Grade 7
Earth Science

Oak Meadow
Teacher Manual

Oak Meadow, Inc.
Post Office Box 1346
Brattleboro, Vermont 05302-1346
oakmeadow.com

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Lesson

Observation and Measurement

Learning Objectives

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

- Demonstrate good scientific observation skills.
- Record scientific measurements accurately.
- Demonstrate and explain the relationship between mass, volume, weight, and density.

Reading

Read the following sections (found in Reading Selections at the end of this lesson).

- Observation and Change
- Objective Observations and Inferences
- Scientific Argument
- Systems of Measurement
- Mass, Volume, and Density
- States of Matter

Before you begin reading, glance over the length of the reading selections in this week's lesson. You will find quite a bit of reading! You might already be familiar with some of the information, and some of it will probably be new to you. It's a good idea to read one or two sections and then take a break before reading more. That way, you are more likely to remember what you read.

In addition to the reading selections in this coursebook, you are encouraged to learn more about topics you are interested in by visiting the library, reading newspapers and scientific journals, and doing research online. You'll find a list of online resources at

ASSIGNMENT SUMMARY

- ☐ Complete the reading selections.
- ☐ Record detailed observations in an outdoor setting.
- ☐ List helpful observation tools and explain their purpose.
- ☐ Demonstrate how volume can change without altering mass.
- ☐ Explain the relationship between volume, mass, and density.
- ☐ Lab Investigation:
  - Option 1: Water Clock
  - Option 2: Comparing Volume and Mass
- ☐ Optional activities:
  - Activity A: Human Clock
  - Activity B: Calculating Density
- ☐ Complete lesson 1 test.

www.oakmeadow.com/curriculum-links/. You can use these links to learn more about lesson topics.

Your student may benefit from discussing the reading selections with you to help clarify the information. You can ask questions to prompt a discussion or an expanded explanation. Depending on your student, you may want to suggest that the reading be done in sections rather than all at once.

Assignments

Before you begin your assignments, read them through to get a sense of what you'll be doing and how long it will take. This will help you manage your time better. Just like with the reading, you may want to do a few assignments at a time and then take a break instead of pushing to get them all done at once. You have a full week to complete these assignments, so there's no rush.

1. For your first assignment, you'll be conducting an outdoor observation in a natural setting. This might be your yard, a nearby park, woods, a tree in the middle of the sidewalk, a pond, or a stream. Bring a notebook and pencil, and sit quietly for a few minutes while you observe the natural surroundings. Use as many senses as you can. Look carefully for all the details you can notice, and then close your eyes for a bit to tune into other senses.

   Write down a general description of the area in which you are observing, and then write a detailed description of one part of the area or an object within the area you are observing. Be as specific as you can, and use clear, objective language.

   Let the student make initial judgments about how detailed to get with the descriptions. Look for the use of specific language that is objective (anyone observing this detail would agree on its attributes). If the student is using subjective language (language that conveys personal feeling or judgment), point this out and discuss ways in which the observation can be described objectively.

2. List any tools or instruments that would be useful in making a more detailed analysis of your observation and briefly explain why they would be useful. What would you do with them?

   Students might mention any of the following tools and explain how they would be useful: magnifying glass, ruler, watch, thermometer, binoculars, measuring cup, or weight scale. If students have difficultly thinking of tools, you can ask questions to prompt them: How much does that stick weigh? How big is that rock? How quickly did the squirrels race up the tree trunk?

3. Take two pieces of paper of identical size and weight and crumple them into two loose balls of similar size. Demonstrate how you can change the volume of one without changing its mass. Then, tear a piece off one of the papers, and crumple the paper back into a ball so that it matches the size of the second ball. Have you changed its mass or volume?

If possible, conduct your demonstration in front of someone else, and explain what is happening in scientific terms. Alternately, you can video your demonstration and explanation, or you can put your explanation in writing or in audio form. Make sure to define mass and volume as you are describing what happened.

Students might change the volume of the paper ball by making it larger (a looser ball) or smaller (a tighter ball). The volume has changed but the mass has not (the paper still weighs the same as it did when it was flat because no matter has been added or taken away). When a piece of the paper is torn off, the paper's mass has decreased. There is not as much "stuff" there as there was in the beginning. The student's demonstration should include definitions of mass and volume, and a clear explanation of what is happening.

4. Explain why it is always true that if two objects have the same volume but one object has a greater mass than the other, the object with the greater mass will also have a greater density. Give an example that is different than the examples in the reading section. You can do a video or audio recording or write down your explanation and example.

   The object with the greater mass has the greater density because it has more matter in the same amount of space (volume). Density is a measure of how tightly the molecules are packed into a space. If, in the same amount of space, one substance has more mass than another, it will also have greater density. Density is calculated by dividing an object's mass (usually expressed as weight on Earth) by its volume or size. Students should provide an example, such as two balls of equal size, but one made out of yarn and one made out of clay. The clay ball has a greater mass and density, even though the balls are the same volume.

Lab Investigation

Choose one of the following lab investigations to complete.

- Option 1 **Lab Investigation: Water Clock**
- Option 2 **Lab Investigation: Comparing Volume and Mass**

All lab investigations are found in the *Earth Science Lab Manual*. Read through each before making your choice. Assemble all your materials before you begin. Use good scientific habits by taking careful observations and measurements, recording your data in an organized way, and using precise, detailed language.

Lab investigations provide students with an opportunity to develop scientific skills and practice the scientific method. Look for students to follow the procedure with care, take accurate measurements, and record their observations in an organized manner. Summaries and conclusions should include the use of scientific terminology and concepts. See the lab manual for the full description of each lab investigation.

Option 1 Lab Investigation: Water Clock

Water was sometimes used to measure time before clocks and watches were invented. In this investigation, you will make a water timer.

Conclusion

Write a summary of the procedure you followed in this investigation and how successful it was. What worked well? What was difficult? What might you do differently next time in order to make a more accurate or useful water clock?

Look for students to reflect on how well the investigation worked. Ideas for what to change or improve should be specific.

Option 2 Lab Investigation: Comparing Volume and Mass

This investigation explores volume and mass.

Conclusion

1. Answer the following questions:

   a. Look at your drawings of your first two containers. Did the volume of water the container held remain the same when you altered its shape? Did the mass of the clay change? Explain your answer.

   The volume of water the container held probably changed when the shape was altered. The mass of the clay did not change because no clay was taken away or added.

   b. Look at your two one-cup bowls. The containers both hold the the same volume of liquid (they are the same size on the inside, even if they are not the same shape). Do the two empty bowls have the same mass? Explain your answer.

   The bowls do not have the same mass because one ball of clay was larger than the other, so one bowl has a greater mass even though they both hold the same volume of water (they are the same size on the inside).

2. Write a summary of the procedure you followed in this investigation and what the process demonstrated about mass and volume.

   Students should be able to explain the relationship of mass and volume using scientific terminology.

Activities

The following activities are optional, and are offered to give you more ways to explore the lesson material. These activities are not required. Feel free to choose whatever looks interesting to you.

- Option A: Human Clock
- Option B: Calculating Density

The activities in this course are optional. Students are encouraged to choose those that interest them. See the coursebook for the full description of each activity.

Test

Answer the following questions using the knowledge you have gained in this lesson. Use correct terminology and refer to scientific concepts to support your answer whenever possible.

1. Explain the difference between quantitative and qualitative observations and give an example of each.

   Quantitative observations are measurable and include numbers such as weight, time, speed, or height. Qualitative observations are descriptions of attributes such as color, texture, smell, or sound.

2. Explain the relationship between mass, volume, and density. You don't have to give the formulas; just explain things in your own words.

   Mass is the amount of matter in an object, measured as the pull of Earth's gravity on matter. Volume is the amount of space an object takes up. Density is the amount of matter per volume (the amount of substance in the space).

3. What are the three most common states of matter on Earth? Give an example of each, and explain how they are different.

   The three most common states of matter on Earth are solid (such as a table or an eyelash), liquid (such as water or honey), and gas (such as steam or oxygen). Solids have a definite shape and and volume. Liquids have a definite volume, but will assume the shape of the container. Gases will change shape and volume depending on the container.

4. Describe the three steps of a scientific argument.

   The three steps of a scientific argument are 1) make a claim based on research; 2) provide evidence (data) to support the claim; and 3) show your reasoning for how the data support the claim.

5. What is the difference between an observation and an inference?

   An observation is something that is objectively detected or measured. An inference is an explanation about what the data might indicate. Inferences are based on evidence (observations and data) but are not facts; they are logical deductions or conclusions that may explain what happened.

Learning Checklist

This learning checklist can be filled out by either you or the adult who is supervising your work. This checklist will help you keep track of how your skills are progressing and what you need to work on. You or your home teacher can also add notes about where you'd like help.

Here is what the different headings mean:

Developing: You still need to work on this skill.

Consistent: You use this skill correctly most of the time.

Competent: You show mastery of this skill.

Please remember that these skills continue to develop over time so you aren't expected to be able to do all of them yet. The main goal is to be aware of which skills you need to focus on.

SKILLS	Developing	Consistent	Competent	Notes
Describe observations in detail				
Record accurate measurements				
Summarize procedure and what it demonstrated				
Demonstrate and explain the relationship between mass, volume, and density				
Use scientific terminology in explanations				

Lesson

Scientific Method

Learning Objectives

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

- Explain the steps of the scientific method.
- Identify the variables being controlled and the variable being tested in a controlled experiment.
- Differentiate between causation and correlation.

ASSIGNMENT SUMMARY

- ☐ Complete the reading selections.
- ☐ Apply the scientific method.
- ☐ Identify the difference between correlation and causation.
- ☐ Lab Investigation: Celery Experiment
- ☐ Complete lesson 2 test.

Reading

Read the following sections (found in Reading Selections at the end of this lesson).

- Scientific Method
- Variables and Controlled Experiments
- Causation and Correlation

Remember to check the curriculum resource links at www.oakmeadow.com/curriculum-links/ to learn more about lesson topics.

You may want to ask questions about the reading to prompt a discussion and make sure your student understands the material.

Assignments

Scan through the assignments, lab investigation, test, and reading selections before you begin to get a sense of what you'll be doing and how long it will take. It's best to do a few assignments at a time and then take a break instead of trying to get everything done at once.

1. Imagine you are conducting an experiment to answer the question "Can a paper bag hold more weight when it is dry or when it is wet?" Answer the following questions about how you would apply the scientific method to conduct this experiment.

   a. State a hypothesis for this experiment.

A hypothesis might be "A wet paper bag will not be able to hold the same amount of weight as a dry paper bag," or "The wetter a paper bag becomes, the more easily it will break when weight is added." The hypothesis should be clear and testable.

b. Create a list of materials. Be as precise as possible. For instance, what size paper bag would you use? How many would you need for your experiment? What would you use for a weight?

Sample materials list: 10 paper lunch bags, pan of water, bag of apples (to use as weights)

c. Explain the procedure you'd follow for testing your hypothesis. What would you do first? What next? Write down the procedure step-by-step, including how long to soak the bags that you are getting wet, and how many times you will try the experiment (How many wet bags will you test? How many dry bags?). Will you try the experiment with two or more types of wet bags (for instance, bags that have soaked for 5 minutes, bags that have soaked for 15 minutes, and bags that have soaked for 30 minutes)? Remember, every aspect of the experiment needs to be controlled as much as possible so write down your procedure very clearly.

The step-by-step procedure should be very specific and clearly worded. You might want to follow the instructions and do the experiment—this will usually show the student where more clarity is needed.

d. What observations will be recorded? This experiment uses two different groups: dry bags and wet bags. Imagine you are doing the experiment—what will you write down? If possible, create a data table that has labeled rows and columns that show what data will be collected.

Data collected will include type of bag (dry or wet) and how much weight it could hold before breaking (number of apples, for example). If a data table is created, it should show how many trials to do.

e. In this experiment, what are the elements that you controlled? What would be exactly the same each time the experiment is repeated?

The controlled variables are the size, shape, and weight of the bag and the type of weight. These should all be the same. The dry bags should all be equally dry, and each group of wet bags should all be equally wet.

f. If all the elements are exactly the same each time you do the experiment, what is the one thing that is different? What is the variable you are testing?

The isolated variable is the moisture content. That is the one factor that changes, so the difference between the strength of the dry bag and the strength of the wet bag is what is being tested.

2. A cause-and-effect relationship or causality (A always leads to B) is difficult to prove because there are often many factors involved. Answer the following questions about causation and correlation.

   Both of the following examples show correlation, not causation, because even though the two events (A and B) are often found together, one does not cause the other to happen every time.

   a. More ice cream is sold during the summer than during the winter. Does this show correlation or causation? Does A (hot weather) always lead to B (eating ice cream)? Explain your answer.

   b. People who stand in line use their cell phones more often than people who are not standing in line. Does this show correlation or causation? Does A (waiting in line) always lead to B (using a cell phone)? Explain your answer.

3. In the early 1900s, it was noticed that villages with a high number of babies being born also had a high number of storks in the town. Did the presence of more storks cause more babies to be born? Did more babies being born cause more storks to appear? Was there correlation or causation? (Actually, there were more houses in these villages to house all the new families, and storks like to nest near chimneys, so more storks lived there.) Draw a comic, poster, or illustration that uses this example (or another one) to explain the statement "Correlation does not imply causation."

   The student's drawing should be easy to understand, labeled as needed to explain the difference between correlation and causation. Hopefully, students will have fun with this assignment!

Lab Investigation

Complete the following lab investigation using the steps of the scientific method (full instructions are found in the lab manual).

- **Lab Investigation: Celery Experiment**

Use good scientific habits by taking careful observations and measurements, recording your data in an organized way, and using precise, detailed language.

Lab Investigation: Celery Experiment

This investigation tests how quickly water travels through a plant's stem to its leaves (this is called capillary action).

Conclusion

1. Write a summary of your results. What do you observe? How fast did the colored water get absorbed by the celery? Did the rate of absorption (how quickly the colored water was absorbed) increase as time went by?

   The results should be reported with accurate measurements and clear descriptions.

2. Write a conclusion explaining what your experiment demonstrated, and how you might do it differently next time.

   Look for students to articulate that measuring how far the colored water moved up the stem demonstrated the rate at which the plant absorbs water, and to make note of ways in which the experiment might be changed, either to improve its effectiveness, to gather more data (for instance in smaller time increments), or to gather new data (for instance seeing if water with oil in it is absorbed at the same rate as plain water).

Test

Answer the following questions using the knowledge you have gained in this lesson. Use correct terminology and refer to scientific concepts to support your answer whenever possible.

1. List and explain each of the steps in the scientific method.

   The steps of the scientific method are as follows:

   Question: The problem or question is usually the result of an observation a person makes about something they have noticed that they do not know the explanation for.

   Hypothesis: The hypothesis is an educated guess as to the reason or answer for the observed behavior or question.

   Procedure: The procedure describes how the experiment will be conducted step-by-step.

   Results: The observed results form the data collected from performing the experiment.

   Conclusion: A conclusion is the interpretation of what the results indicate, including what may have influenced the results.

2. How is the scientific method similar to the logical thinking one does for the accomplishment of any project or task? Give an example from your own experience.

   Usually a person makes a guess about what will work, and then goes through the steps to test their "hypothesis." Afterward, the person will consider the results and draw conclusions about whether or not the process worked or was effective. Sometimes a hypothesis is tested over and over to be sure of the results. Students are asked to give an example; sample responses might include making adjustments to a hat so it stays on in high winds, experimenting with the sugar to lemon ratio in lemonade, or trying out different building designs when constructing a block tower.

3. What is a controlled experiment? What is being "controlled"? Include an example with your explanation.

   A controlled experiment carefully monitors each factor, keeping all factors the same except one, which is being tested. Testing for one factor at a time eliminates the influence of variables in the results and conclusions. An example might be doing a seed growth experiment in which all seeds are treated the same except for the amount of sunlight they get.

4. In your own words, explain the difference between correlation and causation.

   This is a very tricky concept and many adults confuse the two. Correlation refers to a relationship between two events, which may be incidental, and causation indicates a proven cause-and-effect relationship where one event always leads to another (A always causes B). Many events are correlated even though they do not directly influence one another or have many factors influencing them.

5. How can causation be proved?

   Causation is very difficult to prove, and scientists use methodical, repeated, controlled experiments to try to prove or disprove causality.

Learning Checklist

Your student may be filling out the learning checklist in the coursebook. You can keep your own notes on this checklist, and use the student's checklist to note where the student needs help or where there are discrepancies (for instance, the student might report feeling competent with recording accurate measurements but you notice that this area still needs work).

SKILLS	Developing	Consistent	Competent	Notes
Follow the steps of the scientific method				
Identify variables in a controlled experiment				
Record accurate measurements				
Differentiate between correlation and causation				
Use scientific terminology in explanations				

Lesson

Earth's Movement

Learning Objectives

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

- Describe the three motions of Earth.
- Explain the relationship between the tilt of Earth's axis and the seasons.
- Demonstrate how day and night and the seasons occur on Earth.

Reading

Read the following sections (found in Reading Selections at the end of this lesson).

- Earth's Rotations and Revolutions
- Seasonal Cycles

If you come across a concept that you have trouble grasping, discuss it with an adult or ask questions. Another way to help you understand a concept more clearly is to explain it to someone. Their questions will help you realize which elements you understand and can explain fully and which elements are still murky in your mind.

ASSIGNMENT SUMMARY

- ☐ Complete the reading selections.
- ☐ Explain the difference between an equinox and a solstice.
- ☐ Explain the different between the two equinoxes.
- ☐ Draw a diagram showing Earth's position relative to the sun at different times of the year.
- ☐ Lab Investigation: Earth's Movement
- ☐ Optional activity: Sundial
- ☐ Complete lesson 6 test.

Assignments

1. What is the difference between an equinox and a solstice?

   The equinoxes (spring and autumn) are when the days and nights are of equal length all over the world. The solstices (winter and summer) are when there is the greatest difference between the length of the day and night; these differences are most noticeable the further away from the equator one travels.

2. What is the difference between the vernal equinox and the autumnal equinox?

   Earth is positioned at the same angle in relation to the sun for both equinoxes, and the days and nights are equal length. The difference is only in name: the vernal (spring) equinox is experienced during the transition from winter to summer, and the autumnal equinox is experienced during the transition from summer to winter. When it is the vernal equinox in the Southern Hemisphere, it is the autumnal equinox in the Northern Hemisphere.

3. Draw a diagram that shows Earth's positioning in relation to the sun during the equinoxes and during the summer and winter solstices.

   The diagram should be clearly labeled to show the different positioning of Earth at different times of the year (refer to the diagram in the coursebook).

Lab Investigation

Complete the following (see the lab manual for complete instructions):

- **Lab Investigation: Earth's Movement**

If possible, perform your demonstration in front of an audience (or videotape it) and explain what is happening. (You might want to practice this first.) You can answer the questions on video or in writing. Remember to use correct terminology and precise language.

Lab Investigation: Earth's Movement

In this investigation, you will model how Earth's tilt, spin, and orbit combine to create our daily and yearly cycles.

Conclusions

Answer the following questions using scientific terminology and complete sentences.

1. If the two points on the globe's surface where the knitting needle passes through represent the North Pole and the South Pole, what does the entire knitting needle represent?

   The knitting needle represents Earth's axis, an imaginary line around which Earth rotates.

2. What does the tilting of the knitting needle represent?

   This represents the fixed tilt of Earth on its axis, which does not vary as Earth revolves around the sun.

3. When spinning your model, what does this spinning movement represent?

   It represents Earth's rotation on its axis.

4. Why does the sun appear to rise in the east and set in the west?

   The sun appears to rise in the east because of the direction in which Earth spins on its axis.

5. When you spin your model to show day and night, how many hours does one rotation represent?

   24 hours

6. Explain how your model demonstrates the difference between the summer solstice and the winter solstice.

   Students should give a clear explanation of the position of Earth in relation to the sun at each solstice, and differentiate between the Northern and Southern Hemispheres. At the summer solstice in the Northern Hemisphere, the North Pole is at its closest point to the sun; this coincides with the winter solstice in the Southern Hemisphere, when the South Pole is at its furthest point from the sun.

Activities

The following activity is optional.

Activity: Sundial

See the coursebook for a full description of this optional activity.

Test

1. Explain why we have day and night.

   Day and night are the result of Earth rotating on its axis, toward and away from the sun.

2. How long does it take Earth to make one rotation on its axis? How long to make one revolution around the sun?

   It takes 24 hours for one Earth rotation, and one year for Earth to complete one revolution in its orbit around the sun.

3. If it is the summer solstice in the Northern Hemisphere, is it also the summer solstice in the Southern Hemisphere? Explain your answer.

   No, it can't be the summer solstice in both hemispheres at once. When it is the summer solstice in the Northern Hemisphere, it is the winter solstice in the Southern Hemisphere. This is because the summer solstice happens when one pole is at its closest point to the sun, at which point the opposite pole will be at its furthest from the sun.

4. Describe the three ways that Earth moves through space.

   Earth rotates on its axis, orbits around the sun, and moves through the galaxy along with the sun and the rest of the solar system.

5. Explain the relationship of the tilt of Earth's axis and the seasons. What would happen if Earth's axis were perpendicular and not tilted?

   This question may present a challenge for students because it is not explained in the text, so students will have to make this connection on their own. If Earth was not tilted toward or away from the sun at any point in its orbit, it would be as though every day was an equinox. All days and nights would be identical in length, and there would not be the extreme variations of winter and summer, with their longer and shorter days and nights.

6. When it is March 21st, is it the vernal equinox or the autumnal equinox? Explain your answer.

   This question also asks students to apply their knowledge as it is a tricky question. The answer is that it depends on where you are. March 21st is the vernal (spring) equinox in the Northern Hemisphere, and the autumnal equinox in the Southern Hemisphere.

Learning Checklist

Use this learning checklist to keep track of how your skills are progressing. Include notes about what you need to work on.

SKILLS	Developing	Consistent	Competent	Notes
Differentiate between Earth's rotations and revolutions				
Model how Earth's tilt and orbit create seasonal cycles				
Model how Earth's rotation creates sunrise and sunset				
Demonstrate how the seasons differ in the Northern and Southern Hemisphere				

Lesson 7

Earth's Moon

Learning Objectives

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

- Describe the movement of the moon in space.
- Diagram the phases of the moon.
- Model a lunar and solar eclipse.
- Explain the relationship between the gravitational pull of the moon and Earth's tides.

Reading

Read the following sections (found in Reading Selections at the end of this lesson).

- Earth's Moon
- Moon's Rotations and Revolutions
- Solar and Lunar Eclipses
- How the Moon Influences Tides

Remember to use library books, newspapers, scientific journals, and online research to learn more about any topic that interests you, or to help you better understand topics that you find confusing. Bookmark the curriculum resource links page on oakmeadow.com for easy access to good resources.

ASSIGNMENT SUMMARY

- ☐ Complete the reading selections.
- ☐ Record changes in the moon over one week.
- ☐ Draw a diagram of the moon's phases.
- ☐ Model a solar and lunar eclipse.
- ☐ Explain how the moon influences Earth's tides.
- ☐ Lab Investigation: Moon Moves
- ☐ Optional activities:
  - Activity A: Moon Story
  - Activity B: Moonscape
- ☐ Complete lesson 7 test.

Assignments

1. Find out what time the moon rises and sets this week. Try to see the moon every night and make note of its changes. Notice if you can also see it in the daylight hours. Do you see it in the eastern sky (as it is rising) or in the western sky (as it is setting)? When you view the moon at day or night, visualize where the moon, Earth, and sun are in order for you to see the moon in its current phase. (This might be easier after you have done the lab investigation in this lesson.) Write a brief description of your moon sightings for one week. Note any changes you noticed in its appearance and when it rises and sets.

   Look for clear descriptions of the moon observations. Students should note that the moon rises and sets later each day.

2. Draw a diagram of the moon's phases, showing the moon's position relative to Earth during its orbit. Make sure to include the location of the sun in your diagram as well. Label each phase of the moon and show the corresponding areas of waxing and waning.

   The diagram should be labeled and easy to understand, and convey the information seen in the diagram in the coursebook.

3. Explain how a lunar eclipse and a solar eclipse occur. Use objects or people to model what is happening during each type of eclipse. You can video your explanation and modeling, or you can write a description.

   A lunar eclipse occurs when Earth is directly in between the moon and the sun. A solar eclipse occurs when the moon is directly in between Earth and the sun. A lunar eclipse happens during the full moon (and is seen at night) and a solar eclipse happens during the new moon (and is seen during the day). The student should demonstrate and explain these phenomena.

4. Make a poster or write a paragraph that explains why we have high tides and low tides and why they happen twice a day. Include information about neap and spring tides.

   The explanation should mention that the moon's gravitational pull on Earth results in the movement of the oceans. As our planet makes one full 24-hour rotation, high tides are experienced by areas that are aligned with the moon, and low tides are experienced by the two "sides" of Earth (the areas at a right angle to the moon). Spring tides occur during every full and new moon, when the moon and sun line up with Earth and we experience the highest high tides and lowest low tides. Neap tides occur during every first and third quarter moon, when there is the least variation between high and low tides.

Lab Investigation

Complete the following (all labs are found in the lab manual):

- **Lab Investigation: Moon Moves**

If possible, perform your demonstration in front of an audience (or videotape it) while explaining what is happening. You can answer the questions on video or in writing. Remember to use correct terminology and precise language.

Lab Investigation: Moon Moves

Using modeling, you'll explore the motion of the moon.

Conclusions

1. When simulating the moon revolving around Earth, how long does one complete revolution represent in real time?

   The moon completes one full orbital revolution every 27.3 days. It also completes one full rotation on its axis every 27.3 days.

2. How would the moon look from Earth if the moon did not rotate on its axis? What would we see that is different than what we see now?

   If the moon did not rotate, we would still see all the phases of the moon as it revolved around Earth, but we would also see all sides of the moon rather than just one "face" of the moon.

3. Write a summary of this experience. Did it help you better understand the movement of the moon in relation to Earth and the sun? What areas are still hard to understand?

   Note any areas students are still confused about, and go over the reading, conduct additional research, or do more modeling to help clarify things.

Activities

Choose one of the following optional activities to explore more aspects of the moon.

- Activity A: Moon Story
- Activity B: Moonscape

Test

1. Why does the moon shine?

   Moonlight is a reflection of the sun's light.

2. Why do we only see one side of the moon?

   We only see one "face" of the moon because the moon rotates on its axis at the same speed at which it revolves around Earth.

3. Explain the difference between the far side of the moon and the dark side of the moon. When does the dark side of the moon face Earth?

   The far side of the moon is the side that never faces Earth. The dark side of the moon is the side that is facing away from the sun (nighttime on the moon). The dark side of the moon faces Earth during every new moon.

4. How long is one lunar day (the amount of time it takes for the moon to complete one rotation on its axis)?

   27.3 Earth days

5. How long does it take for the moon to make one revolution around Earth?

   27.3 Earth days

6. Explain the difference between a solar eclipse and a lunar eclipse.

   Both eclipses happen when the moon and sun are in alignment with Earth. A lunar eclipse occurs when Earth is directly in between the moon and the sun, and a solar eclipse occurs when the moon is directly in between Earth and the sun.

7. Why does a lunar eclipse only happen during the full moon and a solar eclipse only happen during a new moon?

   A lunar eclipse only happens during the full moon because the moon has to be directly facing the sun in order for Earth to come between the moon and the sun and have its shadow block out the sunlight. A solar eclipse only happens during the new moon because the moon has to be in between Earth and the sun, which means Earth is directly facing the dark side of the moon (the new moon).

8. How does the moon influence Earth's tides?

   The moon's gravity acts on Earth's oceans by pulling them toward the moon. The areas that are aligned with the moon (both facing the moon and facing away from the moon) experience high tides, while the areas that are sideways to the moon at a 90° angle experience low tides.

9. Why are the tides higher during a full moon and a new moon?

   During the full and new moons, the sun and moon are in alignment, so the sun's gravity is added to the influence of the moon's gravity, resulting in more dramatic variations in the tides.

Learning Checklist

Use this learning checklist to keep track of how your skills are progressing. Include notes about what you need to work on.

SKILLS	Developing	Consistent	Competent	Notes
Record changes in the moon's appearance				
Diagram moon's position relative to Earth during its orbit				
Model moon's position relative to Earth during its orbit				
Model the difference between a solar and lunar eclipse				
Explain the moon's influence on Earth's tides				