Our Sun, The Original Clock

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Rationale

Student engagement and interest is imperative to learning. Students are more likely to retain learned information if it is presented in a way that is enjoyable for them. Providing experimentation and tactile practice for children is more likely to result in memorable and enjoyable learning. A topic, such as space, is vast and can therefore be challenging for students to comprehend in a way that is relatable to their lives. Providing students with first hand experiences to experiment with space exploration will result in lessons that they will remember.

This particular lesson therefore reinforces my personal teaching philosophy. It is a lesson that provides students with a topic that is engaging and tactile. It allows them to explore the greater world, relates to history and also gives them opportunities to prove their predictions. Space is a grand topic and through relating it to their lives through the simple action of telling time, they will be able to make the connection between the sun and their lives.

While researching for this project information was gathered from NASA (2005), including the template utilized in the activity. It is important to use a template that has accurate measurements. Specificity and accuracy are important in the pursuit of scientific knowledge. It is therefore critical to introduce students to these tools in their intended form and discuss the importance.

Grade and Strand

Grade: 6	**Strand:** Understanding Earth and Space Systems
Curriculum Area: Science	**Unit:** Bodies in the Solar System

Ontario Ministry of Education Specific Expectations

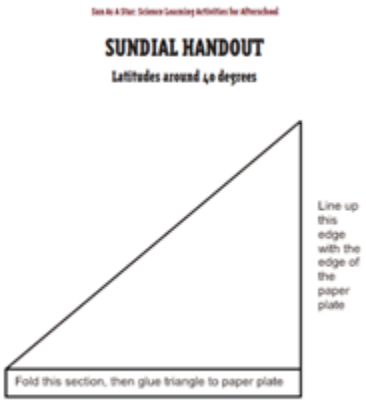
Overall Expectation 2. investigate characteristics of the systems of which the earth is a part and the relationship between the earth, the sun, and the moon;

Specific Expectation 2.1 follow established safety procedures for handling tools and materials and observing the sun

Specific Expectation 2.2 use technological problem-solving skills (see page 16) to design, build, and test devices (e.g., a sundial, a model of the earth's rotation around the sun) for investigating the motions of different bodies in the solar system

Materials

- Paper plates
- Printed triangle template suited to the approximate latitude of the school location (NASA & the American Museum of Natural History, 2005). At this stage students do not need to have latitude explained to them.
- Scissors
- Glue appropriate for paper
- Sturdy tape capable of attaching paper products to pavement
- Pencils
- Graph paper for recording



Safety Considerations

Students must be aware of how to safely handle tools to make sundials, specifically the scissors that will be used to cut out the triangles needed to construct the sundial.

Students must be advised of the risks and dangers around viewing the sun. You must never look directly at the sun because it can damage your eyes and vision. Therefore, students must be reminded to observe the shadows cast by the sun and never the sun directly.

Procedure

Note - This experiment requires a few days of sunny and clear weather.

The lesson begins with a group discussion to engage students and capture their interest. It will also connect to their prior knowledge and experiences.

The teacher will begin this by introducing some historical facts about how humanity has tracked time. We did not have access to smart phones and electronic wrist watchers until recent history. Have students make predictions on how old clock technology is to engage their curiosity and

interest. After this discussion, the teacher can reveal that mechanical clocks were invented in the 14th century (over 700 years ago). With this established, the teacher can ask the students how they presume humanity told the time of day prior to the invention of clockwork and battery powered timepieces. After this stage in the discussion the teacher will show an image of a sundial and ask the students to make observations and inferences about the image. Can they identify its purpose? How might it work? What inferences can they make about its relationship to the sun?

After the group discussion the teacher will address the following questions:

- Can we create a sundial (using the materials provided) that can tell us general times like - when to get up? When to eat lunch? When to go home from school? When to go to bed?
- How do shadows change over the course of the day?
- How can we use the sun and shadows to indicate what time of day it is?

Task Instructions

Step 1. Students will be formed into groups of three. Students will use the provided objects detailed in the ***materials*** section above.

Step 2. Students will go outside to a part of the school yard that is well lit and take note of the shadows on the ground. They will then select a spot on the yard where they will set up their experiment. This spot needs to be away from a high-traffic or play area. The teacher will take note of these locations and mark them with chalk.

Step 3. The students will use their plate and paper triangle to plan out how to build a sundial that will tell the time. They can use what they have noticed in the environment and the small instructions on the triangle (cut here, fold here, glue here) to assist them in building.

Step 4. Students will construct their sundials together. They will go through the phases of planning, building, testing, re-evaluating, and re-designing, etc. until they are satisfied with their design.

Step 5. Students will place their sundial down and record the position. Students will secure their sundial to the ground with tape.

Step 6. Using the pencil, the students will revisit their selected spot throughout the day and note on their paper plate the location of the shadow cast by their sundial. They will mark the shadow with the time they observed it at.

Step 7. Students will revisit their sundial over the next few days to take note of any visible patterns. They will make connections and analyze their results. Students can also compare with

their friends to see if others are receiving similar results. Students will record on the graph paper what they notice and conclude.

Step 8. Students will share their findings and conclude how they could indicate the times of day based on the shadows cast by their sundials.

Step 9. The teacher will guide a lesson on the earth's relation to the sun, using a ball and flashlight to demonstrate how the rays of the sun touch the earth as it spins on its axis. Students will make connections to their sundial and this demonstration.

After the experiment concludes the class will take part in multiple discussions to unpack what they have learned throughout the process. They will share their results with their peers and answer the questions established earlier. The conclusion of the lesson will be that the sun is the original clock that humanity has used for thousands of years. The bodies in space move with consistency that has aided human knowledge of time across cultures and time.

5E Instructional Model Process

This exercise is an example of a *guided inquiry*. A guided inquiry is a task where the teacher guides the students through an exploration of a science topic. Teachers provide support and answer questions but allow the students to explore the topic on their own with some instruction.

The teacher will guide the students through an exercise to observe and explain how the sun's light reaches the earth. Students will then design and conduct their own test. Finally, the teacher will guide the students through a lesson and explanation to connect their tests to the content.

Initiating and Planning - Engage

Predicting - Students will make predictions on how people might have told time without battery powered watches and clocks. They will predict what tools may have been used in the past and would still be effective in the present day. After observing their shadows students will predict how their observations might aid them in creating their sundial.

Observing & Searching - Students will observe the shadows on the ground prior to building their sundial. They will also search for a proper spot to place their sundial that is safe and has less foot traffic. Also students will want to find a location where it will get a lot of sun throughout the day.

Inferring - Students will make inferences based on previous experiences of how shadows change over the course of a day. Students have likely observed their shadows on the ground when they arrive at school, play at recess, or go home for the day. They might have noticed how long they

are in the early morning and evening. These inferences will help guide them in building and placing their sundial.

Performing and Recording - Explore

Using instruments - Students will be provided with paper plates, a piece of paper with a triangle on it, pencils, a marker, glue, and tape. The triangle on the piece of paper will have some instructions on it that students can choose to acknowledge and follow or ignore. These materials are instruments that students will use to measure shadows.

Gathering data - Students will gather data on the direction of their sundial's shadow. This will be the size of the shadow cast and the direction of the shadow on their paper plate. Does the shadow continue to line up with the times they put on the plate on the first day? Students will gather this data over multiple days.

Recording - Students will record the shadow meeting these spots on the paper plate over the course of a week. They will look for consistencies and discrepancies with the direction the sundial's shadow is pointing in. Students will have to formulate ways to record this information so that they can easily recall it on future dates and use it in discussions with their peers. Therefore, they must learn how to properly record information for the purpose of recall.

Analysing and Interpreting - Explain & Evaluate

Comparing- Students will compare their results to their peers. Did their peers have similar results and changes in their sundial? If a group picked a spot that ended up having less consistent sun, did that change their results? What conclusions can that lead us to when we compare to our peers?

Analyzing - Students will analyze their results. They will use their results to determine how they know the four points of the day that they were requested to find. What might the changes of the shadow direction mean? How can these relate to the sun overhead? Students may not have ever considered their relation to the sun in such depth. By analyzing the information they will make connections between the shadows, time of day and possibly the position of the sun.

Evaluating - Students will evaluate their designs and placements and conclude what could be improved and what worked. Students may conclude that their design needed more work, or that it could be improved in a way that would allow for better data collection.

Communicating - Elaborate & Evaluate

Discussing - The teacher will invite discussion and have the students volunteer to give their findings and conclusions based on their experimentation. What have they discovered about the sun's light and how it creates shadows? Were they accurately able to tell time for the 4 points of the day?

Explaining - Using a flashlight and a ball the teacher can demonstrate how the sun's rays reach the earth throughout the course of the day. Because the earth spins on its axis there are times when the sun is shining directly on a spot, times it is shining indirectly and times that it is not reaching a spot at all as it is facing away from the sun. Depending on the location of where we are on the earth as it spins, the sun's light reaches us differently and causes shadows to form differently. Therefore we were able to use our sundials to tell time.

Reporting - Students will be allowed to show their results and conclude how they could answer the original question of "If (the teacher) removed all the watches and clocks from this class, how would (the class) be able to tell - when to get up? When to eat lunch? When to go home from school? When to go to bed?" Students would need to use words to describe how the shadows differed on their sundial during those times.

References

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