Grade 7
Earth Science

Oak Meadow
Lab Manual

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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.

Materials

- an empty plastic milk container (or any other clear container that you can puncture)
- large pan or bucket
- metric ruler
- marker
- clock or watch
- sewing needle or push pin

Procedure

1. Fill the plastic container with water. Mark the container at the top of the water line. This is your "fill" line.
2. Position it so one corner hangs over the edge of a counter or table. Place the large pan or bucket beneath the container.
3. Use the sewing needle or push pin to poke a very small hole near the bottom of the container. Start timing the water flow as soon as you make the hole. Make sure the pan beneath it is in the right spot to catch the water!
4. As the water flows, mark the container showing the water level at regular time intervals. This is called calibration. You are determining the amount of water that flows in a certain amount of time. Depending on the size of the drip and amount of water you are using, your water marks might be made every 15 seconds, every 30 seconds, or every minute.
5. When all the water has run out of the container, note how much time it took for all the water to drain out. Write this down, and mark your container to show how much time each interval measures. For instance, if it took seven minutes for the water to drain out, and you made a mark for each minute, the top "fill" line would be marked 0, the first minute mark below is

marked "1 minute," the next minute mark is labeled "2 minutes," etc., down to the bottom line, which is labeled "7 minutes."

6. Refill the container (you can use the water in the pan or bucket). Hold your finger over the hole at the bottom of the container while you are filling it to keep water from spilling out. Place it on the edge of the counter over the bucket and let go of the hole.
7. Do a household activity, such as make your bed, put away the dishes, or go collect the mail. When you finish, come back and look at the water container. How long did the activity take according to your water clock?
8. Bonus challenge: Create a water alarm clock! Can you set up a system so your water clock will make noise when a certain amount of water has fallen into your pan?

Conclusions

1. Write a summary of the procedure you followed in this investigation and how successful it was.

2. What worked well? What was difficult?

3. What might you do differently next time in order to make a more accurate or useful water clock?

4. Based on your lab investigation, do you think a water clock can be an accurate way to measure time? Why or why not?

Lab Investigation: Comparing Volume and Mass

This investigation explores volume and mass.

Materials

- modeling clay
- metric ruler or tape measure
- towel (to catch drips)

Procedure I: Comparing Volume

1. Construct a small round bowl from the modeling clay.
2. On the data table below, draw a simple picture of your bowl, and measure the height, diameter, and circumference of the *inside* of the bowl. This will be tricky, especially if your bowl is small, but do the best you can and write down accurate measurements next to your drawing. Make sure to note what unit you are using for your measurements (centimeters, inches, etc.).
3. Place the bowl on the towel. Fill the bowl with water up to the very brim (do this while the clay is still wet), and then carefully pour the water into a measuring cup to measure the volume of water the bowl holds. Do your best not to spill water, but don't worry if you spill a little. Write down the volume of water the bowl holds next to your drawing of the bowl.
4. Change the shape of the container. You can make it into a larger or smaller bowl, or into a taller or flatter bowl—change it however you like, but keep it hollow so it can hold water, and don't add or subtract any clay.
5. Draw a simple picture of your new container, and include the measurements of the inside of the bowl (not the outside). Write down the measurements next to the drawing of the new bowl.
6. Fill the new container with water up to the brim, and then carefully pour the water into a measuring cup to measure the volume. Write this down next to your second drawing.
7. Create a third shape, again without adding or subtracting clay, and repeat the process.

Data Table: Volume of Water in Bowls of Different Shapes

	SKETCH OF BOWL SHAPE	MEASUREMENTS OF INSIDE OF BOWL	VOLUME OF WATER BOWL WILL HOLD
Bowl 1			
Bowl 2			
Bowl 3			

Procedure II: Comparing Mass

1. Shape the clay into a solid ball and then divide it into two sections, one larger than the other. (You can weigh them if you'd like to be sure they are different.)
2. Shape both pieces into bowls that will hold one cup of water each. This will take some time to get it right. Keep reshaping and measuring the volume each holds until you have them equal.
3. Pour out the water once you have finished shaping the bowls to have equal volume.

Conclusions

1. Look at your drawings of the first three containers you made for procedure I. Did the volume of water the container held remain the same when you altered its shape? Did the mass of the clay change when you altered its shape? Explain your answer.

2. Look at the two one-cup bowls you made for procedure II. The containers both hold 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.

3. Explain what these two procedures demonstrated about mass and volume.

4. Can you think of another way to demonstrate mass or volume? If you were teaching someone about the concepts of mass and volume, how might you modify these procedures to make them more effective?

Scientific Inquiry: Observation and Measurement

To help you learn to think like a scientist, you'll conduct a scientific inquiry into any topic you'd like, and relate it to the unit's theme: Scientific Habits. There is a scientific inquiry related to each unit. This is a substantial project that is designed to take approximately two weeks.

Here's how it works: Think about something you are interested in. This can be something new or something you've been interested in or curious about for a long time. Next, look for ways to connect your interest with the topic of the unit by incorporating methods of observation and measurement. That means your project will involve observing and measuring something.

You can create a project of your own choice based on *your* interests. Perhaps you love bicycling. You might design a project that measures the number of pedal rotations it takes to travel a certain distance in different gears or using bikes of different sizes. Or maybe you love gymnastics, and you want to find out about the different materials and densities of gymnastic mats and flooring. Or you might like spending time in nature, and you want to observe trees, flowers, or insects, and record changes or activities over the course of a week. Maybe you enjoy drawing and want to learn more about methods of scientific drawing. (There are some project ideas below if you need help deciding what to do.)

Whatever topic or question you choose to explore, you'll share what you have learned by creating an original project of some kind. It doesn't have to be a big project—in fact, don't try to do too much. Keeping your project timeline in mind and discussing your ideas with others before you begin will help keep your project realistic.

Here are the different steps of your scientific inquiry (these are more fully explained below):

- ☐ **Question:** Identify a question or pose a hypothesis.
- ☐ **Research:** Investigate your topic by gathering data.
- ☐ **Design:** Plan your project and what you'll end up with when it is finished. Just remember to keep it small and realistic! What can you accomplish well in two weeks?
- ☐ **Discuss:** Discuss your project idea with others and refine your design.
- ☐ **Create:** Create a form that lets you share your findings with others.

- ☐ **Share:** You might share your project at home with friends and family, in the community, or share it online.
- ☐ **Reflect:** Assess your project design and reflect on the learning experience.

Scientists often work in groups, so you might consider working with one or more partners on your project. Feel free to collaborate with others on any phase of your project.

Project Design and Implementation

The following procedure will lead you through your project step-by-step. Of course, you are free to go in another direction and create your own project steps, if you have other ideas. These steps are provided to help you break down the project into stages to help you manage your time and make steady progress. Two weeks is a good timeline to aim for, but you may choose to do a longer, more complex project.

If you have questions or need help for any of these stages, ask an adult to guide you. **Read through all the steps before you begin** so you have an idea of the scope of the project from beginning to end.

Question: Identify a question or pose a hypothesis that is measurable or observable. For instance, you might ask, "Do scientists still draw things by hand?" or "What is the heaviest thing on earth per cubic centimeter?" When looking for a topic to explore, consider what intrigues you. What questions do you wonder about? Then find a way to observe or measure it.

Write down your question here. You might want to brainstorm lots of questions, and then choose one to explore.

What will you measure or observe to help you answer this question? Be as specific as possible.

What materials will you need? How much time will you need to collect your data?

How will you collect your data? This can be observations and measurements, but might also include collecting data from reputable sources.

If you need to create a data table to compile and organize your measurements or observations, make sure to do that before you begin.

Research: Before you begin gathering data through measurements and/or observations, investigate your topic, if necessary, to gain an overview or background knowledge that can help you. For instance, you might read articles, watch videos, and view the research of others before you begin your own data collection. Take notes while you are gathering information, and keep track of your sources (you'll need to include them with your project).

List your research sources, if any.

Write down notes about data collection. For instance, will you do multiple trials? Will data be collected at different times of the day?

Design: Plan your project and what you'll end up with when it is finished. Just remember to keep it small and realistic! What can you accomplish well in two weeks? You might create a video that shows what you observed or measured, or you might make a graph of the data.

Write down your ideas for how to share the data you have collected. What form will the project take? What will you produce from your measurements and observations?

Discuss: Discuss your project idea with others, both adults and peers, and refine your design based on idea feedback. Plan each step of your project—this will help you keep it realistic and stay on track to complete it in two weeks. Ask for help if you need it.

Notes on feedback from others:

Plan how to carry out your project. What will you do first? What will happen next? Write down the steps you'll follow to bring the project to completion. You will probably add additional steps along the way as you get going, too. The more detailed you can be in the project planning stages, the more smoothly your project will unfold.

Create: Collect your data and compile your findings into a form that lets you communicate what you've learned and share it with others. Check off each step as it is completed. Depending on your project, you may add additional steps during this phase of the project.

- ☐ Assemble materials.
- ☐ Draw a data table to record results.
- ☐ Make observations and measurements.
- ☐ Compile data into a visual or written form or presentation that is ready to share.

Share: Your project should be designed to share with others in some form. You might share your project at home with friends and family, or post it online to share it. You might do a YouTube video or do a presentation for your homeschooling group. If you've created a model or piece of art, you might see if you can display it in your local library, community center, or park.

Who will you share your project with?

Where and how will you share your work?

Will you need to coordinate with others in order to share the work? Does anything need to be done in advance to prepare for sharing the work? For instance, if work is shared in a public space, you may need to make arrangements in advance.

Reflect: Assess your project design and reflect on the learning experience. A project reflection is found below.

Project Ideas

Your observation and measurement project can be an experiment, a model, a citizen science activity, a survey, or a modification or adaptation of a tool or other item. Your end product might be a written description, a photo essay, a poster or collage, an informational graphic (diagram, map, graph, etc.), or a simple presentation. It's up to you!

Below you will find some project suggestions but you are strongly encouraged to come up with a project of your own design, either based on these ideas or on other topics that you find intriguing. This is the chance for you to ask questions of your own, seek answers, experiment with possibilities, and then share your knowledge in some way. If you have any questions, or need help with your project design, ask for help.

If you choose a project below, feel free to customize it in any way you'd like. Your project should have relevance and meaning for you.

Project Idea 1: Field Observations

Explore different methods of scientific drawing and conduct at least two observations "in the field" by observing something in the natural world. Record your observations, using a combination of carefully drawn and labeled illustrations and factual details. Create a mini-field notebook.

Project Idea 2: Matter Matters

Find out about the smallest particles of matter known to scientists at this time. What are they? How much is known? Or find out what natural element has the greatest density and which has the least density. Create a chart or graphic explaining what you find out.

Project Reflection

After you have completed your project, complete this self-assessment. Consider each question carefully. Take the time to reflect on the experience before answering.

Thinking back on the process of creating your project, what worked out better than expected?

What didn't work out as planned?

Were you able to find enough helpful, reliable resources? Did you use a variety of resources?

Once you began creating your project, did your plans change? If so, how and why?

Did you have enough time to complete your project to your satisfaction? If not, what do you feel you could have done better or differently if you had more time?

Would you like to try planning and implementing a longer project next time?

What might you do differently if you were to do this project again?

What advice would you give other students who undertake a project like this?

Fill in the blanks for the following statements.

The most interesting aspect about this project was

The most difficult part for me was

I'd like to improve my skills in the following areas:

I'm happy with the way I

Lab Investigation: Earth's Movement

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

Materials

- orange
- knitting needle or sharpened pencil
- push pin or thumb tack
- light source (preferably one that is multi-directional, like a bare lightbulb)

Procedure

1. Your orange will be used as your Earth model. Identify the North and South Poles of your model, and then push the knitting needle through the orange so that it passes through each of these poles, piercing the center of the orange. This represents the Earth's axis.
2. Place a push pin (or make a mark) on your Earth model to represent your location.
3. Hold the top of the knitting needle so that it is pointing straight up, and then tilt it a little to one side.
4. Place the lamp on a table. This represents the sun.
5. Hold your model so that the pin representing your location faces the lamp.
6. Slowly turn the knitting needle in your hands so that your "Earth" spins toward the east.
7. Move your model to show where the Earth is in relation to the sun at sunrise, noon, sunset, and midnight. Make sure you are spinning your model so the sun appears to rise in the east and set in the west.
8. Now move your model in a large elliptical orbit around the lamp. Be very careful to keep the tilt of the model on its axis constant throughout each revolution around the "sun." (You can also spin Earth on its axis to represent its rotation, if you want to make it even more realistic.)

9. Watch how your location (the pin) changes throughout the orbit. Stop as you go around the sun in the location of the two equinoxes and two solstices.

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?

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

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

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

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

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

Lab Investigation: Moon Moves

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

Materials

- objects or people to represent the sun, moon, and Earth
- lamp with the shade removed

Procedure

1. Represent the sun, Earth, and moon with a friend or using objects. The sun (the lamp) will remain stationary. You will be the moon.
2. Demonstrate how the moon revolves around Earth with the same side always facing Earth. Notice that when one complete revolution is finished, the moon will also have completed one complete rotation on its axis. (Remember that the moon takes the same amount of time to rotate on its axis as it does to orbit once around Earth.)
3. Next, demonstrate the position of the sun, Earth, and moon when the moon is full. Demonstrate the position when the moon is new, and when the moon is in the first and third quarter.
4. Have the moon orbit Earth again and stop in the position where there would be a lunar eclipse.
5. Complete another lunar orbit and show the position of Earth, sun, and moon during a solar eclipse.
6. Demonstrate what would happen if the moon revolved around Earth but did not rotate on its axis.

Conclusions

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

2. How long does one complete rotation of the moon on its axis take?

3. 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?

4. 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?