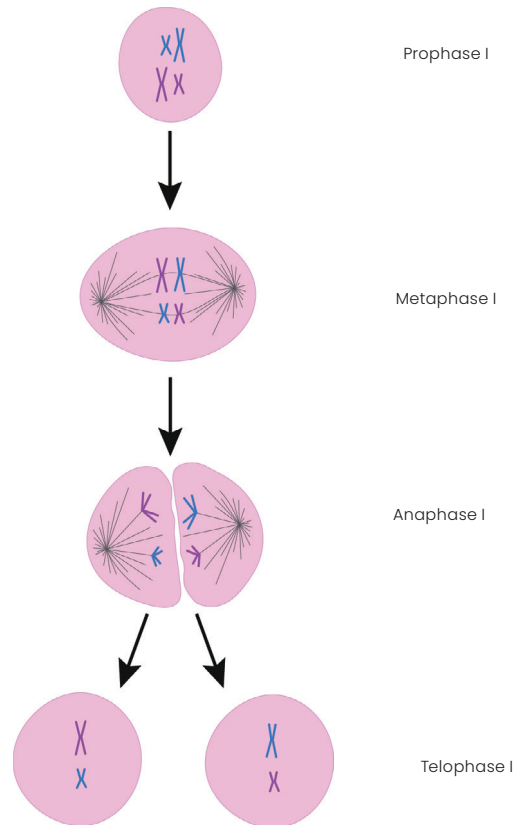
Meiosis is a specialized type of cell division that reduces the chromosome number by half, resulting in the formation of gametes (sperm and egg cells). Unlike mitosis, which creates identical cells, meiosis generates cells with genetic variations. These variations are essential for the diversity of life and play a crucial role in the inheritance of traits from parents to offspring.

The Stages of Meiosis

Meiosis consists of two main stages: Meiosis I and Meiosis II. Each stage is further divided into phases.

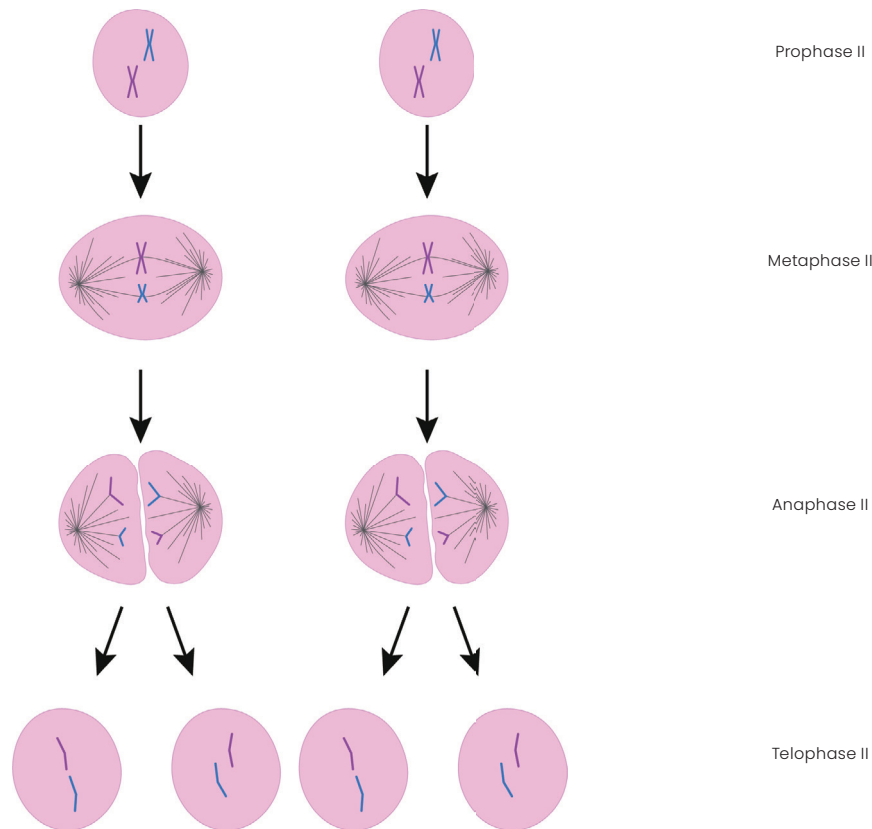
Meiosis I

- 1. Prophase I:** Chromosomes condense and pair up with their matching partners, a process known as synapsis. This is where genetic recombination, or crossing over, occurs, exchanging genetic material between paired chromosomes.
- 2. Metaphase I:** In this stage, the chromosomes, each with two chromatids, line up at the cell's equator. The pairs of chromosomes align independently, adding to the genetic diversity.
- 3. Anaphase I:** The paired chromosomes are pulled apart and move towards opposite ends of the cell. Each new cell now has a unique combination of chromosomes.
- 4. Telophase I:** The cell divides into two daughter cells, each with half the original chromosome number ($2n$). These cells are now prepared for the meiosis II.



Meiosis II

1. **Prophase II:** Chromosomes condense again, and a new spindle apparatus forms in each of the daughter cells from Meiosis I.
2. **Metaphase II:** In this stage, the chromosomes, now single chromatids, line up at the cell's equatorial plane.
3. **Anaphase II:** The chromatids are pulled apart and move to opposite ends of the cell.
4. **Telophase II:** The chromatids reach their respective ends, and the cells divide once more, resulting in a total of four unique daughter cells, each with a haploid (n) set of chromosomes.



Meiosis is vital because it creates genetic diversity among offspring. The unique combinations of genetic material result in individuals with a variety of traits, allowing for adaptation to different environments and enhancing the chances of survival.



Elaborate

Form a group. Prepare the materials listed below and perform the procedures indicated.

Materials:

Assorted colored beads (at least two different colors)

Yarn

Markers

Scissors

Small zip lock bag

Procedures:

Bead Preparation: Get the set of beads. Assign one color for chromosomes from the mother and another color for chromosomes from the father. If needed, you may use markers or labels to differentiate them.

A. Modeling Meiosis I:

1. Take two pieces of yarn and twist them together to represent a homologous chromosome pair.
2. Arrange these pairs in a line, representing a cell before meiosis I.
3. Replicate the process of meiosis I: Homologous chromosomes pair up (prophase I). Chromosomes exchange genetic material (crossing-over). Homologous chromosomes separate into two different cells (anaphase I).
4. Physically demonstrate these steps using your bead-chromosomes and the yarn strings.

B. Modeling Meiosis II:

1. Recall that meiosis II follows meiosis I and results in the formation of four non-identical daughter cells.
2. Separate the chromosome pairs from your meiosis I model into two separate pipe cleaners/strings.
3. Show how these separated chromosomes undergo another division (meiosis II) to create four unique daughter cells.

Guide Questions

1. Why is it important to assign different colors to beads representing chromosomes from the mother and father in this activity?
2. Describe the process of homologous chromosome pairing and arrangement using yarn strings. How does this represent a cell before Meiosis I?
3. During the replication of Meiosis I, explain how the physical demonstration with bead-chromosomes and yarn strings illustrates the steps of homologous chromosome pairing, crossing-over, and separation into two different cells.



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which statement best describes meiosis?
- a. A type of cell division that occurs in plants only.
 - b. A type of cell division that occurs in somatic cells.
 - c. A type of cell division that produces gametes or sex cells.
 - d. A type of cell division that produces identical daughter cell.
- ____ 2. How many cell divisions occur during meiosis?
- a. One division
 - b. Two divisions
 - c. Three divisions
 - d. Four divisions
- ____ 3. Which of the following describes the result of meiosis?
- a. Four identical daughter cells
 - b. Two identical daughter cells
 - c. Four non-identical daughter cells
 - d. Two non-identical daughter cells
- ____ 4. During which phase of meiosis do homologous chromosomes pair up and exchange genetic material?
- a. Prophase I
 - b. Metaphase I
 - c. Anaphase I
 - d. Telophase I

- _____ 5. How many chromosomes do human gametes (sperm and egg cells) contain after meiosis?
- a. 23 chromosomes
 - b. 46 chromosomes
 - c. 92 chromosomes
 - d. 69 chromosomes
- _____ 6. Crossing-over in meiosis occurs between which structures?
- a. Daughter cells
 - b. Homologous chromosomes
 - c. Non-homologous chromosomes
 - d. Sister chromatids
- _____ 7. Which of the following occurs during Prophase II?
- a. Chromatids reach the poles, and each of the two cells divide.
 - b. Chromosomes align at the equatorial plane in each of the two cells.
 - c. Chromosomes condense and become visible in the two daughter cells from Meiosis I.
 - d. Sister chromatids are finally separated and moved to opposite poles of the cells.
- _____ 8. Which of the following is a result of meiosis in terms of the chromosomes of each daughter cell?
- a. Increase the number of chromosomes
 - b. Reduce the number of chromosomes
 - c. Maintain the same number of chromosomes
 - d. Produce identical cells with same chromosomes
- _____ 9. What type of cells undergo meiosis in the human body?
- a. Muscle cells
 - b. Nerve cells
 - c. Sex cells
 - d. Somatic cells
- _____ 10. During which phase of meiosis do chromosomes line up at the equatorial plane of the cell?
- a. Prophase II
 - b. Metaphase I
 - c. Anaphase II
 - d. Telophase I

LESSON 5

Sexual and Asexual Reproduction



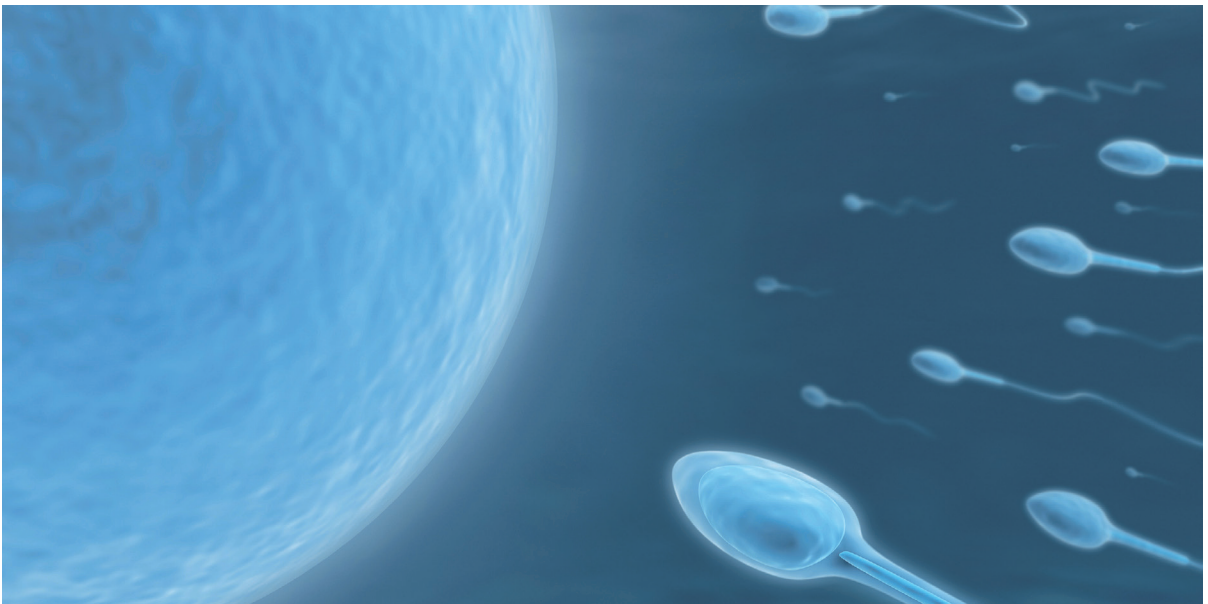
Target

At the end of this lesson, you will be able to:

- ◇ Describe sexual and asexual reproduction.
- ◇ Differentiate the two types of reproduction according to the parents involved and similarities of offspring to parents.
- ◇ Provide examples of organisms that undergo sexual and asexual reproduction.



Engage



How do different organisms reproduce?



Explore

Access the interactive
to perform the activity.



Asexual Reproduction

Objective

- Describe what asexual reproduction is.

Instructions from the Interactive

Ditto is an organism that can reproduce asexually. Help her learn about each process by showing her how one differs from another. Click the organisms in each box for Ditto to see how each process works.

Guide Questions

1. Which type of asexual reproduction is characterized by fertilization of the egg without the involvement of the sperm?
2. Which type of asexual reproduction involves spores which can grow into a new organism?
3. What do you call the type of asexual reproduction in which the parent organism disintegrates a certain body part which grows into a separate individual organism?
4. Which type of asexual reproduction involves the division of the parent organism which results to two organisms with identical genetic makeup?
5. Which among the processes of asexual reproduction involves breaking an organism to be followed by regeneration to be able to reproduce?



Explain

Reproduction is a fundamental process in the life of living organisms that ensures the continuation of a species. There are two primary methods of reproduction: sexual and asexual.

What is Sexual Reproduction?

In sexual reproduction, specialized cells called **gametes**, such as the sperm and egg cells, combine to create a new organism. The union of gametes occurs

through a process called **fertilization**, resulting in genetically diverse offspring due to the unique combination of genetic material from both parents. This genetic diversity is advantageous as it can lead to better adaptability and increased chances of survival in changing environments. Sexual reproduction occurs in many plants and animals, including humans, where genetic variation is crucial for species' evolution and diversity.

Organisms Which Undergo Sexual Reproduction

Examples of organisms that undergo sexual reproduction include mammals like humans, dogs, and cats, where genetic material from two parents combines to produce offspring with unique genetic traits.



A mother and her baby



Cat and her kitten

Birds, like chickens, ducks, and eagles also undergo sexual reproduction. In aquatic habitats, fish like tilapia and milkfish reproduce sexually, with males and females releasing their gametes into the water for fertilization.



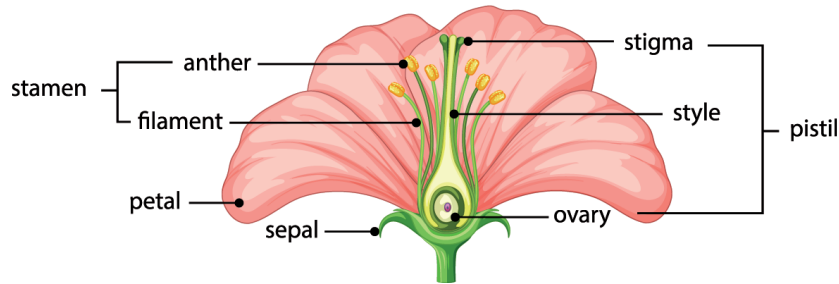
A pair of ducks with their ducklings



Eggs of fish are soft and jelly-like

Many plants like tomato, mango, and coconut reproduce sexually. Flowers are the reproductive structures where sexual reproduction occurs. Plants produce male and female gametes, and **pollination** helps transfer pollen from the male parts (stamen) to the female parts (pistil), leading to the formation of seeds.

Parts of a flower



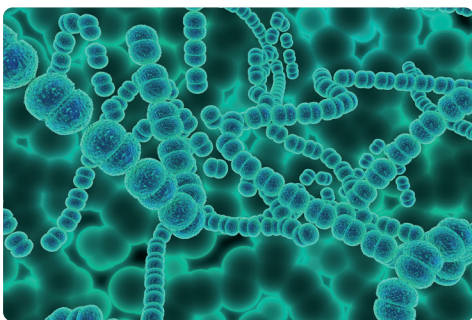
The flower is involved in sexual reproduction in plants.

What is Asexual Reproduction?

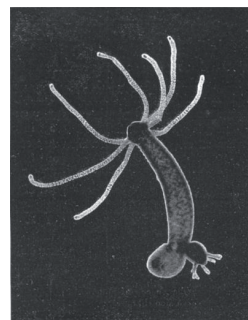
In asexual reproduction, a single organism can produce offspring without the involvement of gametes. This process typically involves the duplication of genetic material and subsequent division, resulting in genetically identical offspring or clones. Asexual reproduction often leads to rapid population growth, especially in stable and favorable environments. However, it lacks genetic diversity, which can limit adaptability and increase susceptibility to environmental challenges.

Organisms Which Undergo Asexual Reproduction

Bacteria often reproduce asexually through a process called **binary fission**, where a single bacterial cell divides into two identical daughter cells. Yeast is a type of fungus that reproduces asexually through **budding**. A small bud forms on the parent cell grows, and eventually detaches to become a new yeast cell. Another organism that reproduces asexually is hydra, a freshwater animal. It also reproduces through budding. A small outgrowth forms on the body of the hydra, eventually detaching to become a new individual.



Bacteria multiply through binary fission.



The hydra can reproduce using budding.

Plants can also reproduce asexually through **vegetative reproduction**. This is a form of asexual reproduction in plants where new plants develop from non-reproductive parts such as stems, leaves, or roots. Potatoes reproduce by forming new plants from underground **tubers**, which are enlarged portions of the plant's stem. Bamboo spreads rapidly through **rhizomes**, underground stems that give rise to new shoots and can lead to the growth of new bamboo plants. The katakataka plant can reproduce by growing new plants on its leaves.



A potato reproducing through a tuber



Bamboo rhizome



Elaborate

Find a partner. One of you will think of three organisms that undergo sexual reproduction while the other will think of three organisms which undergo asexual reproduction. Play a game of charades to guess the organism your classmate selected. A charade is a game in which players act out a word or phrase without speaking, while the other players try to guess what it is.



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. What is a key characteristic of sexual reproduction?
- a. Involves one parent
 - b. Involves two parents
 - c. Occurs in plants only
 - d. Produces genetically identical offspring

- ____ 2. Which of the following is required in sexual reproduction?
- a. Gametes
 - b. Spores
 - c. Clones
 - d. Rhizomes
- ____ 3. Which process results in the formation of a zygote in sexual reproduction?
- a. Budding
 - b. Fertilization
 - c. Germination
 - d. Pollination
- ____ 4. In a flowering plant, what is the male reproductive organ called?
- a. Pistil
 - b. Stamen
 - c. Ovary
 - d. Sepal
- ____ 5. Which of the following is a method of asexual reproduction?
- a. Fertilization
 - b. Budding
 - c. Pollination
 - d. Meiosis
- ____ 6. Binary fission is a common form of asexual reproduction in which organisms?
- a. Plants
 - b. Animals
 - c. Bacteria
 - d. Fungi
- ____ 7. In which type of reproduction do offspring inherit a unique combination of traits from both parents?
- a. Asexual reproduction
 - b. Sexual reproduction
 - c. Surrogate reproduction
 - d. Vegetative reproduction
- ____ 8. Which of the following produces genetically identical offspring?
- a. Asexual reproduction
 - b. Sexual reproduction
 - c. Surrogate reproduction
 - d. In vitro reproduction
- ____ 9. A potato growing a new plant from an eye is an example of sexual reproduction through _____.
- a. Budding
 - b. Binary fission
 - c. Fragmentation
 - d. Tubers

- _____ 10. What is the primary advantage of sexual reproduction for a species?
- a.** Production of identical offspring
 - b.** Increased genetic diversity
 - c.** Faster reproduction
 - d.** Resistance to diseases

LESSON 6

Levels of Biological Organization



Target

At the end of this lesson, you will be able to:

- ◇ Identify the different levels of biological organization.
- ◇ Arrange the levels of biological organization from cells to the biosphere.
- ◇ Describe the connections between the levels of biological organization to one another using labelled diagram.



Engage



How can we organize the living things in our planet?



Explore

Access the interactive
to perform the activity.



Levels of Biological Organization

Objective

- Explain what biological organizations are.

Instructions from the Interactive

1. Place each level of organization on the golden hexagon for you to be able to get more information on the different biological levels of organization.
2. Once done with one level, place it back to where you got it from then proceed to the next one.

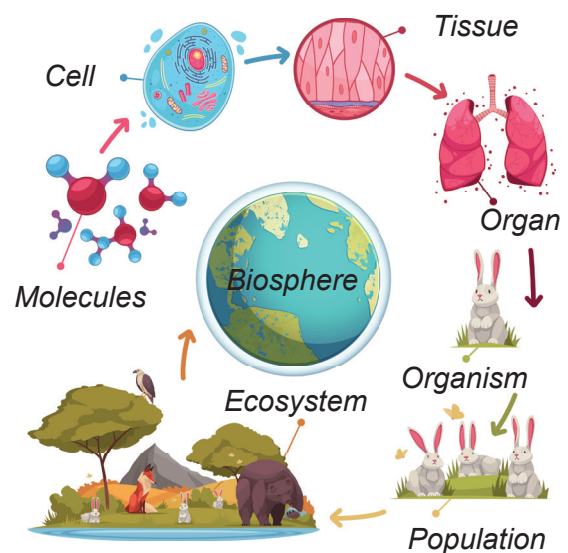
Guide Questions

1. What is the smallest unit of life?
2. How do tissue and organs differ from each other?
3. Explain how each level of organization differs.



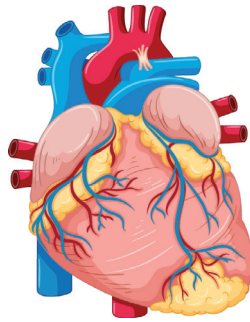
Explain

Everything around you, whether it is a leaf, a rock, or even the air you breathe, is made up of particles called **atoms**. They are like the building blocks of the universe. When atoms get together, they form something called a **molecule**. These molecules are essential to the structure of the cell. The **cell** is the smallest unit of life.



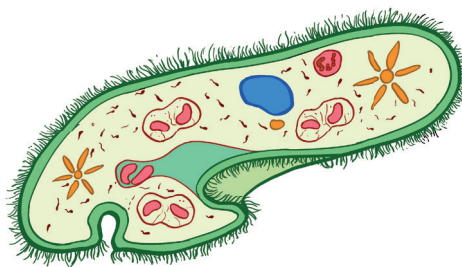
Levels of biological organization

As you have learned from the previous lessons, a cell has many organelles which perform important functions in keeping a living thing alive. When cells with similar function team up, we call them **tissues**. For example, muscle tissue helps you move, while epithelial tissue lines your organs. Tissues, in turn, work together to create organs. **Organs** are structures composed of different tissues working together to carry out specific functions. For example, the heart is an organ made up of muscle tissue, nerve tissue, and connective tissue, all working together to pump blood.



The heart is an organ composed of different tissues

When organs with the same function work together, they form **organ systems**. Imagine the circulatory system as a team, with the heart, blood vessels, and blood working together to transport oxygen and nutrients. All these organ systems working in harmony make up a living being, or what we call an **organism**. Whether it is a tiny bacterium or a complex human, organisms do all the things necessary to stay alive, like growing, reproducing, and eating.



A bacterium is a microscopic organism

Imagine a group of similar organisms living in the same place. We call that group a **population**. But life is not just about interacting with organisms just like you. It is also about interacting with others. When different species in a place interact, we call that a **community**. Sometimes, they help each other out (mutualism), sometimes

they compete for stuff (competition), and sometimes, one organism eats another (predation).



An egret eating a fish.

Life is all part of a big, interconnected system called an **ecosystem**. Think of it like a giant web of life wherein living things like animals and plants and non-living things like rocks and water work together. Energy and nutrients flow through this web to keep everything alive. Now, imagine our entire planet as the ultimate ecosystem, where all life exists. We call that the **biosphere**.

Understanding the connections between different levels of biological organization is important in appreciating life around us and protecting the biosphere for all the living things in this planet.



Elaborate

Find a partner. Draw a poster showing the correct sequence of the levels of biological organization. You are free to design or color your poster to your liking so long as you can show the increasing order of biological organization from cell to biosphere. Present your work to the class.





Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. What is the fundamental unit of life, consisting of various organelles performing specialized functions?
- a. Atom
 - b. Cell
 - c. Molecule
 - d. Organelle
- ____ 2. How do cells with similar functions come together to form a higher level of biological organization?
- a. They bond with molecules.
 - b. They combine to make organelles.
 - c. They combine to make organelles.
 - d. They form tissues with specific function.
- ____ 3. Which term describes structures made up of different tissues working together to perform specific functions within an organism?
- a. Atom
 - b. Cell
 - c. Molecule
 - d. Organ
- ____ 4. Why is it essential for cells to have organelles?
- a. To store genetic information
 - b. To provide structural support
 - c. To carry out various tasks
 - d. To regulate temperature
- ____ 5. At which level of biological organization do populations of different organisms interact in an environment?
- a. Community
 - b. Ecosystem
 - c. Organism
 - d. Biosphere

- _____ 6. How do different species within a habitat typically interact with each other?
- a.** They merge to form a new species.
 - b.** They run away from each other.
 - c.** They form a single population.
 - d.** They compete for resources.
- _____ 7. In an ecosystem, what flows through the interconnected web of life to sustain living organisms?
- a.** Air and water
 - b.** Heat and light
 - c.** Energy and nutrients
 - d.** Rocks and minerals
- _____ 8. Which term describes the ultimate interconnected system where all life exists on Earth?
- a.** Biosphere
 - b.** Environment
 - c.** Ecosystem
 - d.** Habitat
- _____ 9. Why is the presence of multiple organisms within an ecosystem important in preserving life?
- a.** It increases the energy that is present in the ecosystem.
 - b.** It intensifies the competition occurring between organisms.
 - c.** It allows for more interactions that could support more life..
 - d.** It helps larger organisms to find food and resources.
- _____ 10. Which of the following does not belong to the level of biological organization?
- a.** Cells
 - b.** Tissues
 - c.** Communities
 - d.** Evolution

LESSON 7

Trophic Levels and the Food Pyramid



Target

At the end of this lesson, you will be able to:

- ◇ Identify the different trophic levels.
- ◇ Describe the trophic levels of an organism as levels of energy in a food pyramid.
- ◇ Demonstrate transfer of energy between organisms from one trophic level to another using examples of food pyramids.



Engage



How do interactions among living things maintain ecological balance?



Explore

Pyramid Building

Objective

- Identify the organisms involved in the food chain and food web.

Instructions from the Interactive

A food chain portrays the process of how living things obtain their food. It also shows how nutrients and energy are passed from one organism to another.

1. Pedro Palanca is a biology student who wants to build a prototype of a pyramid. In addition, he wants it to have a biological twist by putting the trophic levels in his prototype to show a food chain.
2. Help him find out the correct order of the organisms starting with the producers up to the tertiary consumers by dragging the organisms to a specific level in the pyramid in which they belong.
3. You may also include the organisms that can be considered as decomposers in a community and place them in the decomposer box.

Guide Questions

1. Which organism has the highest level of energy among the organisms?
2. Which organism will receive the least amount of energy?
3. Which organism harnesses energy coming from the sun?

Access the interactive
to perform the activity.

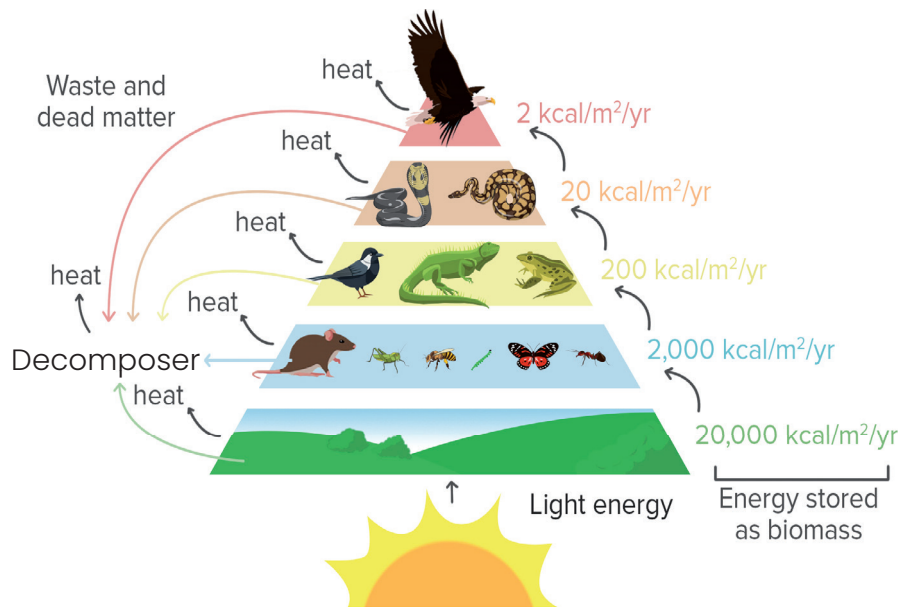




Explain

A **trophic level** refers to each of the hierarchical levels in an ecosystem, consisting of organisms sharing the same function in the food chain and the same nutritional relationship to the primary sources of energy.

We can visualize this through a **food pyramid** or **energy pyramid**. The food pyramid or energy pyramid is a visual representation of the energy flow within an ecosystem, demonstrating the different trophic levels, or feeding positions, of organisms. Study the food pyramid below.



A food pyramid showing different trophic levels and energy transfer.

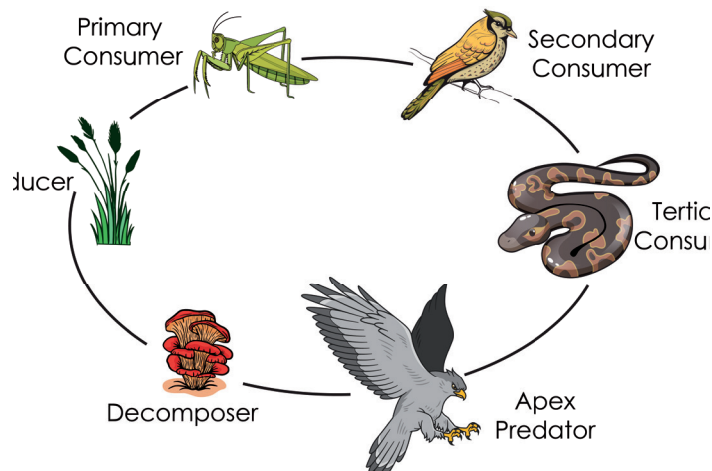
At the base, we have the **producers**. These are organisms that can produce their own food using sunlight and matter available in their surroundings. Plants are examples of producers.

Going up a trophic level, we meet the **primary consumers**. They feed on the producers. These animals are usually herbivores or plant-eating organisms. Next, is the trophic level that consists of **secondary consumers**, which are typically carnivores or omnivores, that eat the primary consumers.

Above them are the **tertiary consumers**, which are animals that eat secondary consumers. Finally, at the top are **apex predators** or **quaternary consumers**, which have no natural predators. **Decomposers**, like fungi and bacteria, break down dead organisms at all trophic levels, recycling nutrients back into the ecosystem.

The pyramid is widest at the bottom and narrows upwards, symbolizing the energy loss that occurs at each trophic level due to metabolism and heat—thus, in a balanced ecosystem, producers are the most abundant, and top predators are the least.

The relationship between different trophic levels can also be seen in a **food chain**. A **food web** is a complex network of interrelated food chains within an ecological community. It demonstrates how different species are interconnected through their feeding relationships.



A food chain showing the different trophic levels



Elaborate

Find a partner. Draw a food web consisting of plants and animals that are found in the Philippines. Using arrows, show which organisms are eaten by which. Also include decomposers in your food and show their role in the ecosystem. You may also use cutouts of plants and animals. Prepare a gallery walk inside the classroom and explain your work to your classmates.





Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. Which organism creates food for itself using sunlight and matter from the surroundings?
- a. Apex predators
 - b. Carnivores
 - c. Herbivores
 - d. Producers
- _____ 2. Which trophic level includes animals that exclusively feed on plants?
- a. Producers
 - b. Primary consumers
 - c. Tertiary consumers
 - d. Quaternary consumers
- _____ 3. How does energy flow in a food pyramid?
- a. It increases as you move up the pyramid.
 - b. It remains the same at every level.
 - c. It decreases as you move up the pyramid.
 - d. It is evenly distributed among all levels.
- _____ 4. Why do apex predators occupy the top of the food pyramid?
- a. Because they eat only plants.
 - b. Because they can make their own food.
 - c. Because they have no predators.
 - d. Because they are the smallest organisms.
- _____ 5. What is most likely to happen if all plants die in a food pyramid?
- a. The rest of the food pyramid will collapse.
 - b. Other organisms will start producing their own food.
 - c. The primary consumers will increase in number.
 - d. The tertiary consumers will increase in number.

- _____ 6. What is most likely to happen if all primary consumers die in a food pyramid?
- a.** Decomposers will increase in number.
 - b.** Producers will increase in number
 - c.** Secondary consumers will increase in number.
 - d.** Tertiary consumers will increase in number.
- _____ 7. Which trophic level includes organisms that feed on dead organic matter?
- a.** Decomposers
 - b.** Primary consumers
 - c.** Secondary consumers
 - d.** Tertiary consumers
- _____ 8. What is the primary source of energy for producers in a food pyramid?
- a.** Decaying matter
 - b.** Sunlight
 - c.** Water
 - d.** Wind
- _____ 9. Why do most ecosystems not have more than four or five trophic levels?
- a.** Because there is not enough sunlight.
 - b.** Because there is not enough energy left.
 - c.** Because there is too much energy available.
 - d.** Because apex predators dominate all levels.
- _____ 10. What do trophic levels represent in the ecosystem?
- a.** The different types of ecosystems.
 - b.** The energy flow within an ecosystem.
 - c.** The number of species in an ecosystem.
 - d.** The number of trophic levels in an ecosystem.



Extend

Form a group. Create a diorama depicting the interactions between plants, animals, and humans in a habitat. Use recycled or reused materials. Present your diorama in an exhibit inside the classroom or the school hallway. Prepare a short, informative presentation about your diorama. This should include key facts about the habitat, the organisms present, how the organisms reproduce, and the specific interactions depicted. Invite other students into your class exhibit. Be ready to guide visitors through your diorama exhibit. Explain the interactions displayed, answer questions, and engage in discussions about the importance of understanding ecological relationships.



Rubric for Assessment

Criteria	4 (Exemplary)	3 (Proficient)	2 (Approaching Proficiency)	1 (Needs Improvement)
Presentation of Interactions	Clearly showcases multiple interactions between plants, animals, and humans, providing a comprehensive understanding of their relationships.	Displays several interactions between plants, animals, and humans, though some may be less evident.	Few interactions are showcased, and they might not be clearly depicted.	Interactions between plants, animals, and humans are not evident or are incorrectly represented.
Detail and Accuracy	The diorama contains multiple accurate and detailed models of plants, animals, and humans interacting.	The diorama has accurate models of plants, animals, and humans.	The diorama includes basic models of plants, animals, and humans, but may have some inaccuracies.	The diorama has minimal or inaccurate models of plants, animals, and humans.
Creativity	Demonstrates a high level of creativity and originality in presenting the interactions, making the scene vivid and engaging.	Shows creativity in design and arrangement.	Limited creativity is shown in design and arrangement.	Little to no creativity is evident in the design or arrangement.
Neatness and Organization	All elements are neatly arranged with clear distinctions between different parts. The overall scene has a well thought out composition.	Elements are organized and neat.	Some elements may appear cluttered or out of place.	The overall appearance is disorganized or messy.

QUARTER 3

You experience different challenges which requires effort, energy, and time to overcome. In this quarter, you will learn how force, motion, and energy are interrelated in the physical world. You will explore the concept of force and its impact on objects. You will also distinguish the difference between distance and displacement, and the relationship between speed and velocity. Moreover, you will gain a comprehensive understanding of heat, temperature, heat transfer, and energy transformation, recognizing heat as a distinct form of energy. As we explore this together, you will be able to explain many natural phenomena that happen in your everyday life.

LESSON 1

Force



Target

At the end of this lesson, you will be able to:

- ◇ Explain different kind of forces.
- ◇ Describe real-life situations showing balanced and unbalanced forces.



Engage



What makes an object move?



Explore

Access the interactive
to perform the activity.



Tug-of-War

Objective

- To discover the difference of balanced and unbalanced forces

Instructions from the Interactive

1. For Team A, place as many players as you want by dragging the player icon from the panel to the left side of the rope. Observe the movement of the rope and the value of the net force acting on the rope.
2. For Team B, place as many players as you want by dragging the player icon from the panel to the right side of the rope. Observe the movement of the rope and the value of the net force acting on the rope.

Guide Questions

1. Place 1 player on the left side of the rope and 2 players on the right side of the rope. What will be the movement of the rope: to the left, to the right, or at the center? What is the value of the net force acting on the rope?
2. Place 2 players on the on the left side of the rope and 2 players on the right side of the rope. What will be the movement of the rope: to the left, to the right, or at the center? What is the value of the net force acting on the rope?
3. Place 5 players on the left side of the rope and 3 players on the right side of the rope. What will be the movement of the rope to the left, to the right, or at the center? What is the value of the net force acting on the rope?
4. Place only 1 player on the left side of the rope and no player on the right side of the rope. What will be the movement of the rope to the left, to the right, or at the center? What is the value of the net force acting on the rope?



Explain

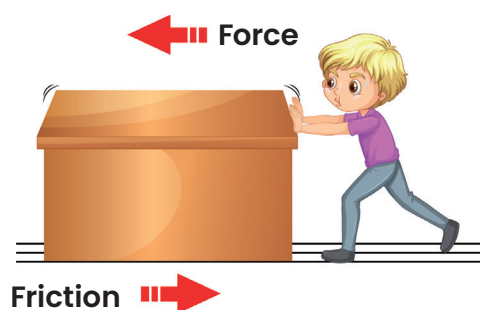
Force is simply a push or pull that can change the direction or motion of an object.

Gravitational Force

Gravitational force is a force that pulls everything with mass toward each other. It is the reason why when you drop something, it falls to the ground. The bigger and heavier something is, the stronger its pull. This force keeps the Earth and other planets in our solar system moving in their orbits around the Sun.

Frictional Force

When you apply force to push a box on the ground, both the box and the ground experience something called frictional force. This force acts to resist motion when two surfaces are in contact.



Friction acting against a box being pushed

Applied Force

Have you ever wondered how you are able to move things around, or how you stop them from moving? You can do this by applying force. Applied force can cause objects to move, stop, or change direction.

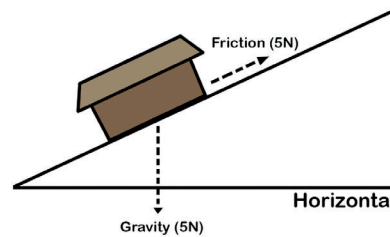
Net Force

Another important concept is net force. Net force refers to the overall force acting on an object when the individual forces acting on it are combined. It takes into account both the magnitude or strength and direction of these forces. When multiple forces are acting on an object, they can either work together or oppose each other.

Balanced Forces

If the forces acting on an object are of equal strength and in opposite directions, they balance each other out. In this case, the object will not accelerate or change its state of motion, but instead, it will remain at rest or move at a constant velocity if it was already in motion.

An example of this is a box resting on an inclined plane. The gravity keeps it on the inclined plane, while the frictional force keeps it from sliding.



Friction acting against a box being pushed

Unbalanced Forces

When the forces acting on an object are not equal or are acting in different directions, they create a nonzero net force. In this scenario, the object will experience acceleration in the direction of the greater force. If the forces are in opposite directions, the object will also experience a change in motion.

An example is a soccer player kicking a ball. She is applying enough force on the ball towards the goal and it causes the soccer ball to move in that direction.



Unbalanced force is acting on the soccer ball as it moves towards the goal.



Elaborate

Find a partner. Look around the classroom and nearby areas. Find examples of situations that shows balanced or unbalanced forces. Write your answers in the table below.

Balanced Forces	Unbalanced Forces



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which of the following best describes the concept of force?
- a. A push or pull on an object.
 - b. The measure of an object's mass.
 - c. The speed at which the object is moving.
 - d. The energy stored in an object due to its position.
- ____ 2. Why does a rocket move upwards when it is launched?
- a. Due to gravity
 - b. Due to friction
 - c. Due to magnetism
 - d. Due to the force of released gases

- ____ 3. When you lift a backpack off the ground, which force are you working against?
- a. Gravitational force
 - b. Magnetic force
 - c. Tensile force
 - d. Elastic force
- ____ 4. What force is responsible for keeping a satellite in orbit around a planet?
- a. Gravitational force
 - b. Frictional force
 - c. Tensile force
 - d. Magnetic force
- ____ 5. Which force slows down a ball when you roll it in the floor?
- a. Magnetic force
 - b. Frictional force
 - c. Gravitational force
 - d. Tensile force
- ____ 6. When a spacecraft re-enters Earth's atmosphere, various forces come into play. Which forces are involved in this process?
- a. Thrust and air resistance
 - b. Electricity and friction
 - c. Friction and magnetism
 - d. Gravitational force and friction
- ____ 7. If two forces of equal magnitude act in opposite directions on an object, which of the following statements best explains the outcome?
- a. The forces create rotational motion in the object.
 - b. The forces are balanced, and the object remains at rest.
 - c. The object will move in the direction of the smaller force.
 - d. The forces are unbalanced, causing the object to accelerate.
- ____ 8. When unbalanced forces act on an object, what is the likely outcome?
- a. The object will lose mass.
 - b. The object will change its appearance.
 - c. The object will change its state of motion.
 - d. The object will remain in its current state of motion.

- _____ 9. What condition refers to multiple forces acting on an object resulting in a net force of zero?
- a.** Inertia
 - b.** Equilibrium
 - c.** Balanced forces
 - d.** Unbalanced forces
- _____ 10. Which scenario shows unbalanced force?
- a.** A book placed in a shelf.
 - b.** A bike speeding downhill.
 - c.** A cat sleeping steadily.
 - d.** A fruit hanging from a tree.

LESSON 2

Free Body Diagram



Target

At the end of this lesson, you will be able to:

- ◇ Describe the magnitude and direction of forces.
- ◇ Represent force using free body diagram.
- ◇ Determine the direction of the object when force is applied.



Engage



What makes an object move?



Explore

Access the interactive
to perform the activity.



Direction of Forces

Objective

- Observe the direction of objects when forces are applied to it

Instructions from the Interactive

Left and Right

1. Click on the + and – to increase or decrease the amount of leftward and rightward forces acting on the object.
2. Click “Go.”
3. Observe where the object will go to base on the magnitude of forces acting on different directions.

Up and Down

1. Click on the + and – to increase or decrease the amount of upward and downward forces acting on the object.
2. Click “Go.”
3. Observe where the object will go to base on the magnitude of forces acting on different directions.

Guide Questions

1. What happens when the forces acting on the box are equal?
2. What can you conclude from the magnitude of force and the direction to which the box moves?



Explain

A force is a push or a pull that make things move or change direction. Sometimes, forces can balance each other out resulting to zero net force. This is what we call **balanced force**. When forces acting on an object are not equal, it will move, change direction, change its speed, or stop. This is due to **unbalanced forces**.

There is way for us to better visualize these forces and we call this a **free body diagram**. It is an illustration we draw to help us understand all the forces acting on an object.

When we talk about force, we are talking about how strong the push or the pull is (magnitude) and which way it is going (direction). In a free body diagram, we draw the object as a simple shape, like a square, to represent it. Then, we use arrows to show the direction of the force. There are two main forces we usually think about:

Weight – the force that pull things down. On the diagram, we draw an arrow pointing down to show the weight.

Normal force – the force from the surface that supports the object. When you put a book on a table, the table pushes on the book. We draw an arrow pointing up to show this force.

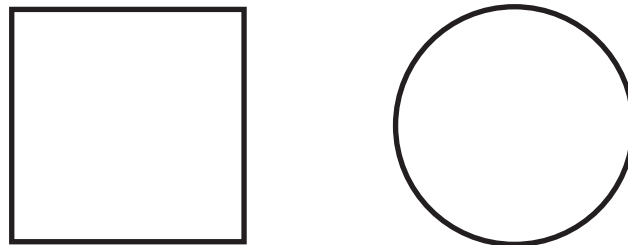
Here are the steps in creating a free body diagram:

Step 1: Identify the Object

Decide which object you want to draw a diagram for. Focus on the object itself and not the forces acting directly on it.

Step 2: Draw a Simple Representation

Draw a simple shape to represent the object. Usually this is a box or a circle to make things easy to work with.

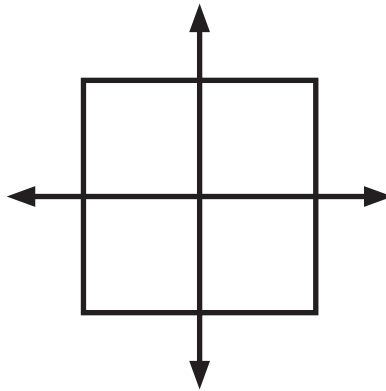


Step 3: Identify the Forces

Identify all the forces acting on the object. These could include weight, normal force, and applied forces.

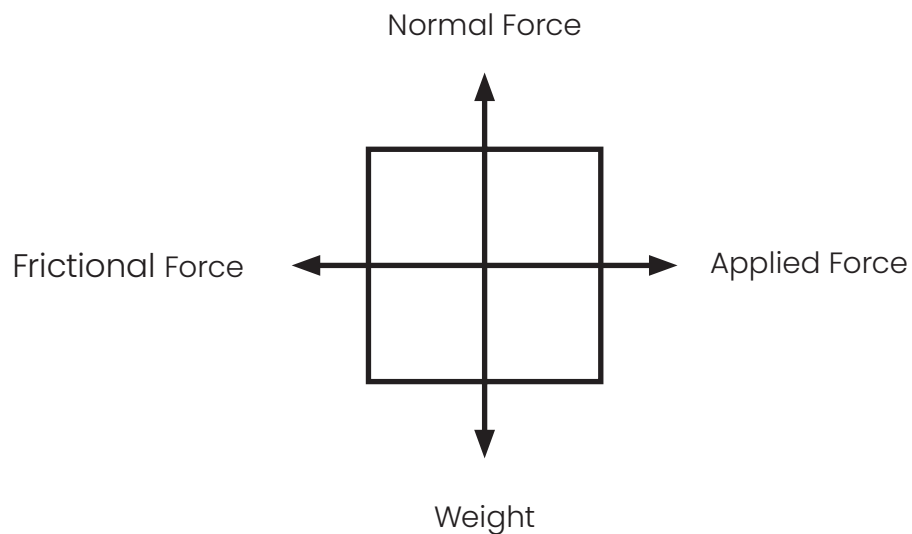
Step 4: Draw Arrows to Represent Forces

For each force you identified, draw an arrow starting from the center of the object and extending outward in the direction of the force. The length of the arrow represents the magnitude or strength of the force.



Step 5: Label the Forces

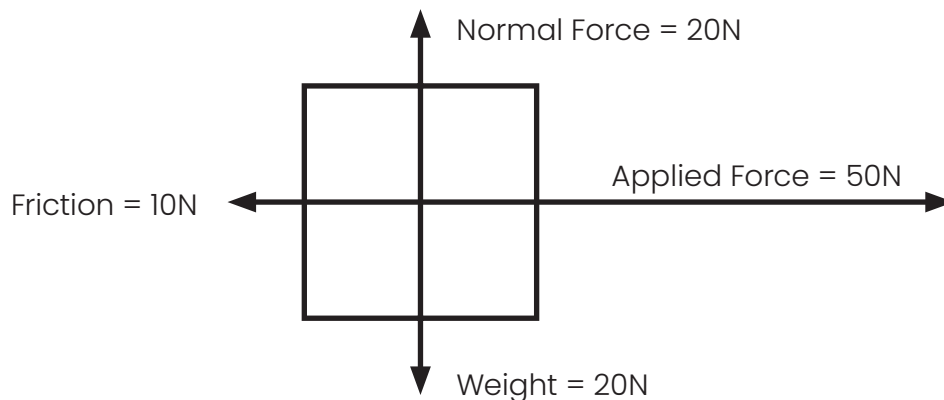
Label each arrow with the name of the force it represents.



Step 6: Indicate Force Magnitude

You can use the length of the arrows to represent the relative magnitudes of the force. Longer arrows mean stronger forces, and shorter arrows mean weaker forces. However, you do not need to measure them precisely; just show the relative strengths.

With your free body diagram complete, you can now analyze it. You can determine how the forces are interacting with the object. You can determine whether the forces are balanced (no acceleration) or unbalanced (causing acceleration or motion).



Elaborate

Find a partner. Choose one from the scenarios listed and draw a free-body diagram to show the forces present. You may decide on the magnitude of force so long as it depicts the scenario accurately. Draw your free-body diagram in the box below.

1. A rightward force is applied to a resting book on top of the table.
2. An egg falling from a nest in a tree. Neglect air resistance.
3. A force is applied to push a box on an inclined plane.
4. A car moving along the road suddenly makes a stop.
5. A soldier jumping off a plane in a parachute.

Free-Body Diagram



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. If an object is at rest, what can be said about the net force acting on it?
- a. There is a single large force acting on it.
 - b. It is moving at a constant velocity.
 - c. The net force is zero.
 - d. The net force is acting downwards.
- ____ 2. When drawing a free body diagram for a car accelerating to the right, what is the most likely direction of the frictional force?
- a. To the left
 - b. To the right
 - c. Upwards
 - d. Downwards
- ____ 3. Which force is commonly overlooked when drawing free body diagrams?
- a. Applied force
 - b. Gravity
 - c. Friction
 - d. Tension

- _____ 4. What does a free body diagram of a bird flying upwards include?
- a.** Lift force upwards and weight downwards
 - b.** Lift force upwards and friction sideways
 - c.** Weight downwards and friction sideways
 - d.** Friction and normal force in all directions
- _____ 5. If two forces, 5 N and 10 N, are acting in the opposite directions on an object, what is the net force?
- a.** 15 N in the direction of the larger force.
 - b.** 5 N in the direction of the smaller force.
 - c.** 5 N in the direction of the larger force
 - d.** Zero, as they cancel each other out.
- _____ 6. In a tug of war where one team is slightly stronger, how is the force of the winning team represented in a free body diagram?
- a.** With a shorter arrow
 - b.** With a longer arrow
 - c.** With a dotted line
 - d.** With a triangle
- _____ 7. If an object is moving at a constant velocity, what can be inferred about the forces acting on it?
- a.** They are rapidly changing.
 - b.** One force is greater than the others.
 - c.** All forces acting on it are balanced.
 - d.** There is no force acting on it.
- _____ 8. Why might an object not accelerate even when a force is applied to it?
- a.** It is too heavy.
 - b.** There is a counteracting force of equal magnitude.
 - c.** There is no friction acting on the object.
 - d.** The force is not real.

_____ 9. Which statement about weight is true?

- a.** Weight is how much space an object occupies.
- b.** Weight does not change with location.
- c.** Weight is an upward force.
- d.** Weight is the gravitational force on an object.

_____ 10. What does a longer arrow in a free body diagram indicate compared to a shorter arrow?

- | | |
|-----------------------|--------------------------------------|
| a. Less force. | c. The same force. |
| b. More force. | d. The direction of movement. |

LESSON 3

Distance and Displacement



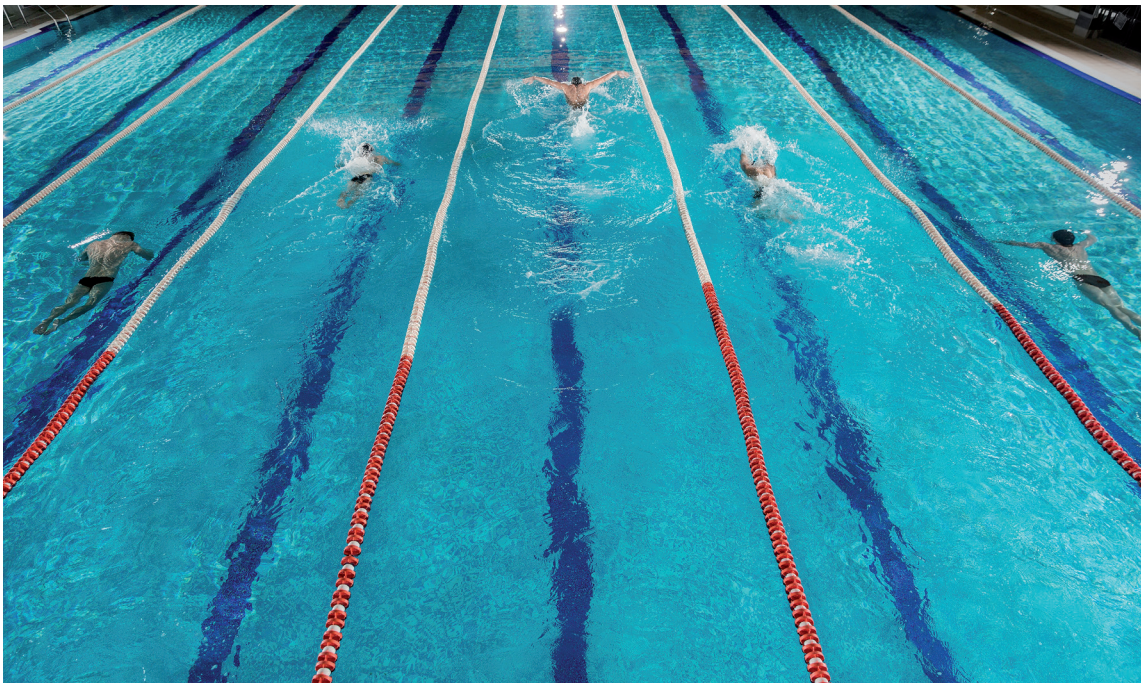
Target

At the end of this lesson, you will be able to:

- ◇ Describe what a reference point is.
- ◇ Explain the difference between distance and displacement.



Engage



How do we measure how far we have moved?



Explore

Access the interactive
to perform the activity.



Distance and Displacement

Objective

- Distinguish between distance and displacement.

Instructions from the Interactive

1. For Route 1, click Peter and let him move from point A to point B. Record the length of the path covered from point A to point B. When Peter arrives at point B, click again for him to move from point B to point C. Record the length of the path covered by Peter from point B to point C. Next, try to add the lengths of path covered from point A to point B and from point B to point C. Record your calculation.
2. For Route 2, click the RESTART button and let Peter move from point A to point C. Record the length of the path covered from point A to point C.

Guide Questions

1. For Route 1, what is the length of the path covered by Peter from point A to point B?
2. For Route 1, what is the length of the path covered by Peter from point B to point C?
3. For Route 1, what is the total length of the path covered by Peter from point A to point C (Point A to B + Point B to C)?
4. For Route 2, what is the length of the path covered by Peter from point A to point C?
5. Which route has the shortest length of path covered by Peter from his house to his school?

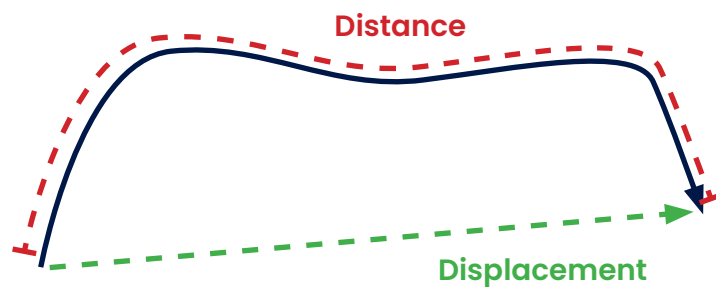


Explain

Motion refers to the change in position of an object with respect to a reference point. A **reference point** is like a marker or a specific spot that you use to see if something is moving and how far it is moved.

Distance is how much ground an object has covered during its movement. Think of it like the total length of the path it traveled, no matter which way it went. If you walk around your house in a big circle, the distance is the total length of that circle.

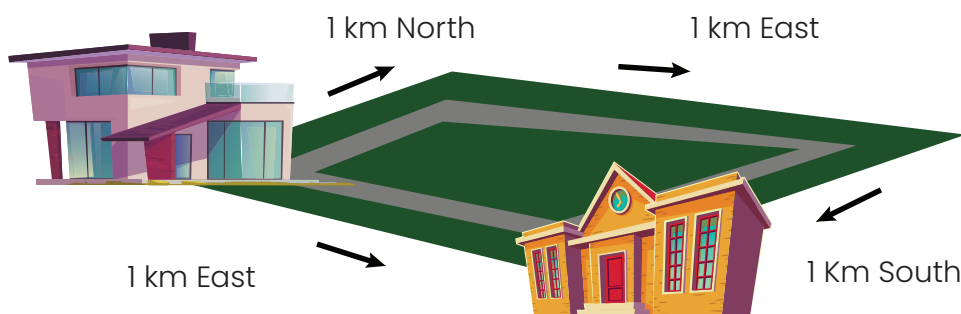
Displacement considers where you started and where you ended up, in a straight line. It does not care about the path you took to get there. Using the same example, if you walk in a circle and end up back where you started, your displacement is zero – because you did not actually move away from your starting point.



Difference between distance and displacement

Remember, distance cares about all the steps you took, while displacement only cares about how far out your way went from the starting point. Distance does not depend on direction, while displacement does.

For example, Abby's school is 1 kilometer east from her home.



If she walked to school by going one kilometer to the north, one kilometer to the east, and then one kilometer to the south to reach her school, the distance she traveled is three kilometers because we added up all those kilometers she walked. However, her displacement is still one kilometer because it is how far from her house is to the school, which is directly east.



Elaborate

Find a partner. Think of the popular areas and landmarks in your community. Look for its distance from your home and the shortest way possible to travel from your home to that place. You may use a map or mobile map applications for this activity. Share your findings in class.



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. Which of the following statements is true about distance?
- a. Distance is always zero.
 - b. Distance depends on direction.
 - c. Distance does not depend on direction.
 - d. Distance is the shortest distance the object took.
- _____ 2. Which of the following statements is true about displacement?
- a. Displacement cannot be zero.
 - b. Displacement does not involve a starting point.
 - c. Displacement does not depend on direction but only on the final position.
 - d. Displacement is the difference between the objects initial and final position.

- _____ 3. Which of the following statements is true about distance and displacement?
- a.** You can have zero distance and non-zero displacement.
 - b.** You cannot have zero distance and non-zero displacement.
 - c.** You can return to your starting point and have non-zero displacement.
 - d.** You can have a negative distance as much as you can have positive distance.
- _____ 4. Which of the following is a unit for distance?
- a.** Kilogram
 - b.** Hours
 - c.** Meters
 - d.** Liters
- _____ 5. How do you define the movement with a reference point?
- I. North, east, south, west II. Before and after III. Right, left, up, down
- a.** I only
 - b.** II only
 - c.** I and II
 - d.** I and III
- _____ 6. A student goes for a walk, covering 2 kilometers to the east, then returns to the starting point. What can be said about the student's displacement?
- a.** The displacement is 0 kilometer.
 - b.** The displacement is 2 kilometers.
 - c.** The displacement is 4 kilometers.
 - d.** The displacement is 2 kilometers to the west.
- _____ 7. Which of the following best describes displacement?
- a.** The speed at which an object moves in a straight line regardless of the direction of motion.
 - b.** The total path traveled by an object in a circular motion.
 - c.** The change in position of an object from its initial point to its final point, taking direction into account.
 - d.** The time it takes for an object to cover a specific distance.

- _____ 8. A hiker walks 2 kilometers north, then 3 kilometers east, and finally 1 kilometer south. What is the total distance covered by the hiker?
- a. 4 kilometers
 - b. 5 kilometers
 - c. 6 kilometers
 - d. 7 kilometers
- _____ 9. A car travels 100 kilometers north, then turns and travels 50 kilometers south. What is the car's displacement from its starting point?
- a. 50 kilometers
 - b. 50 kilometers south
 - c. 100 kilometers
 - d. 100 kilometers north
- _____ 10. A person takes a walk around their neighborhood. They start at their house, walk 500 meters east, then turn around and walk 300 meters west before returning home. What is the total distance covered during the walk?
- a. 500 meters
 - b. 800 meters
 - c. 800 meters east
 - d. 800 meters west

LESSON 4

Speed and Velocity



Target

At the end of this lesson, you will be able to:

- ◇ Distinguish between speed and velocity.
- ◇ Apply vector concepts to precisely describe both speed and velocity in various scenarios.
- ◇ Represent motion using distance-time graphs.
- ◇ Interpret distance-time graphs to extract information about an object's motion.



Engage



How do you describe the motion of an object?



Explore

Access the interactive
to perform the activity.



Speed and Velocity

Objective

- Distinguish between speed and velocity.

Instructions from the Interactive

1. Follow the story of Maria who is travelling to school.
2. Click the bus and observe the distance and the time it takes to travel from Maria's house (Point A) to her school (Point B). Record your observation.

Guide Questions

1. What is the distance covered by the bus from Maria's house (Point A) to her school (Point B)?
2. What is the total time travelled by the bus from Maria's house (Point A) to her school (Point B)?
3. What is the direction of the bus from Maria's house to her school? (Left, Right, Up, or Down)
4. Divide the distance covered by the time travelled by the bus from Maria's house to her school. Record your calculation.



Explain

Speed is a measure of how fast or how slow an object is moving, or how quickly the object is changing position. We can calculate this by:

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

Speed is a **scalar quantity**. It has magnitude but no direction. For example, a car traveled 60 kilometers in one hour. Its speed is 60 kilometers per hour. You will know how fast it is going, but you will not know which direction. Common units of speed include kilometers per hour (km/hr.) and meters per second (m/s).

If we include direction, we are now referring to **velocity**. With the same example about, the car is traveling north, the velocity would then be 60 km/hr. north. We can calculate this using:

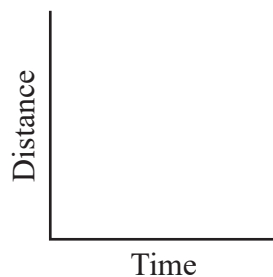
$$Velocity = \frac{\text{displacement}}{\text{time}}$$

Unlike speed, velocity is a **vector quantity**. It has both magnitude and direction. Since velocity includes direction, changing the direction of the object also changes the velocity.

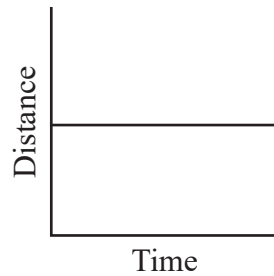
The distance the object took in a span of time can also be represented by a graph called **distance-time graph** or **D-T graph**. This is very useful in understanding the motion of objects.

Here is how it works:

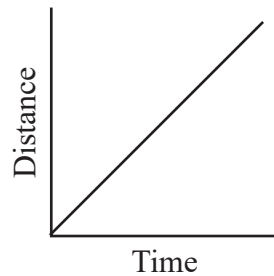
- The horizontal axis represents time. It starts from zero and goes forward in increments.
- The vertical axis, or y-axis, represent distance. It also starts from zero and goes up in increments.
- Each point on the graph represents a specific moment in time and the corresponding distance the object has traveled at that moment. When you plot points on the graph, you can connect them to form a line. The shape tells you about the object's motion.



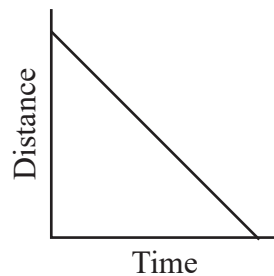
- If the line is flat, it means the object is not moving. Its distance is not changing. This means that the object is **stationary**.



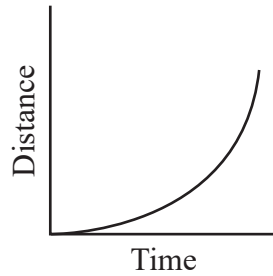
- If the line slopes upward, it means that the distance is increasing, and that the object is moving away from its starting point. In this case, the object maintains a speed. This is an example of **uniform motion**.



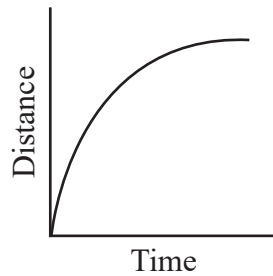
- If the line slopes downward, it means that the object is getting closer to its starting point, still with constant speed. This is another example of uniform motion.



- If the speed of the object is changing, we have the graph shown below. This represents motion with **increasing speed**.



- If the speed of the object is decreasing, we have the graph of motion with **decreasing speed**.

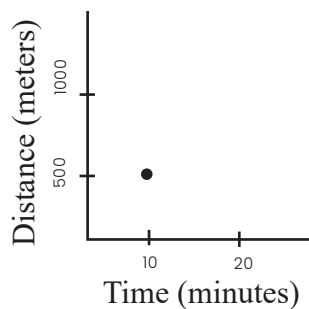


Let us have an example.

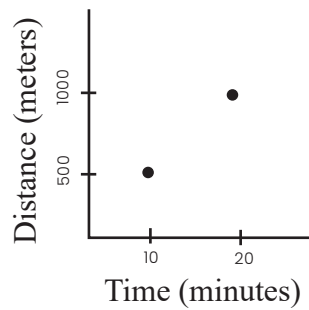
Let us say you start at home and walk to a park. After 10 minutes, you have walked 500 meters. You mark this point on the graph (10 minutes, 500 meters). Then, after 20 minutes, you have walked 1000 meters. You marked this point (20 minutes, 1000 meters). If you connect these points, you will have a line that shows how your distance from home changed over time.

Let us try to plot.

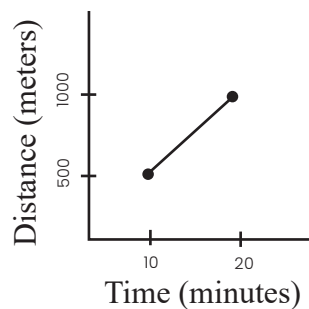
Point 1 – 10 minutes, 500 meters



Point 2 – 20 minutes, 1000 meters



Now, let us connect the points.



We can say that you are going farther from the starting point.

Distance-time graphs help us see how things move over time in a clear and easy-to-understand way. These graphs are important because they let us quickly grasp the concept of speed and movement.

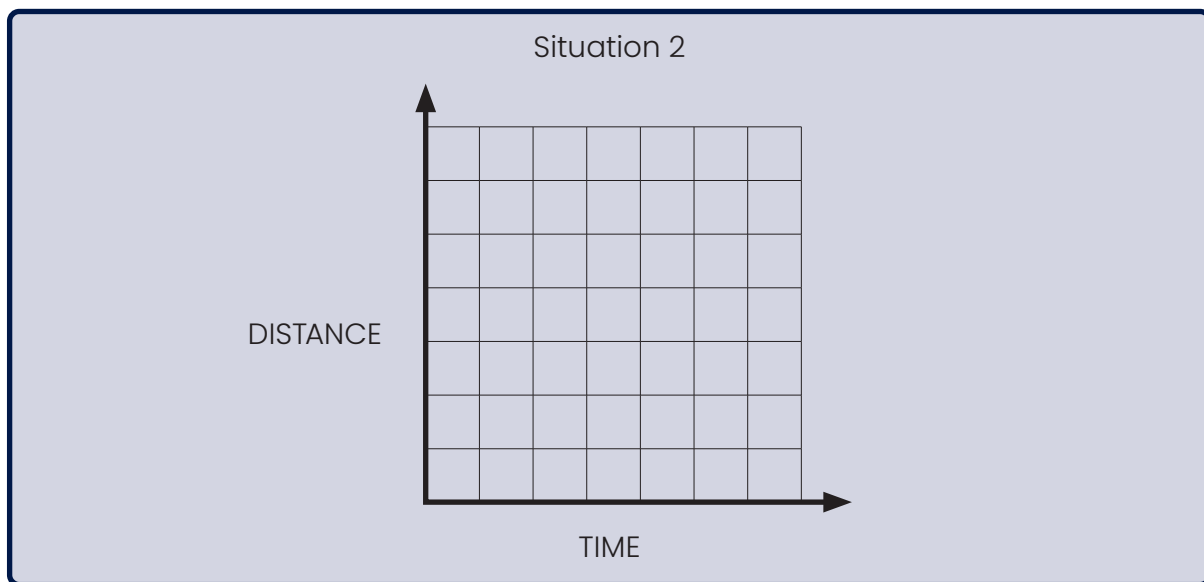
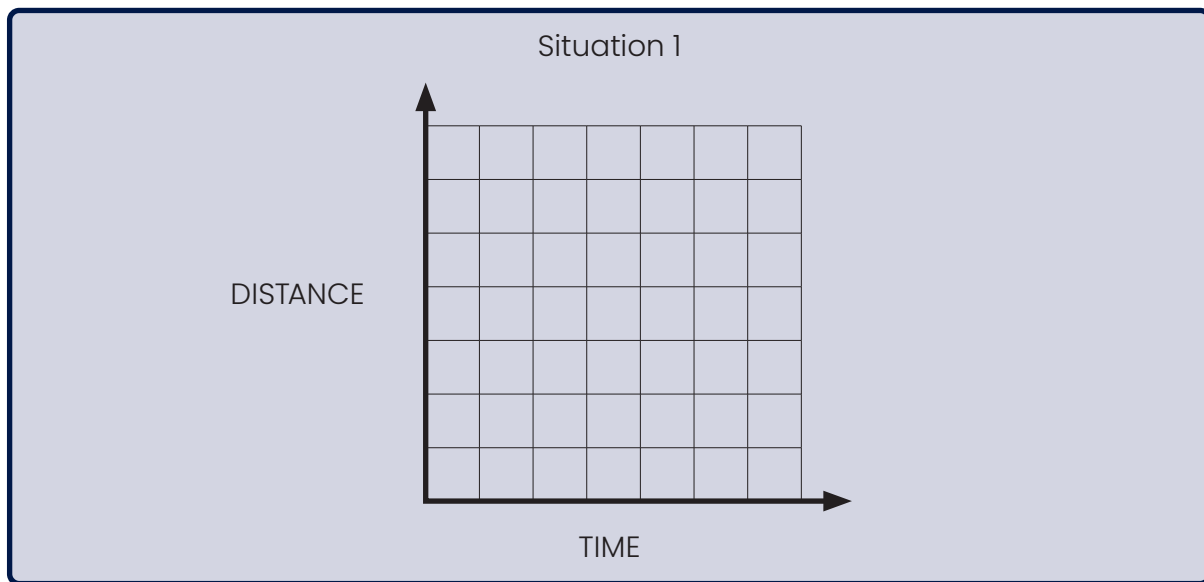


Elaborate

Form a group. Work together to create a distance-time graph for each of the following situation. Draw your distance-time graph in the boxes below. Present your work in class and explain how you came up with the graph.

Situation 1: Imagine a car driving along a straight highway at a steady speed of 60 km/hr. in a straight line from Brgy. Sta. Cruz to Brgy. Sta. Ines. The car maintains this speed without any changes in direction. It traveled for 3 hours and covered 180 kilometers.

Situation 2: A book is placed on a table and does not move.



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which statement best describes speed?
- a. The rate at which the object is moving.
 - b. The rate at which the object is at rest.
 - c. The rate at which the object is floating.
 - d. The rate at which the object invisible.

- _____ 2. What is the main difference between speed and velocity?
- a.** Speed tells you how fast something is moving, while velocity also includes direction.
 - b.** Speed tells you the time it takes for an object to move while velocity says the same but with direction.
 - c.** Speed tells you how far something has travelled, while velocity tells you how long it took it travel.
 - d.** Speed tells you the direction of the object, while velocity tells you where it came from.
- _____ 3. What is the velocity of a car that traveled straight towards the east for 2 hours and covering 100 kilometers?
- a.** 50 km/hr
 - b.** 200 km/hr
 - c.** 50 km/hr east
 - d.** 200 km/hr east
- _____ 4. What is the speed an object that is not moving at all?
- a.** 0 m/s
 - b.** 1 m/s
 - c.** 10 m/s
 - d.** 100 m/s
- _____ 5. Which of the following statements is true?
- a.** A car going in circles has uniform velocity.
 - b.** A car going in circles constantly changes its velocity.
 - c.** Speed should be uniform when creating distance-time graphs.
 - d.** Units are not necessary when creating distance-time graphs.
- _____ 6. How are speed and distance related?
- a.** Speed describes how fast the object traveled over a distance for a certain time.
 - b.** Speed describes the direction of the distance traveled by an object and how much time it took.
 - c.** Speed describes the total amount of distance covered by an object divided by the force applied.
 - d.** Speed is nonzero when the distance is zero while distance cannot be nonzero when the speed is zero.

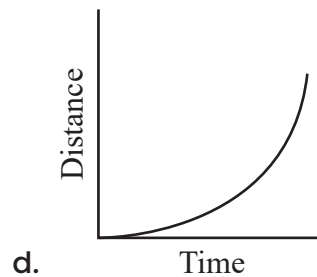
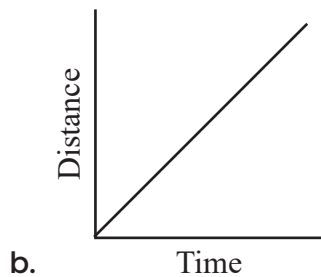
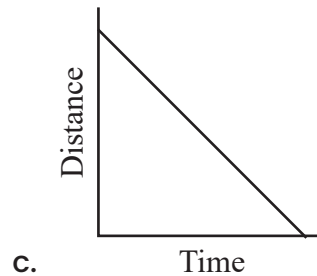
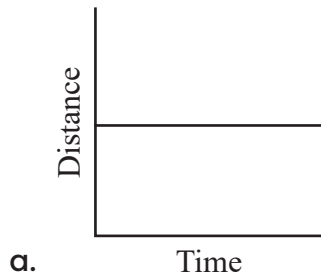
_____ 7. A scalar quantity has _____.

- a. Direction only
- b. Magnitude only
- c. Both magnitude and direction
- d. Magnitude, direction, time, and force

_____ 8. A vector quantity has _____.

- a. Direction only
- b. Magnitude only
- c. Both magnitude and direction
- d. Magnitude, direction, time, and force

_____ 9. Which graph represents changing velocity?



_____ 10. If two objects travel the same distance but one takes longer, how do their graphs compare?

- a. The faster object will have a horizontal line.
- b. The slower object will have a steeper slope.
- c. The faster object will have a steeper slope.
- d. They will have the same slope.

LESSON 5

Heat and Temperature



Target

At the end of this lesson, you will be able to:

- ◇ Define heat and temperature.
- ◇ Explain the difference between heat and temperature.



Engage



How does it feel being close to a bonfire?



Heat and Temperature

Objective

- Investigate the difference of heat and temperature at the molecular level

Procedures from Interactive

1. Drag the thermometer from the panel and place it over Beaker 1 with hot water to measure the temperature of the water inside.
2. Do the same for Beaker 2 with warm water and for Beaker 3 with cold water.
3. Drag the dropper from the panel and get a dye from the container.
4. Place a drop of dye into the center of Beaker 1 with hot water. Observe the behavior of the dye inside the beaker.
5. Repeat procedure 4 for Beaker 2 with warm water and for Beaker 3 with cold water.
6. Record the data from steps 1 to 5 in Table 1.

Data

Table 1. Behavior of Dye and Temperature

Beaker	Description	Temperature	Behavior of Dye
1	Hot		
2	Warm		
3	Cold		

Guide Questions

1. In which beaker did the dye scatter the fastest?
2. In which beaker did the dye scatter the slowest?
3. How will you relate the temperature of the water to the rate of scattering of the dye inside the beaker?



Explain

Heat is a measure of the total thermal energy of a system. It is a form of energy from the internal energy of particles within a system. Heat is important in the understanding energy transfer and transformation in various physical and chemical processes. The transfer of heat from one object to another occurs when there is a temperature difference between them. The flow of heat is from hotter to colder objects.



You can feel the heat from the hot cup of coffee as energy moves towards your hand.

Temperature is the average kinetic energy of particles in a substance or system. These particles can be atoms or molecules that comprise the system. The S.I. unit for temperature is the Kelvin (K). Scientific measurements use this scale and the lowest temperature that can be obtained is 0 K, which we refer to as absolute zero. However, Celsius is the most used temperature scale in most countries including the Philippines. Water freezes at 0 °C and boils at 100 °C at standard atmospheric pressure. The Fahrenheit scale is used in other countries like the USA.



Thermometers are used to measure temperature.



Elaborate

Find a partner. Find five objects around the classroom and the campus. Using a thermometer, measure the temperature of each object. Record the temperatures of each object in Celsius in the table below.

Object	Temperature
1.	
2.	
3.	
4.	
5.	



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. What does temperature measure?
- a. Average chemical energy of particles
 - b. Average potential energy of particles
 - c. Average kinetic energy of particles
 - d. Average solar energy received by Earth
- ____ 2. How can we accurately measure the temperature of an object?
- a. Using your hand
 - b. Using a barometer
 - c. Using a thermometer
 - d. Using a heat detector
- ____ 3. What is the S.I. unit for temperature?
- a. Celsius
 - b. Degree
 - c. Fahrenheit
 - d. Kelvin
- ____ 4. Shane toasted his bread using an oven. What happens to the bread inside the oven?
- a. Heat is added to the bread.
 - b. Heat is removed from the bread.
 - c. The coldness in the bread is removed.
 - d. The temperature of the surroundings is decreased.
- ____ 5. The water in teacup A is hotter in teacup B. What can be said regarding their temperature?
- a. Water in teacup A has the same temperature as in teacup B.
 - b. Water in teacup A has a higher temperature than in teacup B.
 - c. Water in teacup A has a lower temperature than in teacup B.
 - d. Water in teacup A will soon become hotter than that of teacup B.

- _____ 6. Which statements best describes heat?
- a.** The absence of cold.
 - b.** It is a unit used to measure temperature.
 - c.** The total mechanical energy of an object.
 - d.** The kinetic energy of particles in a substance.
- _____ 7. A scientist adds heat to a substance in a beaker. What happens to its temperature?
- a.** Increases
 - b.** Decreases
 - c.** Stays the same
 - d.** Reaches absolute zero
- _____ 8. During a cold December morning, Arturo observed two coffee cups that are in contact. Cup A has a lower temperature than Cup B. How does heat flow between the objects?
- a.** From Cup A to Cup B.
 - b.** From Cup B to Cup A.
 - c.** It will depend on the outside temperature.
 - d.** There is no heat flow between the objects.
- _____ 9. In which situation will heat stop moving from one object to another?
- a.** The temperature of the cooler object decreases.
 - b.** The temperature of the hotter object increases.
 - c.** Both objects involved reach the same temperature.
 - d.** One of the objects freezes.
- _____ 10. What happens to the heat energy when an ice cube melts in your hand?
- a.** The heat energy is absorbed by the ice from your hand.
 - b.** The heat energy is transferred from the ice to your hand.
 - c.** The heat energy is destroyed in the process.
 - d.** The heat energy converts to mechanical energy.

LESSON 6

Heat Transfer



Target

At the end of this lesson, you will be able to:

- ◇ Explain the different methods of heat transfer.
- ◇ Identify examples of situations that involves heat transfer.
- ◇ Explain, in terms of the particle model, the processes underlying convection and conduction of heat energy.
- ◇ Describe heat conductors and insulators.



Engage



How does heat move from one object to another?



Explore

Access the interactive
to perform the activity.



Conduction and Convection

Objective

- Discover how heat can be transferred through conduction and convection.

Instructions from the Interactive

1. Put the alcohol lamp in the center of the table and light it using the candle lighter. Put the tripod over the alcohol lamp. Next, place the wire gauze on top of the tripod.
2. Half-fill the beaker with water. Then, place it on top of the wire gauze. Drag the thermometer from the panel and observe the temperature of the water inside the beaker.
3. When the temperature reaches 50° C, put the metal spoon inside the beaker. Measure the temperature of the metal spoon by dragging the thermometer and letting it touch the tip of the metal spoon. Record your observation in table 1.
4. Remove the metal spoon from the beaker and replace it with the plastic spoon. Likewise, measure the temperature of the plastic spoon by dragging the thermometer and letting it touch the tip of the plastic spoon. Record your observations in Table 1.
5. Remove the plastic spoon from the beaker and measure the temperature of the water inside the beaker using the thermometer from the panel.
6. Drag the glass container from the panel and put it over the setup. Observe the automated temperature reader of the glass container. Record your observations in Table 2.

Data

Table 1.

Temperature of Metal Spoon (°C)	Temperature of Plastic Spoon (°C)

Table 2.

Temperature of Glass Container (°C)	
BEFORE	
AFTER	

Guide Questions

1. Compare the temperatures of the metal spoon and plastic spoon when placed inside the beaker. What have you observed?
2. What is the initial temperature reading of the glass container before putting it over the setup?
3. What happened to the temperature of the glass container after putting it over the setup?

Radiation

Objective

- Discover how heat can be transferred through radiation.

Instructions from the Interactive

1. Assemble the set up for the simulated laboratory activity. Drag the two metal cans from the panel to the table.
2. Half-fill the black metal can and polished metal can with the same amount of boiling water. Cover the metal cans.

3. Insert each thermometer with a rubber stopper into the hole of each can cover.
4. Measure the initial temperature of the water inside the cans. Record your measurement.
5. Click the timer and observe how the temperature changes from time to time. Record your observation.

Data

Time in Seconds (s)	Temperature of Water Inside the Cans	
	Black	Polished
10		
15		
20		
25		
30		

Guide Questions

1. What are the initial temperatures of the water inside the two cans?
2. What happened to the temperature of the water inside the cans after some time?
3. Compare the rate of change in the temperatures of the water inside the black metal can and polished metal can. What have you observed?



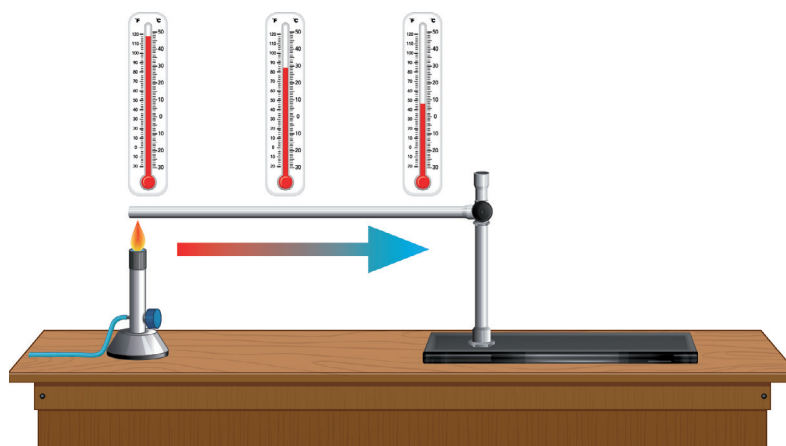
Explain

Heat transfer is the processes of exchanging thermal energy or heat between two or more objects or substances driven by a temperature difference. Heat flows from regions of higher to lower temperatures to attain **thermal equilibrium**, where all objects or substances have the same temperature.

Conduction

Conduction is the transfer of heat through a solid material. This process of heat transfer is better explained in terms of the particulate model of matter. Using our understanding of the particle model of matter, conduction occurs due to the collision and interaction of particles within the material. Energy is passed from one particle to the next through vibrations and collisions.

Study the figure below. Suppose you have a metal bar with one end exposed to a flame. The energy transfer continues throughout the metal bar from particle to particle until thermal equilibrium is reached. Metals are generally good conductors of heat because of the high density of free electrons that can efficiently transport thermal energy.

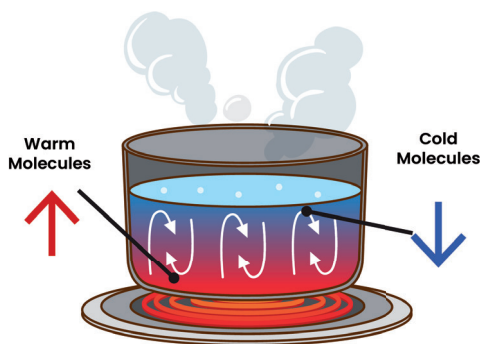


Heat moves from one end of the metal rod to another through conduction.

Convection

The transfer of heat through the movement of fluids, which can be liquids or gases, is called convection. It involves the movement of the fluid itself. This occurs when warmer, less dense fluid rises and displaces cooler and denser fluid which creates a convection current.

We can further understand the process of convection through the particle model of matter. When a fluid is heated, the particles gain kinetic energy and move more rapidly. These particles near the heat source are heated



first, therefore gaining energy. They become less dense and rise to the top of the fluid while the cooler particles are denser and move to the bottom. This leads to a continuous circulation pattern within the fluid leading to the transfer of heat.

Radiation

Radiation is the transfer of heat through electromagnetic waves, such as light. This type of heat transfer does not require a medium to travel. Heat can be transferred in vacuum, like how the heat from the Sun reaches Earth. All objects emit thermal radiation. The hotter an object is, the more energy it emits in the form of electromagnetic waves. When you sit near a bonfire, you feel the warmth coming from the flames through radiation.



Most pans and pots are made from metals for better conduction of heat

Conductors and Insulators

Conductors and insulators are materials that differ in their ability to conduct heat. This is due to the way they allow or inhibit the transfer of thermal energy based on their atomic or molecular structure.

Conductors are materials that easily allow the flow of heat through them. In conductors, the atoms or molecules are tightly packed and have free electrons that are responsible for carrying thermal energy that are not closely bound to the nuclei. Common conductors of heat are metals such as copper, aluminum, silver, and gold.

Insulators, on the other hand, are materials that resist the transfer of thermal energy through them. The atoms or molecules of an insulator are far apart and the electrons are tightly bound to the atomic nuclei. The particles are not efficient in transferring energy to their neighboring particles, which results in the material acting as a thermal barrier. Common insulators of heat are wood, rubber, plastic, and ceramic.



Elaborate

Divide the class into two groups. The groups will play a game of charades. Charades is a game where players act out words or phrases without speaking, while others guess what is being portrayed. The groups will guess different activities that involves heat transfer. After guessing the word correctly, the groups will also identify if the heat transfer is done through conduction, convection, or radiation. The group with the most points wins.



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. Which of the following is NOT a method of heat transfer?
- | | |
|---------------|---------------|
| a. Conduction | c. Insulation |
| b. Convection | d. Radiation |
- _____ 2. Dave is choosing a material that transfers heat most rapidly through conduction. Which material should he use?
- | | |
|----------|------------|
| a. Air | c. Plastic |
| b. Metal | d. Wood |
- _____ 3. When cooking on a metal pan over the flame of a gas stove, Ron notices that the pan is not heated uniformly. Which part of the pan gets hot first due to conduction?
- | | |
|-----------|----------|
| a. Bottom | c. Sides |
| b. Handle | d. Top |
- _____ 4. Which process involves heat transferred by the movement of a heated fluid such as water or air?
- | | |
|---------------|----------------|
| a. Conduction | c. Compression |
| b. Convection | d. Radiation |

- ____ 5. What is the mode of heat transfer in the outer space?
- a.** Conduction
 - b.** Convection
 - c.** Insulation
 - d.** Radiation
- ____ 6. Which statement best describes conduction?
- a.** Heat transfer through fluid motion.
 - b.** Heat transfer even without a medium.
 - c.** Heat transfer through direct contact of particles.
 - d.** Heat transfer through electromagnetic waves.
- ____ 7. Which material will best conduct heat?
- a.** Ceramic
 - b.** Copper
 - c.** Rubber
 - d.** Wood
- ____ 8. What causes convection currents in a fluid?
- a.** Color variation
 - b.** Conductivity
 - c.** Radioactivity
 - d.** Thermal differences
- ____ 9. What is the function of a heat insulator?
- a.** To generate heat
 - b.** To slow down light
 - c.** To reduce heat transfer
 - d.** To conduct heat effectively
- ____ 10. Sam left her spoon in her mug while making coffee. When thermal equilibrium is reached, what object would have the higher temperature?
- a.** The mug
 - b.** The spoon
 - c.** The coffee
 - d.** All would have the same temperature

LESSON 7

Energy Transformation



Target

At the end of this lesson, you will be able to:

- ◇ Explore how heat energy can be converted into electrical energy.
- ◇ Describe innovations and devices that convert various forms of energy into electrical energy.



Engage



How is energy transformation involved in producing the electricity we use every day?



Explore

Access the interactive
to perform the activity.



Power Plant

Objective

- Observe the processes involved in producing electricity in power plants.

Instructions from the Interactive

1. Drag the components of a power plant from the Power Plant Component Pane into the Assembly Plane.
2. Make sure that the components are arranged properly. If you have arranged it correctly, electricity will flow towards the street lamp and it will be lighted up.
3. Once the power plant is assembled properly, hover on each component and read the process that occurs.

Guide Questions

1. What are some fuel sources that are commonly used in conventional power plants?
2. What energy transformations occur throughout the power plant to generate electricity?
3. What are some negative effects of power plants in the environment?
4. What are other ways to produce electricity without the use of power plants?



Explain

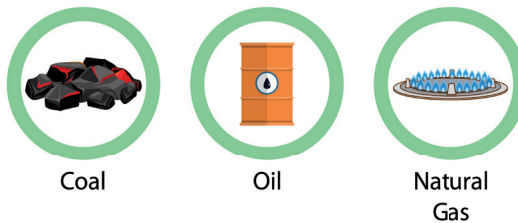
Energy transformation of heat energy into electricity is a fundamental aspect of how we generate power for every day consumption. This transformation involves several key steps and technologies, depending on the energy source being used.

A **power plant**, also known as an electric power station or generating station, is a facility or infrastructure designed to generate electricity. In a power plant, fuel is used to convert heat energy to electrical energy.



A power plant converts energy from fuel into electrical energy

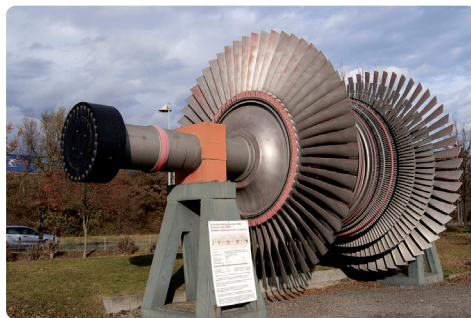
The process begins with a heat source. This could be from burning fossil fuels (coal, natural gas, oil), nuclear reactions, or geothermal heat which comes from the heat in the Earth's interior.



Conventional power plants use fossil fuel as heat source.

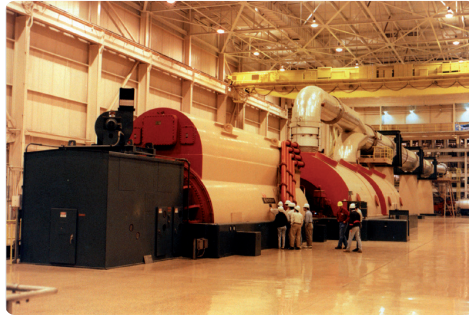
The heat from the source is used to raise temperature of a fluid (usually water) in a boiler or heat exchanger. This process converts thermal energy from heat source into kinetic energy (movement of particles). The fluid, now at a high temperature and pressure, is transformed into steam. This steam contains a significant amount of thermal energy in the form of kinetic energy of the water molecules.

The steam is directed onto the blades of a turbine which causes it to spin. The spinning motion converts the kinetic energy of the high-pressured steam into mechanical energy in the form of rotating motion.



Large turbines are used in power plants.

The rotating turbine is connected to a generator. A **generator** is a machine that converts mechanical energy into electrical energy.



Generators inside a power plant.

The electric current produced in the generator is then collected to be fed into the electrical grid. It can be used to power homes, industries, and various other applications. Through a series of energy transformations, we can generate electricity and provide comfort and help for many people.



Electricity generated in power plants are distributed to homes through power lines.

Renewable Sources of Electricity

Renewable energy comes from natural sources that can be readily replaced or take a long time to run out, like the sun, wind, water, and the heat inside the Earth.

1. Solar Energy

Solar energy is captured from the sunlight. Large panels, called solar panels, are made of materials that convert sunlight directly into electricity.



A solar energy farm

2. Wind Energy

Wind energy uses the power of moving air. Tall towers with large blades, called wind turbines, are built in windy places. When the wind blows, it turns the blades of these turbines to create electricity.



Wind turbines are built in places with strong winds.

3. Hydroelectric Energy

Hydroelectric energy comes from the movement of water. This usually happens in a river or a large dam where water is stored. As the water flows down through the dam, it spins turbines and generates electricity.



Hydroelectric power plants are often built in dams along rivers.

4. Geothermal Energy

In some areas, water deep underground gets heated by the Earth's interior and turns into steam. This steam is then used to spin turbines, which generate electricity.



Geothermal power plant in Negros Oriental.



Elaborate

Form a group. Identify a power plant that operates in the Philippines. It can be power plant that uses fossil fuels or renewable energy. Consider the advantages and disadvantages it provides to the community where it is located. Prepare a 5-minute multimedia presentation to share the information you have gathered.



Evaluate

Write the letter of the best answer in the space before the number.

- ____ 1. Which material is a fossil fuel commonly used in power plants?
- a. Alcohol
 - b. Coal
 - c. Water
 - d. Wood
- ____ 2. Which device converts the kinetic energy of steam into mechanical energy?
- a. Heat engine
 - b. Shaft
 - c. Tube
 - d. Turbine
- ____ 3. Where is electricity produced in a power plant?
- a. Boiler
 - b. Turbine
 - c. Heat sink
 - d. Generator
- ____ 4. Which is the correct sequence that represents the path of energy transformation in a power plant?
- a. Chemical → Mechanical → Thermal → Electrical
 - b. Mechanical → Thermal → Chemical → Electrical
 - c. Thermal → Kinetic → Mechanical → Electrical
 - d. Kinetic → Thermal → Mechanical → Chemical
- ____ 5. What does a solar power plant use to generate electricity?
- a. Water
 - b. Wind
 - c. Sunlight
 - d. Coal
- ____ 6. In a hydroelectric power plant, what turns the turbines to generate electricity?
- a. Steam
 - b. Sunlight
 - c. Flowing water
 - d. Burning coal
- ____ 7. What are the tall towers with large blades that generate wind energy called?
- a. Wind panels
 - b. Wind turbines
 - c. Wind dams
 - d. Wind pumps

- _____ 8. How does geothermal energy generate electricity?
- a.** By using sunlight
 - b.** By using heat from Earth's interior
 - c.** By using wind to move blades
 - d.** By using the flow of rivers
- _____ 9. Why are renewable energy sources important for the environment?
- a.** They can easily be replaced when they get broken.
 - b.** They help people in poor communities have jobs.
 - c.** They do not deplete quickly and are less polluting.
 - d.** They are expensive to use but earn more money.
- _____ 10. Which of the following is not a benefit of using renewable energy sources such as wind energy?
- a.** They are sustainable.
 - b.** They help in reducing air pollution.
 - c.** They use natural resources which never run out.
 - d.** They make a lot of noise.



Extend

Form a group. Prepare a 10- to 15-minute documentary showing everyday scenarios where force, motion, and energy is observed. Consider activities such as riding a bicycle, using household appliances, playing sports, or even simple actions like pushing a door. Provide a narration or voice-over explaining how the concepts of force, motion, and energy are shown in the documentary. The class will prepare a documentary film showing and invite other students to your classroom. Be prepared to answer questions from the audience.



Rubric for Assessment

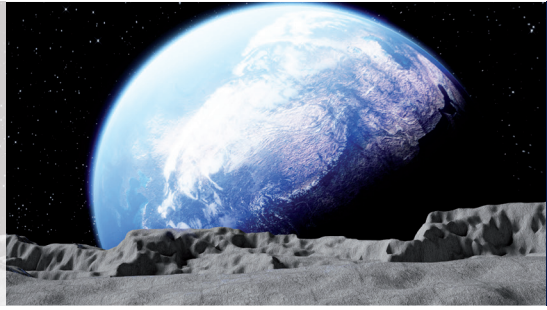
Criteria	3 (Excellent)	2 (Satisfactory)	1 (Needs Improvement)
Content Accuracy	All scientific concepts are accurately presented and clearly linked to real-life scenarios.	Most concepts are accurately presented.	Several inaccuracies in the presented concepts or weak connections to real life scenarios.
Creativity and Engagement	The documentary is highly engaging with creative scenarios and varied visuals. Keeps the viewer interested throughout.	The documentary has engaging moments and shows effort to show creativity.	The documentary lacks creativity and fails to keep the viewer engaged for most of the time.
Video Production Quality	Clear visuals and sound. Effective use of varied shots and angles. Smooth transitions and appropriate background music.	Mostly clear visuals and sound.	Visuals and/or sound are often unclear. Transitions are jarring and background music frequently drowns out narration.
Explanation and Clarity	Narration is clear, concise, and provides a comprehensive understanding of the concepts.	Narration is mostly clear.	Narration is often unclear or lacks depth, making it difficult for viewers to grasp the scientific concepts.
Teamwork and Collaboration	All team members have contributed effectively, and the final product showcases a well coordinated collaborative effort.	Most team members have contributed.	It is evident that some team members did not contribute much, or the team struggled with collaboration, leading to a disjointed final product.

QUARTER 4

The world we live in is full of rich experiences that makes life exciting – the pouring of rain, the winds blowing, the rising and setting of the Sun. In this quarter, you will encounter different natural phenomena such as earthquakes, tsunamis, and weather disturbances. Moreover, you will learn safety measures, emergency preparedness techniques, and the importance of community resilience. By the end of the quarter, not only will you have a better appreciation for the forces of nature, but you will also be empowered with knowledge to safeguard yourself and your community in the face of such events.

LESSON 1

Faults and Earthquakes



Target

At the end of this lesson, you will be able to:

- ◇ Explain how earthquakes occur.
- ◇ Classify geological faults as normal, reverse, or strike-slip fault.
- ◇ Illustrate fault movements using models.



Engage



How do faults produce earthquakes?



Explore

Access the interactive
to perform the activity.



Faults and Earthquakes

Objective

- Explain how faults generate earthquakes.

Instructions from the Interactive

A. Earthquake News

Find out the news about an earthquake.

B. Active Faults

1. Navigate the map of Central Visayas.
2. Observe the damages of the earthquake in different places.
3. Consider the location of the red lines (active faults). Observe the damages on areas located along the faults and compare them with those that are away from the faults.

C. Energy Beneath the Earth Makes the Ground Move

Click any of the blue arrows rapidly to simulate the energy that pushes the rocks together.

D. When Stored Energy is Released

Click the blue arrow some more until the rock breaks.

Guide Questions

A. Earthquake News

1. According to the news, where was the epicenter of the earthquake found?
2. What was the cause of the earthquake?

B. Active Faults

Describe the damages in areas located along the faults and compare it with those that are away from the faults.

C. Energy Beneath the Earth Makes the Ground Move

How is energy stored in rocks?

D. When Stored Energy is Released

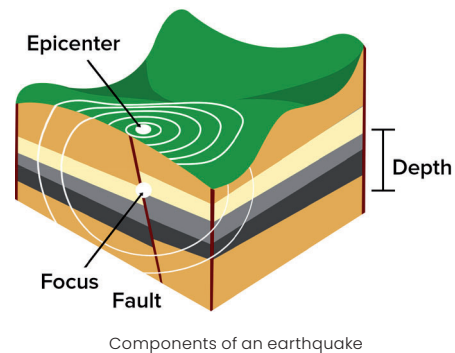
What happens when the stored energy in the rocks is released?



Explore

The sudden movement of the ground when two blocks of the earth move past one another is called an **earthquake**. An earthquake has two main components, the focus and epicenter.

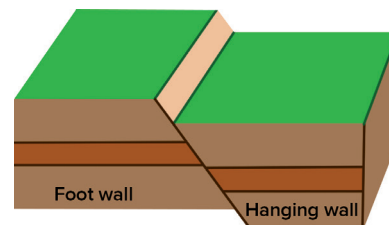
- a. **Focus (hypocenter)** - the point beneath the Earth's surface where the movement originates.
- b. **Epicenter** - the point on the Earth's surface directly above the focus.



Earthquakes happen because of the movement of faults. **Faults** are fractures between two blocks of rocks in the lithosphere that when moving may cause earthquakes. The movement of faults causes the landscape of the Earth to change as we see it today.

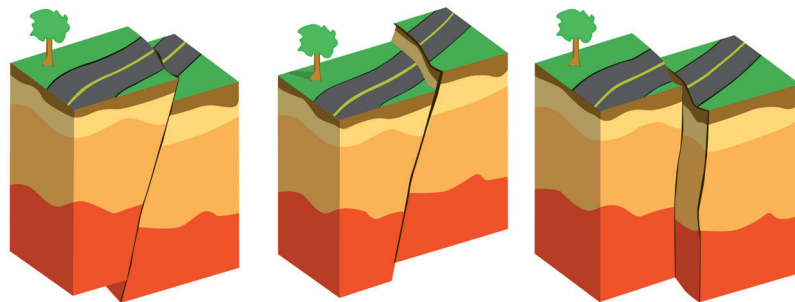
A fault has three components:

- a. **Fault Plane** – it is a plane along where the rupture is.
- b. **Fault Block** – are the rocks separated by the fault plane. The block above the fault line is called the hanging wall while the one below is called the foot wall.
- c. **Fault Line** – is a place above the surface where a fault can be traced.



Faults move relative to the position and direction of the fault blocks. There are three types of faults namely:

- a. **Normal Fault** – this is observed when the block above the fault line moves downward relative to the footwall.
- b. **Reverse Fault** – this is observed when the block above the fault line moves upward relative to the footwall.
- c. **Strike-slip Fault** – this is observed when the rocks are moving horizontally from each other.



Reverse Fault

Normal Fault

Strike-slip Fault



Elaborate

Form a group. Using cardboard boxes and art materials, create models of the three types of faults. Show the direction of movement of fault blocks for each kind of fault using arrows. Present your outputs in class.





Evaluate

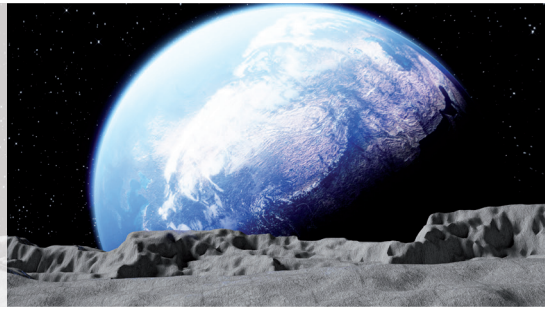
Write the letter of the best answer in the space before the number.

- ____ 1. What primarily causes earthquakes?
- a. Cold temperature
 - b. Sudden movement along fault lines
 - c. Heavy rainfall
 - d. Ocean waves
- ____ 2. What is the focus of an earthquake?
- a. The point on the Earth's surface directly above where the movement starts.
 - b. The center of the Earth where earthquakes happen the most frequent.
 - c. The point beneath the Earth's surface where the movement originates.
 - d. The outermost layer of the Earth where earthquakes are felt.
- ____ 3. What is the epicenter of an earthquake?
- a. The deepest point of an earthquake.
 - b. The point on the Earth's surface directly above the focus.
 - c. The area most damaged by an earthquake.
 - d. The point where seismic waves are strongest.
- ____ 4. Which statements best describes a fault plane?
- a. The surface area damaged by an earthquake.
 - b. A plane along where the rupture occurs in a fault.
 - c. The deepest part of a fault.
 - d. The area where seismic waves are measured.
- ____ 5. When is a normal fault observed?
- a. When the block above the fault line moves upward relative to the footwall.
 - b. When the block above the fault line moves downward relative to the footwall.

- c. When rocks move horizontally away from each other.
 - d. When two blocks of earth move towards each other.
- ____ 6. What characterizes a reverse fault?
 - a. Horizontal movement of the fault blocks
 - b. The block above the fault line moving downward
 - c. The block above the fault line moving upward relative to the footwall
 - d. No visible movement of the fault blocks
- ____ 7. Which statement best describes a fault line?
 - a. The deepest point of a fault
 - b. The point on the surface where a fault can be traced
 - c. The boundary between two tectonic plates
 - d. The line connecting the focus and the epicenter
- ____ 8. What are the two fault blocks separated by the fault plane known as?
 - a. Core and mantle
 - b. Epicenter and focus
 - c. Hanging wall and footwall
 - d. Lithosphere and asthenosphere
- ____ 9. What type of fault movement occurs in a strike-slip fault?
 - a. Vertical movement
 - b. Diagonal movement
 - c. Horizontal movement
 - d. Rotational movement
- ____ 10. Which component of a fault is a place above the surface where a fault can be traced?
 - a. Fault line
 - b. Fault plane
 - c. Fault block
 - d. Epicenter

LESSON 2

Effects of Earthquakes



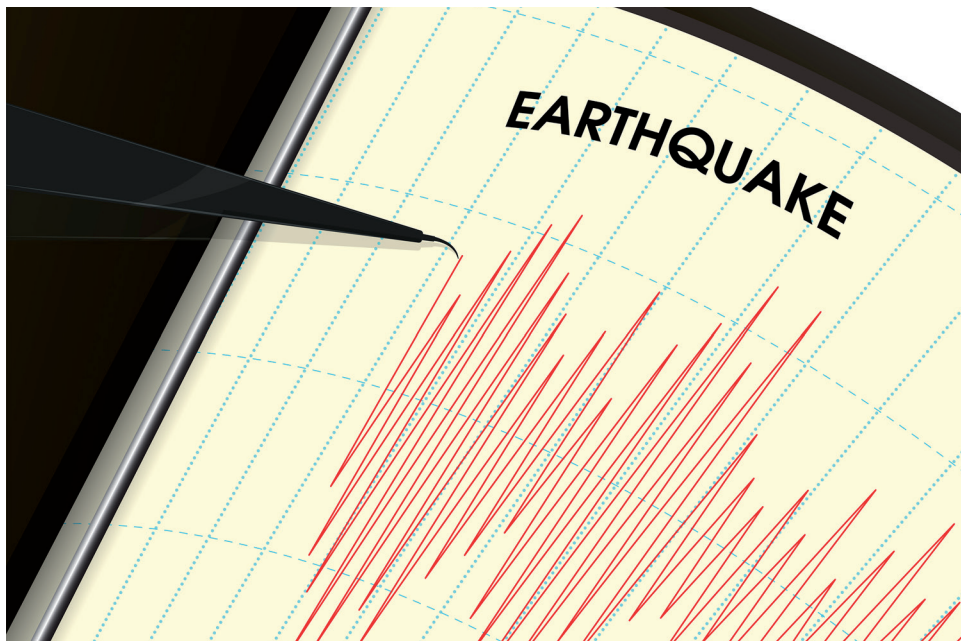
Target

At the end of this lesson, you will be able to:

- ◇ Differentiate magnitude and intensity as scales of earthquake strength and damage respectively.
- ◇ Determine the location of nearest fault systems using the PHIVOLCS Faultfinder.



Engage



How do we describe the strength and effects of an earthquake?



Explore

Access the interactive
to perform the activity.



Intensity of an Earthquake

Objective

- Given an intensity scale number, describe what happens in the surroundings and inside the house during an earthquake.

Instructions from the Interactive

- Observe the different intensity levels of an earthquake by moving the black arrows up or down.
- Record your observation for every intensity number on Table 1.

Data

Table 1. Observations in the Surroundings and Inside the House

Intensity Scale	Observations
I	
II	
III	
IV	
V	
VI	
VII	
VIII	
IX	
X	

Guide Questions

- How destructive can an earthquake be?
- What are some measures a person can do to be safe in the event of an earthquake?



Explain

Earthquakes can have a wide range of effects on a community, and their impact can vary depending on factors such as the magnitude of the seismic waves or the depth of its source. We commonly describe earthquakes using the concepts of intensity or magnitude.

Magnitude quantifies the size or energy output of an earthquake. It is commonly gauged on scales like the Richter Scale or the Moment Magnitude Scale (Mw). On the Richter scale, which ranges from 0 upwards, each whole number jump signifies a seismic wave amplitude that is ten times larger.

Richter Magnitude Scale

Magnitude	Description	What It Feels Like?
Less than 2.0	Micro	Normally only recorded by seismographs. Most people cannot feel them.
2.0 – 2.9	Minor	A few people feel them. No building damages.
3.0 – 3.9	Minor	Some people feel them. Objects inside can be seen shaking.
4.0 – 4.9	Light	Most people feel it. Indoor objects shake or fall to the floor.
5.0 – 5.9	Moderate	Can damage or destroy buildings not designed to withstand earthquakes. Everyone feels it.
6.0 – 6.9	Strong	Wide spread shaking far from epicenter. Damages building.
7.0 – 7.9	Major	Wide spread damage in most areas.
8.0 – 8.9	Great	Wide spread damage in large areas.
9.0 – 9.9	Great	Severe damage to most buildings.
10.0 or over	Massive	Never recorded.

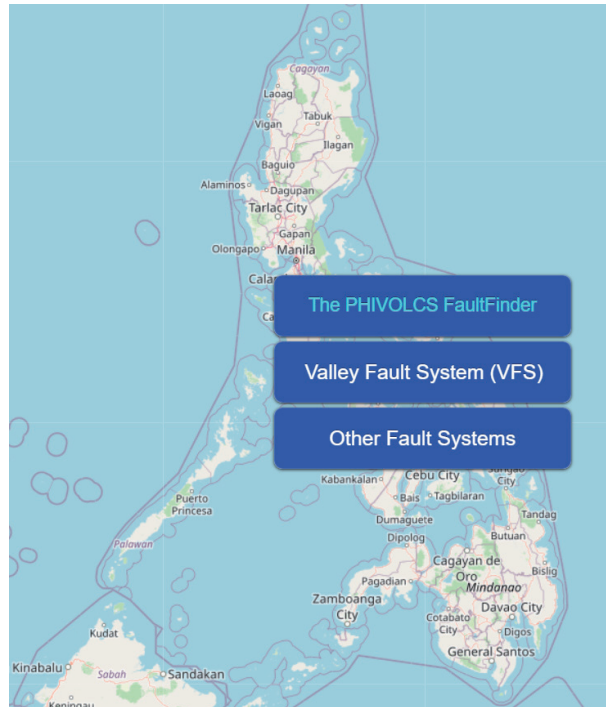
Intensity is a qualitative measure of the effects of an earthquake at a specific location. It describes the degree of shaking and the observed impact on people, buildings, and the natural environment typically described using subjective scales like the Modified Mercalli Intensity (MMI) scale, which uses Roman numerals to categorize the observed effects.

Modified Mercalli Intensity Scale

Intensity	Shaking	Description/Damage
I	not felt	Not felt except by a very few under especially favorable conditions
II	weak	Felt only by a few persons at rest, especially on upper floors of buildings
III	weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake.
IV	light	Felt indoors by many, outdoors by few during the day. At night, some are awakened. Dishes, windows, and doors are disturbed. Walls make cracking sound.
V	moderate	Felt by nearly everyone; many are awakened. Some dishes and windows broken. Unstable objects overturned.
VI	strong	Felt by all; many are frightened. Some heavy furniture moved; a few instances of fallen plaster. Slight damage to buildings.
VII	very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built structures.
VIII	severe	Damage slight in buildings of good design and construction; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures.
IX	violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Building shifted off foundations.
X	extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Earthquakes in the Philippines

The Philippines experiences frequent earthquakes due to its location along the Pacific Ring of Fire, where several tectonic plates interact. The **Philippine Institute of Volcanology and Seismology (PHIVOLCS)**, is a government organization overseeing the country's volcanic and seismic events, aiming to reduce risks from significant earthquakes and volcanic eruptions. They have an app called **PHIVOLCS FaultFinder** that identifies nearby active fault lines. The PHIVOLCS Fault Finder is an initiative of the Philippine Institute of Volcanology and Seismology (PHIVOLCS) to provide information about active fault lines in the Philippines. The application can be accessed at <http://faultfinder.phivolcs.dost.gov.ph/>



The PHIVOLCS Fault Finder webpage



Elaborate

Form a group and access the PHIVOLCS Fault Finder. Choose five provinces in the Philippines. Include provinces in Visayas and Mindanao as well. Identify the fault lines nearest to these provinces. Write your answers on the table below and present your output in class.

Province	Nearest Active Fault Line(s)
<i>Example: Cagayan</i>	<i>Dummon River System Fault Divaacan Fault Casiguran Fault</i>



Evaluate

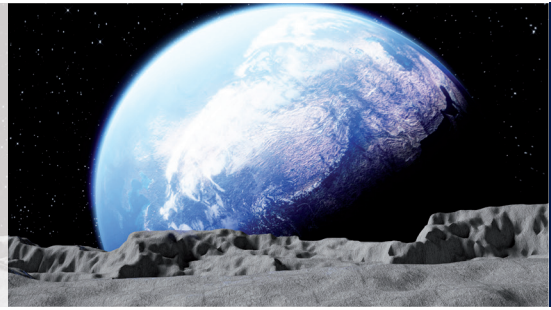
Write the letter of the best answer in the space before the number.

- ____ 1. What scale is commonly used to measure the magnitude of earthquakes?
- a. Epicenter scale
 - b. Mercalli scale
 - c. Richter scale
 - d. Seismic intensity scale
- ____ 2. Which of the following statements about earthquake magnitude is true?
- a. Earthquake magnitude is measured in linear units.
 - b. Earthquake magnitude is the same as seismic intensity.
 - c. Earthquake magnitude is measured in units of distance.
 - d. Earthquake magnitude measures the energy of seismic waves.
- ____ 3. Which of the following refers to a tool or resources related to earthquake fault mapping or monitoring provided by PHIVOLCS?
- a. Maps
 - b. Seismograph
 - c. Fault Finder
 - d. PHIVOLCS.com
- ____ 4. Which of the following factors is NOT typically considered when assessing seismic risk for buildings and infrastructure?
- a. Average wind speeds in the area.
 - b. Building age and structural integrity.
 - c. Proximity to active fault lines.
 - d. Soil and foundation conditions.
- ____ 5. What is the primary difference between magnitude and intensity?
- a. Magnitude measures the energy released, while intensity measures the damage caused.
 - b. Magnitude measures the depth of the earthquake, while intensity measures its duration.
 - c. Magnitude measures the duration of the earthquake, while intensity measures the depth of the seismic waves.
 - d. Magnitude and intensity are essentially the same and can be used interchangeably when describing earthquakes.

- _____ 6. What is the main purpose of identifying fault lines in the Philippines?
- a. Predict weather patterns
 - b. Enhance community safety and preparedness
 - c. Study Philippine geography and history
 - d. Improve the tourism industry
- _____ 7. Where is the Philippine located that contributes to its frequent seismic and volcanic events?
- a. The Pacific Ring of Fire
 - b. The Philippine Trench
 - c. The Himalayan Mountains
 - d. The Mariana Trench
- _____ 8. Which scale is used to measure the intensity of an earthquake?
- a. Richter scale
 - b. Mercalli scale
 - c. Fujiwara scale
 - d. Weighing scale
- _____ 9. How does the depth of an earthquake affect its intensity?
- a. Deeper earthquakes generally have higher intensity.
 - b. Shallower earthquakes generally have higher intensity.
 - c. Depth does not affect intensity.
 - d. Only shallow earthquakes can be felt.
- _____ 10. Why is it important to learn about earthquake magnitude and intensity scales?
- a. To accurately predict when earthquakes will occur
 - b. To understand the energy released and effect of earthquakes
 - c. To prevent earthquakes from happening
 - d. To measure the depth of the earthquake

LESSON 3

Earthquake Preparedness



Target

At the end of this lesson, you will be able to:

- ◇ Demonstrate what to do before, during, and after an earthquake.
- ◇ Prepare an emergency and disaster kit.



Engage



What should we do during an earthquake?



Explore

Access the interactive
to perform the activity.



Earthquake Alert

Objective

- Enumerate the safety measures before, during, and after an earthquake

Instructions from the Interactive

- Perform the indicated actions that will keep one safe before, during, and after an earthquake.
- Each page will be a task to be accomplished to demonstrate safety measures in the event of an earthquake.
- A prompt will indicate if you have successfully accomplished the tasks.
- Record your observations on Table 1.

Data

Table 1. Safety Measures Before, During, and After an Earthquake

	Safety Measures
Before an Earthquake	
During an Earthquake	
After an Earthquake	

Guide Question

Why are these preparations for an earthquake important?



Explain

The Philippines is in the Pacific Ring of Fire where earthquakes are frequent. We should always be prepared for such natural disasters and become knowledgeable of what to do. This will not only save ourselves but also our friends and family.

What to Do Before an Earthquake

1. Identify the earthquake hazards in your area.
2. Tell your family members to check the condition of your home and secure objects that might fall.
3. Familiarize yourself with the exit routes at home, school, and other places that you frequently go to.
4. Know where fire extinguishers, first aid kits, alarms, and communication facilities are located. Learn how to use them beforehand.
5. Prepare a handy emergency supply kit with first aid kit, canned food and can opener, water, clothing, blanket, battery-operated radio, flashlights, and extra batteries.
6. Participate in regular earthquake drills.



Contents of an emergency and disaster preparedness kit.

What to Do During an Earthquake

1. When you are inside a sturdy building or home, stay there and remain calm.
2. Duck under a sturdy desk or table and hold on to it or protect your head with your arms. This is also called duck-cover-hold.

3. Stay away from glass windows, shelves, cabinets, and other heavy objects.
4. If you are outside, move to an open area. Stay away from trees, powerlines, posts, and concrete structures.
5. Move away from steep slopes which may be affected by landslides.
6. If you are near the shore during an earthquake, move quickly to higher grounds if it is safe. A tsunami might occur.
7. If you are in a moving vehicle, ask the driver to stop the vehicle. Do not attempt to cross bridges, overpasses, or flyovers which might be damaged.



Students performing duck, cover, and hold.

What to Do After an Earthquake

1. Be prepared for aftershocks. An **aftershock** is a smaller, less intense earthquake that follows a larger earthquake. This can happen even several days after the earthquake.
2. Once the shaking stops, take the fastest and safest way out of a building.
3. Do not panic even if the surroundings seem heavily damaged. Keep calm and clear your mind.
4. Check yourself for injuries and seek medical help immediately.
5. If you need to evacuate from your residence, leave a message stating where you are going for family members and concerned people to know. Bring your emergency supply kit with you.
6. Be updated on disaster prevention instructions from battery-operated radios or keep extra power for your mobile phones.



Elaborate

Form a group. Prepare an emergency preparedness kit. Start by choosing a durable backpack or bag that is easy to carry. Then, put things inside the bag which you think are essential to surviving after an earthquake for at least three days. Lastly, include a note with emergency contact numbers and any important medical information. Remember that this bag is meant to help you in the immediate aftermath of an emergency, so think about what you would need most during that time. Present your emergency preparedness kit in class and explain why you put the items you have selected.



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. What preparation can you do before an earthquake happens?
- a. Practicing how to run fast
 - b. Preparing an emergency kit
 - c. Ignoring the warnings
 - d. Watching television for updates
- _____ 2. Which action should you do during an earthquake?
- a. Run outside immediately
 - b. Stand in a doorway
 - c. Drop, cover, and hold
 - d. Inform people through social media
- _____ 3. What should be included in an emergency preparedness kit?
- a. Spoon
 - b. Flashlight
 - c. Money
 - d. Notebook
- _____ 4. Which of the following is a safe place during an earthquake?
- a. Under a sturdy table
 - b. In an elevator
 - c. Against a wall
 - d. On top of a tree

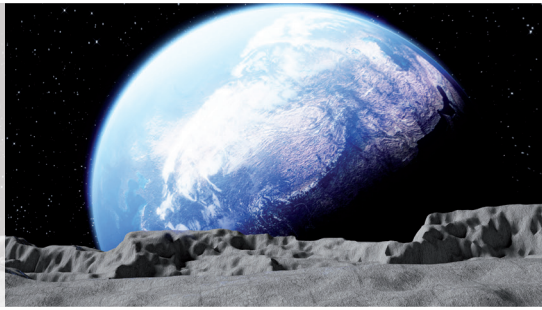
- _____ 5. What is one of the first things you should do after an earthquake?
- a. Check yourself for injuries.
 - b. Call friends to see if their safe.
 - c. Go back inside buildings immediately.
 - d. Post pictures in social media.
- _____ 6. What is the main reason for conducting earthquake drills?
- a. To improve physical fitness
 - b. To prepare students for actual earthquakes
 - c. To pass time during school
 - d. To meet school regulations
- _____ 7. What should you do if you are outside when an earthquake occurs?
- a. Stand under a tree for protection.
 - b. Lie flat on the ground.
 - c. Move away from buildings, trees, and utility wires.
 - d. Immediately enter a building for shelter.
- _____ 8. Why is it important to listen to a battery-operated radio or TV after an earthquake?
- a. To listen to music and relax.
 - b. To get updates on emergency instructions and information.
 - c. To learn about the geological reasons for the earthquake.
 - d. Radios and TVs usually do not work after earthquakes.
- _____ 9. Why is it important to stay out of damaged buildings after an earthquake?
- a. They may have interesting damage to look at.
 - b. They can collapse during aftershocks.
 - c. There is usually free food inside.
 - d. They are usually cooler and provide shade.

____ 10. Which of the following is a good practice for earthquake safety in your home?

- a.** Hanging heavy pictures above beds.
- b.** Securing heavy furniture to the walls.
- c.** Keeping breakable items on open shelves.
- d.** Placing beds next to large windows.

LESSON 4

Tsunami



Target

At the end of this lesson, you will be able to:

- ◇ Explain how tsunamis occur.
- ◇ Describe safety measures to be performed before, during, and after a tsunami.



Engage



How are tsunamis formed?



Explore

Access the interactive
to perform the activity.



Investigating a Tsunami

Objectives

- Describe how a tsunami is generated.

Instructions from the Interactive

1. Explore the tsunami simulation by pressing and holding the blue arrow button to compress the rocks along the fault.
2. Continue to press and hold the blue arrow to simulate the compression of rocks beneath the sea. Observe how the seafloor moves.
3. Meanwhile, observe the number of years counting at the right side of the tsunami simulation.
4. Continue to press and hold the blue arrow until the fault slips and releases a seismic wave.
5. Carefully observe how the water is affected by this.
6. You may repeat this process by clicking the REPLAY button so you can also observe what happens to the height of the wave as it moves towards the shore.

Guide Questions

1. Describe how the seafloor moves.
2. What does the length of holding the blue arrow represent?
3. What does the change in the number of years imply with regards to the process of compression of rocks?
4. What occurred when the fault slipped or when the seismic wave was released?
5. Describe how water is affected when you did Step 4.
6. Describe what happened to the height of the wave as it approached the shore.

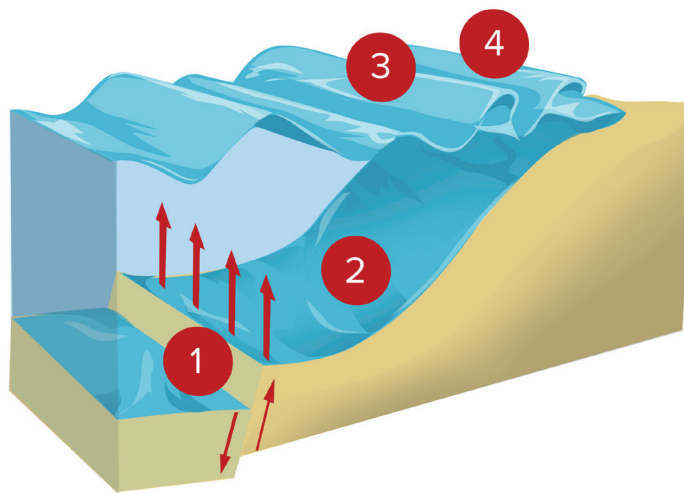


Explain

Tsunami is a Japanese word that means harbor wave. These are waves caused by earthquakes that occurs under the sea. How tall a tsunami is and how fast it approaches depends on the depth of the sea where the earthquake occurred. It usually slows down as it reaches shallow waters but it is destructive once it hits.

How do Tsunamis Form?

As an earthquake happens, the movement of the ground displaces a large amount of water and starts moving in all directions. the water being displaced start to move as a wave.



Stages in the formation of a tsunami

1. When movement along a fault moves the seafloor upward, water is also pushed upward and becomes tsunami waves.
2. An oscillation is set off, which generates series of waves traveling outwards at high speed and low wave height. Sea water is sucked back from the shore.
3. As the waves approach shallower water, the speed decreases and wave height increases.
4. As the waves approach the coastline, they form giant waves which make fast, strong tides that cause the sea level to rise quickly.

According to PHILVOCS, the Philippines is vulnerable to tsunami due to the presence of offshore faults and trenches. It is very important to determine if your area is a tsunami hazard zone. Nevertheless, you should still equip yourselves with knowledge and skills about safety measure before, during, and after a tsunami.



PHILVOCS poster on natural signs of an impending tsunami

Before a Tsunami

1. Always remember that strong earthquakes or a sudden and unusual receding of ocean water, called a drawback, are natural warnings of a possible tsunami.
2. Regularly participate in tsunami evacuation drills if they are conducted in your community.
3. Stay informed and always have a battery-operated weather radio handy. It will also be helpful to keep power banks for mobile devices.

During a Tsunami

1. If you feel an earthquake or see the ocean recede unexpectedly, do not wait for official warnings. Move to higher ground immediately.
2. Head to a higher ground or, if there is no time, to a sturdy building's upper floors.

3. Tune into a radio, watch TV, or check your mobile phone for official news and updates.

After a Tsunami

1. A tsunami is a series of waves, not just one. More waves might follow. Stay away from the shore or low-lying area until officials declare it is safe.
2. Always stay updated with the latest information from local authorities about warnings, road conditions, and the safety of drinking water.
3. Avoid buildings with water around them. They might be unstable due to flooding.
4. If you spot broken gas or power lines, or damaged water mains, report them to the authorities immediately to prevent further hazards.



Elaborate

Look for news articles about recent tsunamis around the world. Read the article and summarize the information it contains including the day and place where the tsunami happened, the effects of the tsunami to the affected communities, and the actions that was taken to help the communities. Share the information you have gathered in class.



Evaluate

Write the letter of the best answer in the space before the number.

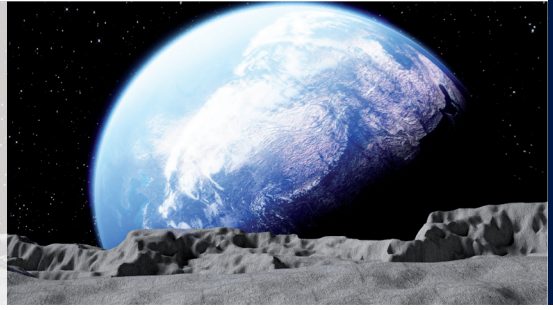
- _____ 1. What is the translation of the Japanese word *tsunami*?
- | | |
|----------------|----------------|
| a. Blue Wave | c. Harbor Wave |
| b. Bottom Wave | d. Tidal Wave |

- _____ 2. What can be a possible indication of an approaching tsunami based on ocean observations?
- a.** A sudden decrease in the size of ocean waves.
 - b.** An increase in the number of seashells on the beach.
 - c.** A noticeable increase in the clarity of coastal waters.
 - d.** An unusual and rapid withdrawal of water from the shoreline.
- _____ 3. What is the recommended action to take before a tsunami is expected to hit a coastal area?
- a.** Go to the beach to monitor the waves closely.
 - b.** Evacuate to higher ground or an inland location.
 - c.** Organize a community gathering to stay together.
 - d.** Stay near the shoreline to assess the situation better.
- _____ 4. What should you do immediately after a safe amount of time has passed after a tsunami hits?
- a.** Return to your home to assess the damage.
 - b.** Go back to the beach to help with rescue efforts.
 - c.** Search inside fallen buildings for possible survivors.
 - d.** Begin rebuilding damaged structures right away.
- _____ 5. Which of the following is NOT TRUE about a tsunami?
- a.** A tsunami's height depends on the ocean depth.
 - b.** The height of the tsunami depends on the wind.
 - c.** Tidal wave is not the same phenomena as tsunami.
 - d.** Tsunamis are caused by underwater earthquakes.
- _____ 6. Which of the following happens when a tsunami reaches shallow water?
- a.** It stops altogether.
 - b.** It slows down a tsunami.
 - c.** It makes the wave higher.
 - d.** It makes the wave faster.

- _____ 7. What do you call the phenomenon when the ocean recedes from land before a tsunami strikes?
- a. Drawback
 - b. Oceanic Floor
 - c. Tidal Wave
 - d. Trench
- _____ 8. Which government agency issues official tsunami alerts in many coastal regions in the Philippines?
- a. DOH
 - b. PAGASA
 - c. PHIVOLCS
 - d. WHO
- _____ 9. What should individuals do when they receive an official tsunami alert?
- a. Continue with their daily activities as usual.
 - b. Gather at the beach to observe the tsunami.
 - c. Immediately evacuate to higher ground.
 - d. Store food and water in a safe container.
- _____ 10. Why does a tsunami start to increase its wave height when it approaches shallow water?
- a. Because it has gathered enough water to become tall
 - b. Because it slows down pushing the waves to greater height
 - c. Because the earthquake origin is strong enough to cause tall waves
 - d. Because the sand and debris in shallow water added up to the waves

LESSON 5

The Atmosphere



Target

At the end of this lesson, you will be able to:

- ◇ Explain how energy from the Sun interacts with the atmosphere.
- ◇ Describe the effects of the Sun's interaction with the atmosphere to climate.



Engage



How does the Earth's atmosphere protect life on the planet?



Explore

Access the interactive
to perform the activity.



Building an Atmosphere

Objectives

1. Determine the composition of the layers of the Earth's atmosphere
2. Identify the objects that can be found in each layer of the atmosphere

Instructions from the Interactive

1. Drag materials from the "Materials Pane" and combine them to create a layer of the atmosphere.
2. After creating the layer, put it in the region relative to the earth's surface.
3. Upon building all the layers, put the objects that can either live in or reach that specific layer of the atmosphere.
4. In Table 1, record the composition of each layer of the atmosphere and the objects that can either live in or reach that layer.

Data

Table 1. Layers of the Atmosphere

Layer of Atmosphere	Composition	Objects that can either live in or reach the specific layer

Guide Questions

1. What are the considerations in determining what composes a layer of the atmosphere?
2. What are the considerations in determining what objects can be found in each layer of the atmosphere?



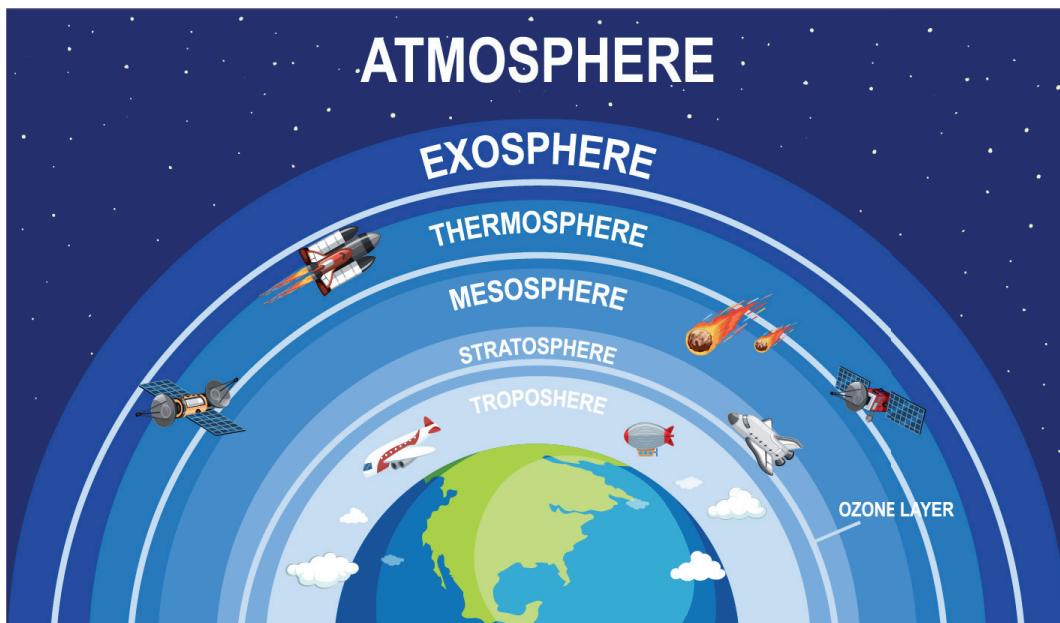
Explain

The **atmosphere** is a layer of gases that surround our planet. Imagine it as a protective blanket that keeps Earth warm, allows us to breathe, and shields us from space's harmful rays. The atmosphere is crucial because it interacts with the Sun to help support life.

When sunlight hits our atmosphere, some of the light is reflected into space. Much of it penetrates the atmosphere and warms our planet. The atmosphere acts like a filter, absorbing and blocking out harmful ultraviolet (UV) rays, thanks to a special layer called the **ozone layer**. Without this protective shield, it would be difficult for life to thrive on Earth.

Layers of the Atmosphere

The atmosphere is not just one blanket that covers our planet. It is composed of different layers with its own properties.



Troposphere

It is the layer closest to Earth's surface. It holds the air we breathe and is where most of the world's weather conditions happen.

Stratosphere

Just above the troposphere, this layer is calm and dry. The all-important ozone layer resides here, catching and absorbing most of the Sun's harmful UV rays.

Mesosphere

This is the layer where meteors or "shooting stars" burn up. It is colder and sits above the stratosphere.

Thermosphere

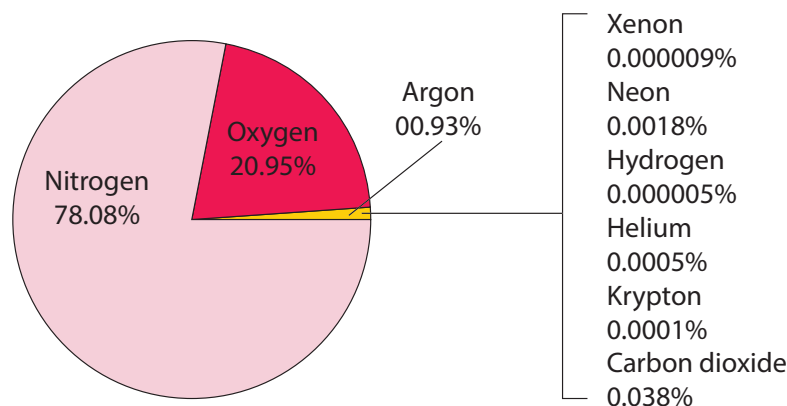
Here, temperatures start to rise again. This layer catches and absorbs the Sun's X-rays and ultraviolet rays, making it hotter. The Northern and Southern lights occur in this layer.

Exosphere

The final layer, stretching out to space. It is the thinnest part of our atmosphere where Earth's gases fade into the vacuum of space.

Composition of the Atmosphere

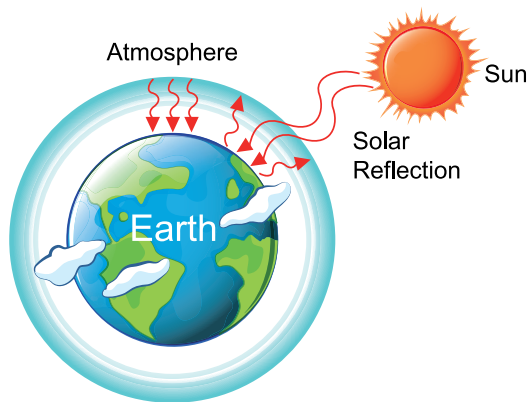
The air we breathe is not made up of just one type of gas. In fact, Earth's atmosphere has a mixture of different gases. The majority, about 78%, is nitrogen, while oxygen, the gas essential for our breathing, comprises about 21%. The remaining 1% consists of various other gases, like argon, carbon dioxide, neon, and helium.



Composition of Earth's Atmosphere

Greenhouse Effect

Within our atmosphere, certain gases have a special role that is crucial for maintaining Earth's temperatures: these are known as **greenhouse gases** like carbon dioxide and methane. When heat enters our atmosphere and warms the Earth, some of this warmth would escape back into space. However, greenhouse gases trap and hold onto some of this escaping heat, much like how a greenhouse keeps plants warm. This is known as the greenhouse effect. This trapped heat ensures our planet remains warm enough to support life.



Greenhouse effect trapping most of the heat within the atmosphere.

Too much greenhouse gases can cause our planet to heat up more than usual, leading to global warming and changes in our climate. This is why understanding and managing our contributions to greenhouse gases is essential for Earth's future.



Elaborate

List at least five actions that you can do to minimize the release of greenhouse gases and address global warming. Present your list in class and explain how each action can help address global warming.

Five Actions to Reduce Greenhouse Gases

1. _____
2. _____
3. _____

4. _____

5. _____



Evaluate

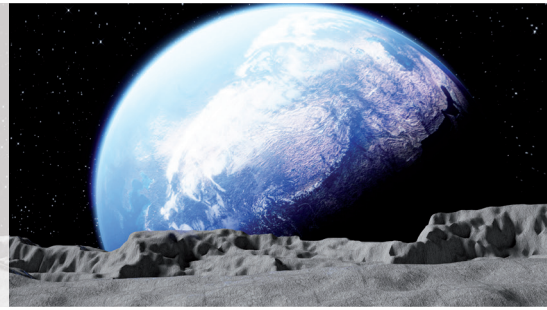
Write the letter of the best answer in the space before the number.

- _____ 1. The Earth's atmosphere is primarily composed of which gas?
- a. Carbon dioxide
 - b. Hydrogen
 - c. Nitrogen
 - d. Oxygen
- _____ 2. Which of the following best describes the greenhouse effect?
- a. A process that cools down the Earth's surface by releasing heat.
 - b. A process that traps some of the Sun's energy, keeping the Earth warm.
 - c. A process that collects gases that is released by different human activities.
 - d. A process that creates a barrier which prevents heat from the Sun to enter Earth.
- _____ 3. Which of the following does NOT happen to the Sun's energy when it reaches the Earth's surface?
- a. It is transformed to light.
 - b. It gets reflected into space.
 - c. It warms up the Earth's surface.
 - d. It gets absorbed by the atmosphere.
- _____ 4. Which gases in the Earth's atmosphere are responsible for the greenhouse effect?
- a. Carbon dioxide and methane
 - b. Hydrogen and helium
 - c. Oxygen and nitrogen
 - d. Water vapor and nitrogen

- ____ 5. What can happen if there is an excess of heat-trapping gases in the atmosphere?
- a. Colder temperatures
 - b. Global warming
 - c. Increased rainfall
 - d. More lightning storms
- ____ 6. Why is it crucial to limit actions that emit heat-trapping gases into the atmosphere?
- a. To create more thunderstorms
 - b. To control global temperature
 - c. To increase the Earth's spin
 - d. To make the planet colder
- ____ 7. Approximately how much of the Earth's atmosphere is made up of oxygen?
- a. 1%
 - b. 5%
 - c. 21%
 - d. 78%
- ____ 8. Which of the following is influenced by both natural processes and human activities?
- a. The distance of Earth from the Sun
 - b. The rotation of the Earth on its axis
 - c. The amount of sunlight the Earth receives
 - d. The balance of gases in the atmosphere
- ____ 9. Which layer of the Earth's atmosphere is closest to the surface and contains most of the Earth's weather phenomena?
- a. Stratosphere
 - b. Troposphere
 - c. Mesosphere
 - d. Thermosphere
- ____ 10. What is the primary function of the ozone layer in the Earth's atmosphere?
- a. To produce oxygen for the planet
 - b. To trap heat and keep the Earth warm
 - c. To absorb harmful ultraviolet radiation from the Sun
 - d. To facilitate radio communication by reflecting radio waves

LESSON 6

The Earth and Its Seasons



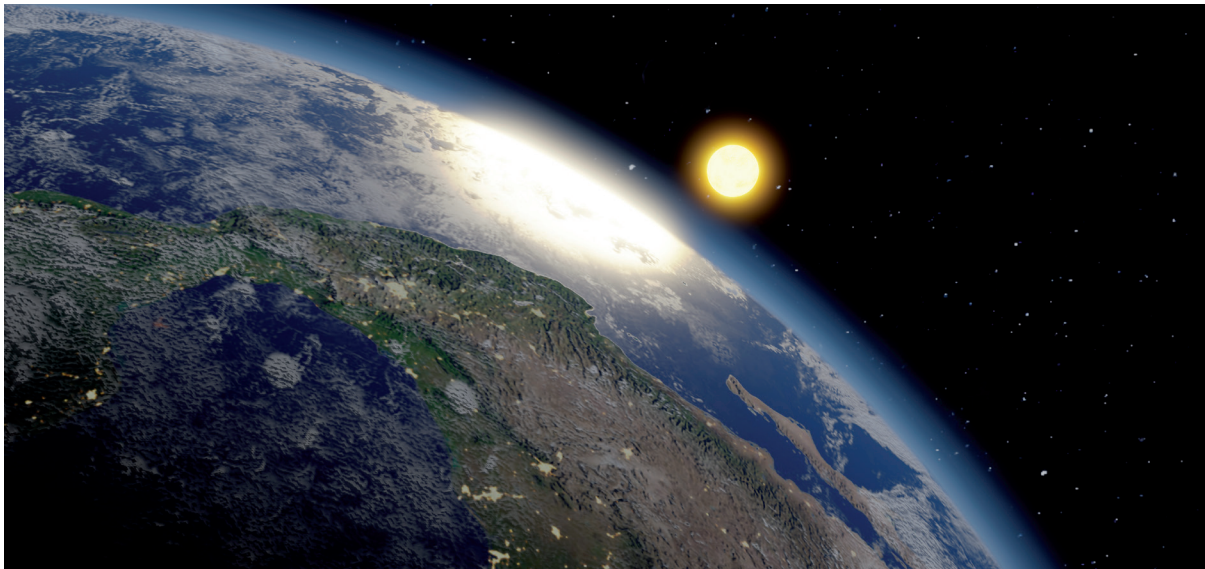
Target

At the end of this lesson, you will be able to:

- ◇ Make a physical model to demonstrate how the tilt of the Earth relative to its orbit around the Sun affects the intensity of sunlight absorbed by different areas of Earth over a year.
- ◇ Describe the different seasons experienced in the Philippines.
- ◇ Explain how the tilt of the Earth affects the changes in the length of daytime at different times of the year.



Engage



How does Earth's position in space affect our lives?



Explore

Access the interactive
to perform the activity.



Seasons in the Philippines

Objective

- Describe the wet and dry seasons in the Philippines.

Instructions from the Interactive

1. Go around the Philippines by moving “Juan” from one point to another.
2. Observe how and when wet and dry seasons occur in different places in the country.
3. Note as well the different effects of these seasons to the community.

Guide Questions

1. When does the country experience wet season? In which part of the country is this significantly felt?
2. When does the country experience dry season? In which part of the country is this significantly felt?
3. How do these seasons impact the population’s agricultural concerns?

Changing Seasons

Objectives

Develop a model that will:

1. Demonstrate the changes in seasons in different parts of the world.
2. Explain the length of daytime and nighttime.

Instructions from the Interactive

1. Manipulate the Earth and the Sun to achieve the following seasons:
 - Winter
 - Summer
 - Spring
 - Fall

2. Determine the amount of heating in the layers specified on the Earth model.
Show a diagram describing the uneven heating of the Earth under Data.

Data



Uneven Heating of the Earth

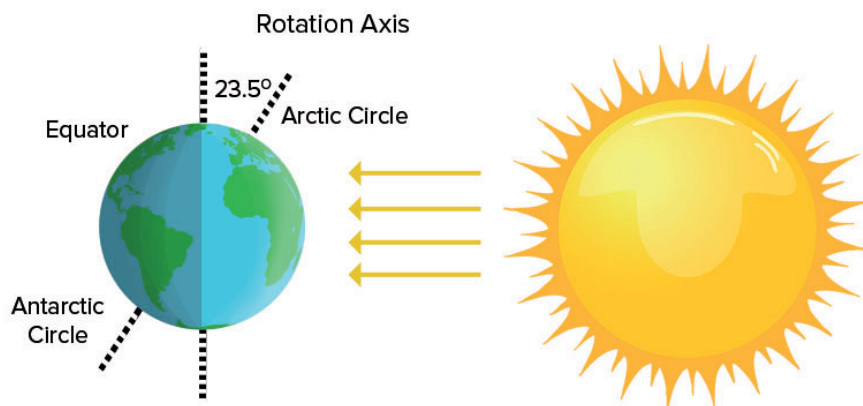
Guide Questions

1. How does uneven heating of the Earth cause different seasons?
2. How does daytime and nighttime occur?



Explain

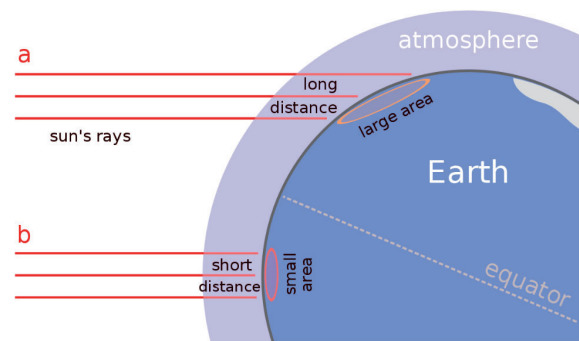
The Earth is tilted approximately 23.5 degrees from its axis, a line perpendicular to its orbital plane. This tilt, combined with our planet's movement around the sun, is responsible for many phenomena we experience, including the changing seasons.



Seasons

As Earth orbits the Sun, different parts of the planet receive varying amounts of sunlight. When the North Pole tilts towards the Sun, it is summer in the Northern Hemisphere. This is because the sunlight received is more intense in this part of the Earth, leading to warmer temperatures. At the same time, the South Pole tilts away from the Sun, causing winter in the Southern Hemisphere. Halfway through the year, the situation reverses: the South Pole tilts towards the Sun, experiencing summer, while the Northern Hemisphere faces away, leading to winter. Spring and autumn (or fall) occur in between these extremes when the tilt of the Earth is such that the amount of daylight is roughly equal for most locations on Earth.

Running horizontally around the middle of our Earth is an imaginary line called the **equator**. It divides our planet into the Northern and Southern Hemispheres. The equator always receives direct sunlight because of its central position, making regions near the equator consistently warm throughout the year. This is why countries close to the equator, like the Philippines, experience tropical climates with minor temperature changes between seasons.



Countries far from the equator receive less light while countries near the equator receive more intense light.

Wet and Dry Seasons in the Philippines

The Philippines experiences two distinct seasons throughout the year due to its geographical location and exposure to different wind patterns. The dry season typically extends from December to May. During this period, the country encounters cool and dry air, resulting in lower humidity levels and clear skies.



Dry season usually lasts from December to May.



Wet season usually lasts from June to November.

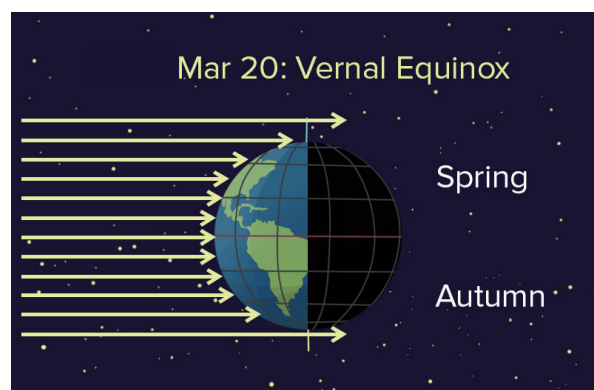
On the other hand, the wet season prevails from June to November. The wet season is characterized by heavy rainfall, posing hazards such as flooding, landslides, and agricultural issues. These two seasons significantly influence the Philippines' climate and impact various aspects of daily life, including agriculture and water resources.

Effect on Length of Daytime and Nighttime

The tilting of Earth does not just affect temperatures; it also impacts how long we see the sun each day. Near the poles, during summer, daylight can last for 24 hours, a phenomenon called the midnight sun. Conversely, during winter, the poles can remain in darkness for extended periods. As we move towards the equator, the differences between day and night's length reduces. At the equator itself, day and night are almost always about 12 hours each, regardless of the season.

Equinox and Solstice

Equinoxes, occurring around March 20th and September 22nd, are when day and night are roughly equal in length worldwide. Solstices, around June 21st and December 21st, mark the longest and shortest days of the year. The summer solstice has the longest day in the Northern Hemisphere, while the winter solstice has the shortest. These events signify Earth's rhythmic journey around the Sun.





Elaborate

Form a group. Prepare the materials listed below. Create a model which demonstrates how the tilt of the Earth relative to its orbit around the Sun affects the intensity of sunlight. The globe or ball will represent the Earth while the lamp or flashlight will represent the Sun. If you are using a ball, mark the equator with a marker or adhesive tape. Demonstrate in class how uneven heating and equinox and solstices look like.

Materials:

Globe or a ball

Marker

Lamp or flashlight

Ruler

Adhesive tape



Evaluate

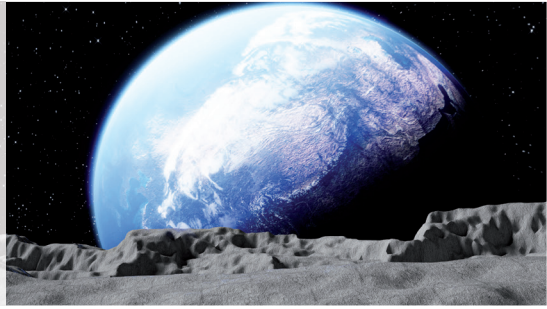
Write the letter of the best answer in the space before the number.

- _____ 1. What causes the different seasons throughout the year?
- a. Earth's tilt on its orbit
 - b. Earth's magnetic field
 - c. Earth's rotation speed
 - d. Earth's distance from the Sun
- _____ 2. Which statement best describes the Earth's axis?
- a. A real line made of metal
 - b. A rope that holds Earth in place
 - c. A giant belt around the planet
 - d. An imaginary line going through Earth
- _____ 3. Which statement is true about the equator?
- a. It is the imaginary vertical line in the middle of Earth.
 - b. It is the imaginary horizontal line in the middle of Earth.
 - c. It is a point in the Earth which experiences the least heat.
 - d. It is a point in the Earth which experiences seasonal change.
- _____ 4. By how many degrees is Earth tilted on its axis?
- | | |
|-----------------|----------------|
| a. 23.5 degrees | c. 90 degrees |
| b. 37.5 degrees | d. 180 degrees |
- _____ 5. What season is experienced in the Northern Hemisphere when the North Pole tilts toward the Sun?
- | | |
|-----------|-----------|
| a. Autumn | c. Summer |
| b. Spring | d. Winter |

- _____ 6. Which scenario would result to summer being experienced in the Southern Hemisphere?
- a.** When the North Pole tilts toward the Sun
 - b.** When the South Pole tilts toward the Sun
 - c.** When the Earth is tilted vertically on its axis.
 - d.** When the Earth is titled horizontally on its axis.
- _____ 7. Why does the equator receive almost the same amount of sunlight all year round?
- a.** Because it has no seasons
 - b.** Because it is closest to the North Pole
 - c.** Because it is made of a special material
 - d.** Because it is always directly under the Sun
- _____ 8. Which event results in roughly equal lengths of day and night worldwide?
- a.** Equinox
 - b.** Midnight sun
 - c.** Solstice
 - d.** Winter
- _____ 9. What season is experienced in the Philippines during the months of December to May?
- a.** Dry season
 - b.** Rainy season
 - c.** Cold season
 - d.** Wet season
- _____ 10. What season is experienced in the Philippines during the months of June to November?
- a.** Dry season
 - b.** Drought season
 - c.** Windy season
 - d.** Wet season

LESSON 7

Weather Systems



Target

At the end of this lesson, you will be able to:

- ◇ Describe different weather systems such as land and sea breezes, monsoons, and the intertropical convergence Zone (ITCZ).
- ◇ Explain how solar energy contributes to the occurrence of different weather systems.



Engage



What weather disturbances do we frequently experience in the Philippines?



Explore

Access the interactive
to perform the activity.



Land Breeze and Sea Breeze

Objective

- Differentiate between land breeze and sea breeze.

Instructions from the Interactive

- Determine wind pressure and wind temperature at ten different points in time.
- Set the timeline of observation. Slide the pointer from one time slot to another to determine the wind pressure and temperature on land and on sea.
- As you observe pressure and temperature, take note of the wind direction, as well.
- Record your observations in Table 1.

Data

Table 1. Observations

Time	Land		Sea		Direction of Wind (Clockwise/ Counter-clockwise)
	Temperature	Pressure	Temperature	Pressure	
AM					
PM					

Guide Question

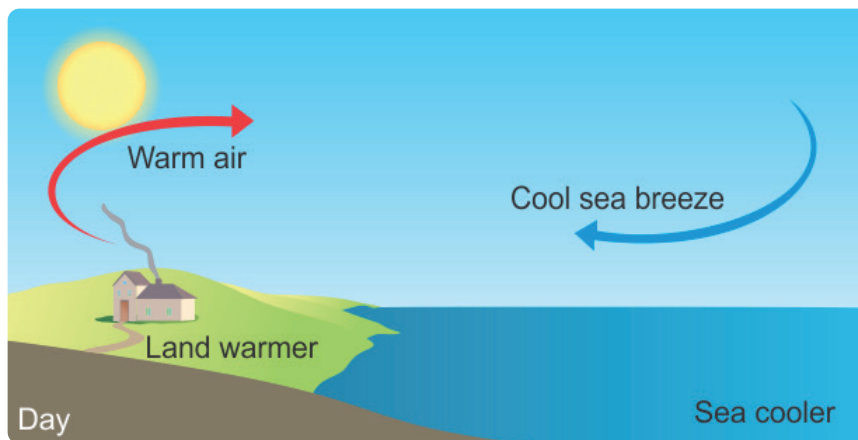
1. What are the conditions for wind to flow from land to sea?
2. What are the conditions for wind to flow from sea to land?



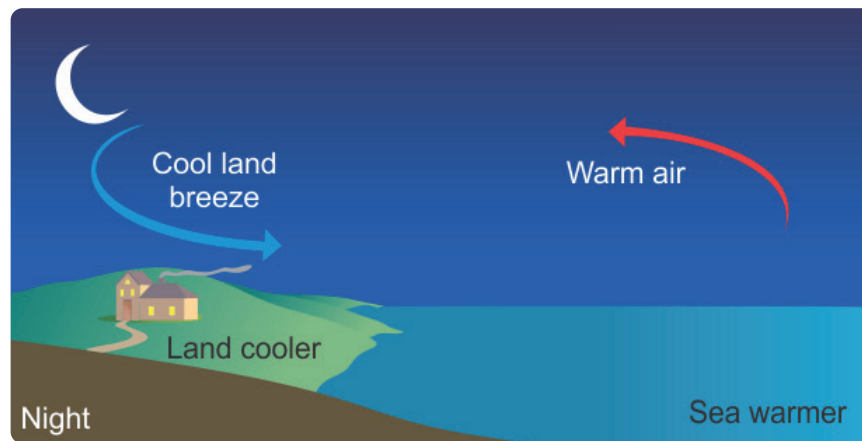
Explain

Land and Sea Breeze

Land and sea breezes, commonly observed in coastal regions, are dynamic wind patterns resulting from the contrasting heat absorption capacities of land and sea. During the sunlit hours, the solid ground heats up more rapidly than the vast expanse of the sea. As the land's surface becomes hot, the air above it warms up, expands, and ascends, leaving behind a low-pressure area. The cooler sea, with its relatively higher pressure, then sends its cooler air towards this low-pressure region, giving rise to the refreshing sea breeze.



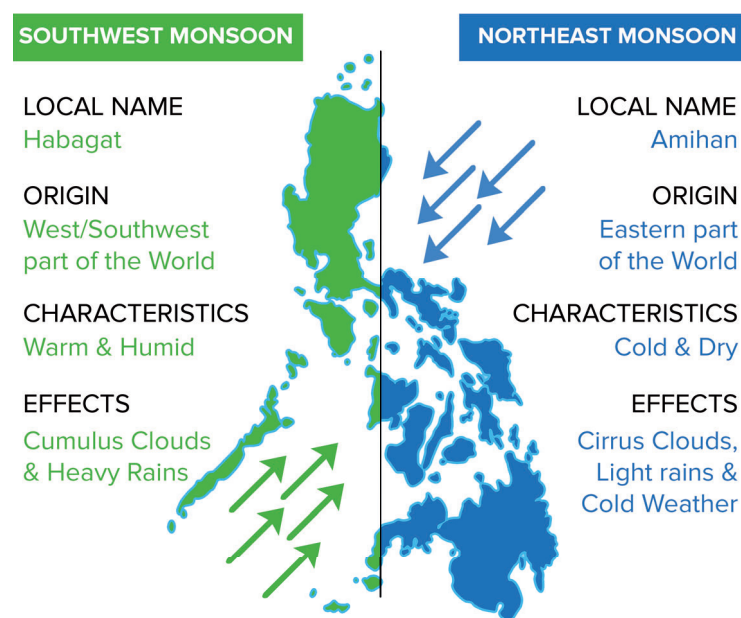
However, the roles reverse once night descends. The land loses its acquired warmth quicker than the sea, causing the air above it to become cooler and denser. This dense air then moves out over the relatively warmer sea, forming the land breeze. This cyclic pattern of breezes plays a significant role in regulating coastal temperatures and provides relief, especially during hot weather.



Amihan and Habagat Monsoon

The Philippines experiences two predominant monsoon winds, named *amihan* and *habagat*. The *amihan* or the northeast monsoon, prevails from October to March which has cooler and drier winds. These winds originate from high-pressure areas in the Asian mainland and travel southwards, bringing in their wake slightly colder temperatures and reduced rainfall.

The southwest monsoon or *habagat* sets in between June and September. Originating from the warm, low-pressure zones over the Pacific Ocean, it brings warm, moisture-laden winds that drench the western parts of the Philippines. These rains are essential for agriculture but can sometimes be too heavy, leading to challenges like flooding.



Intertropical Convergence Zone (ITCZ)

The ITCZ, a belt encircling our planet near the equator, is where the trade winds from the Northern and Southern Hemispheres meet. Trade winds are steady, prevailing winds that blow from the subtropical high-pressure areas towards the equator. As these winds, laden with moisture, converge in this zone, the warm air rises, leading to condensation, cloud formation, and frequent rainfall.

The ITCZ's position moves northward and southward with the changing seasons. Its location and movement heavily influence weather patterns in tropical regions. For countries situated near the equator, such as the Philippines, the shifts in the ITCZ can cause weather disturbances such as heavy rainfall and flooding.



Elaborate

Form a group. Interview adult members of your family preferably your grandparents or someone of old age. With their consent, record the audio or write their answers to the following suggested questions:

1. Did you notice any changes with the start of the northeast monsoon or *amihan*?
2. Is the breeze from *amihan* colder or warmer than when you were younger?
3. Do you feel that it is raining more frequent or less frequent nowadays compared when you were younger?
4. Do you think the typhoons are getting stronger as years pass by?
5. What other changes in weather did you notice?



Prepare a group report summarizing the responses you gathered from your interviewees.



Evaluate

Write the letter of the best answer in the space before the number.

- _____ 1. What causes land and sea breezes?
- a. Changes in ocean salinity
 - b. Solar heating of the ocean
 - c. The movement of ocean currents
 - d. Differences in temperature between land and sea
- _____ 2. When do land breezes typically occur?
- a. During the day
 - b. During the night
 - c. During high tides
 - d. During cold days
- _____ 3. Which of the following best describes the ITCZ?
- a. It is the region where monsoons originate.
 - b. It is a high-pressure belt that brings dry conditions.
 - c. It is a zone where winds from both hemispheres converge.
 - d. It is a consistent wind pattern unaffected by seasonal changes.
- _____ 4. What do we experience when the *habagat* is blowing towards the Philippines?
- a. Cloudier skies
 - b. Colder temperatures
 - c. Frequent rainy weather
 - d. Sunnier skies
- _____ 5. What do we experience when the *amihan* is blowing towards the Philippines?
- a. Colder temperatures
 - b. Shorter nighttime
 - c. Warmer temperatures
 - d. Sunnier skies
- _____ 6. Which wind pattern occurs in the Philippines between June and September?
- a. Amihan
 - b. Habagat
 - c. Land breeze
 - d. Sea breeze

- _____ 7. During which monsoon season does the Philippines experience cooler, drier winds?
- a. Amihan
 - b. Habagat
 - c. Land breeze
 - d. ITCZ
- _____ 8. What is the impact of the movement of the ITCZ northward and southward to our weather?
- a. It causes wind patterns to become steady.
 - b. It reduces the temperature of regions near its location.
 - c. It leads to disturbances like heavy rainfall and flooding.
 - d. It ensures equal day and night lengths in affected regions.
- _____ 9. Which statement best describes the southwest monsoon?
- a. It occurs due to the land cooling rapidly.
 - b. It brings cooler, drier winds from the southwest.
 - c. It is driven by high-pressure zones over the Pacific Ocean.
 - d. It results in warm, moist winds causing heavy rains in the west.
- _____ 10. Why is understanding the Sun's influence on weather patterns important?
- a. To predict volcanic eruptions
 - b. To predict droughts and famine
 - c. To explain the formation of hurricanes
 - d. To predict weather patterns and climate



Extend

Take the role of volunteers who will help survivors of natural disasters to build new homes. You will design and construct a miniature model of an innovative house that can adapt to the diverse weather conditions and earthquakes in the Philippines. Evaluate the effectiveness of your innovative house design by testing it through various conditions such as shaking and strong winds. Prepare a short presentation showcasing your adaptive house model. Explain its features, the tests conducted, and the results. Share your findings with the class, emphasizing the innovative aspects of your design and how they cater to the Philippines' unique environmental challenges.



Rubric for Assessment

Criteria	3 (Excellent)	2 (Satisfactory)	1 (Needs Improvement)
Research & Planning	Demonstrates thorough research on Filipino houses and weather/earthquake conditions. Sketches show clear and innovative ideas.	Some research evident. Sketches show basic ideas.	Minimal research. Sketches lack clarity and innovative elements.
Model Design	Blueprint is detailed with labeled adaptive features, demonstrating understanding of local challenges.	Blueprint has some details with adaptive features labeled and understanding shown.	Blueprint lacks details and labeling. Limited understanding of local challenges.
Weather Adaptability	Model effectively adapts to all simulated weather conditions, showing no leaks, stability issues, or heat problems.	Model adapts to some weather simulations.	Model struggles to adapt to most simulated weather conditions, showing multiple issues.
Earthquake Resilience	Model remains stable during all simulated tremors with minimal to no damage.	Model remains stable.	Model shows significant instability and damage during simulated tremors.
Presentation	Clear, concise presentation showcasing all aspects of the project with understanding and confidence.	Presentation covers most aspects of the project.	Presentation is unclear or rushed, missing significant aspects of the project.