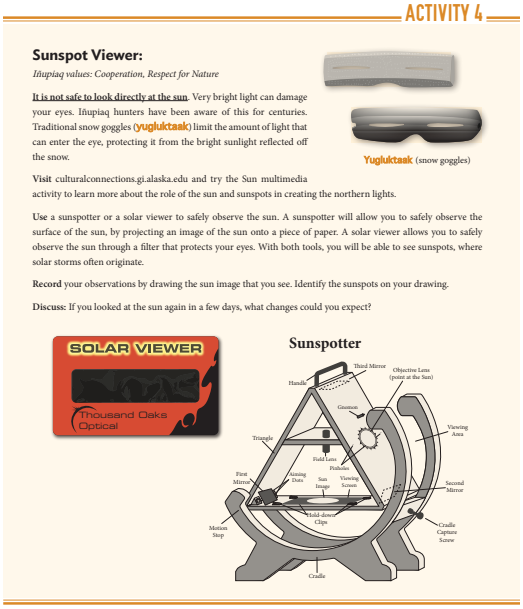
Activity 4: Sunspot Viewer


ACTIVITY 4

Sunspot Viewer:

Iñupiaq values: Cooperation, Respect for Nature

It is not safe to look directly at the sun. Very bright light can damage your eyes. Iñupiaq hunters have been aware of this for centuries. Traditional snow goggles (**yugluktaak**) limit the amount of light that can enter the eye, protecting it from the bright sunlight reflected off the snow.

Yugluktaak (snow goggles)

Visit culturalconnections.gi.alaska.edu and try the Sun multimedia activity to learn more about the role of the sun and sunspots in creating the northern lights.

Use a sunspotter or a solar viewer to safely observe the sun. A sunspotter will allow you to safely observe the surface of the sun, by projecting an image of the sun onto a piece of paper. A solar viewer allows you to safely observe the sun through a filter that protects your eyes. With both tools, you will be able to see sunspots, where solar storms often originate.

Record your observations by drawing the sun image that you see. Identify the sunspots on your drawing.

Discuss: If you looked at the sun again in a few days, what changes could you expect?

Sunspotter

Time: 2-4 class periods (1 class period = 45 min)

Materials:

- Computers or tablets with Internet access
- Sun multimedia activity—available online at culturalconnections.gi.alaska.edu or on the Cultural Connections USB flash drive provided with the activity kit
- Sunspot Viewer Worksheet
- White graph paper
- Rulers
- Build a Sunspot Viewer Instruction Sheet
- Sunspotter (Check this out from your district)
- Solar Viewing Slides
- OR: Materials to build your own sunspot viewers:
    - Binoculars or telescope
    - Cardboard or posterboard
    - Tripod or other stable surface
    - Wall or screen
    - Paper
    - Tape

Standards Addressed:

- NGSS: MS-ESS1: Earth's Place in the Universe: MS-ESS1-3, DCI: ESS2.A: Earth's Materials and Systems
- Alaska Cultural Standards: B.1
- Iñupiat Learning Framework: [B]E.e.1.5
- Iñupiaq Cultural Values: Respect for Nature
- Alaska Science Content Standards: A.1, D.3
- Alaska Reading Standards for Literacy in Science and Technical Subjects: Grades 6-8 Students: Standard 3.

Background Information:

WARNING: It is not safe to look directly at the sun unless using protective Solar Viewing Slides. Very bright light can permanently damage your eyes. Look through the Solar Viewing Slides provided in this kit or use instruments such as telescopes, binoculars and scopes to project an image of the sun onto a piece of paper. **DO NOT LOOK THROUGH THE INSTRUMENT AT THE SUN.**

Sunspots are temporary disturbances in the sun's magnetic field. They appear as dark spots on the surface of the sun and often are the source of solar storms that send charged particles hurtling into space. The spots appear dark because they are cooler than the rest of the sun's surface. Sunspots usually last about one week, and the number of sunspots varies, following a cycle that averages 11.1 years.

Sunspots are the most visible advertisement of the solar magnetic field. Sunspots usually exist in pairs and behave like the opposite ends of a horseshoe-shaped magnet. They contain a concentration of magnetic field lines, which can fill up with solar particles and erupt like volcanoes to send charged particles into space.

When these particles travel toward Earth, they increase the chances of northern lights occurring over Earth. The ancient Chinese first recorded observations of sunspots 2000 years ago. Tracking sunspots is one way to observe solar rotation.

Check out your school district's sunspot viewer for this activity, or make your own sunspot viewer(s). This activity can be done as a whole class, in small groups or as individuals. Combining data from multiple instruments can help build a more thorough and accurate scientific study.

Assessments:

Sunspot Viewer worksheet responses will provide a means of assessing student ability to:

- analyze and interpret data to determine scale properties of objects in the solar system;
- explain the connections between sunspots and the northern lights;
- follow precisely a multistep procedure when taking measurements and performing a technical task;
- read and write Iñupiaq words related to the northern lights;
- understand and use the processes of science to investigate a question;
- understand the cyclical changes controlled by energy from the sun and by Earth's position and motion in our solar system.

Activity Preparation:

1. Determine if you will check out your district's Sunspotter, gather materials listed above to build your own sunspot viewer, construct pinhole sunspot viewers using directions on the National Geographic website, OR rely on the Solar Viewing Slides provided in your kit for this activity.

2. Identify an indoor or outdoor space that will have a clear view of the sun during the time of day that you wish to do this activity.

3. If needed, practice setting up the Sunspotter or building and using the sunspot viewer as shown on the Sunspot Viewer Worksheet. If the projection is not clear, try creating a darkened space, such as a draped table or unlit room.

Activity Instructions:

1. Ask students to partner-read or group-read pages 2-7 of the Kiuġuyat^{NS} / Kiuġiyaq^{NP} Middle School Guide. Discuss the content and check for comprehension.

2. Ask students to visit culturalconnections.gi.alaska.edu (or use the USB flash drive provided with this kit) and try the sun multimedia activity to learn more about the role of the sun and sunspots in creating northern lights.

3. As a class, discuss what students have learned using the multimedia. Create a list of things students know about the sun on the whiteboard or chalkboard. Practice using the Iñupiaq term for sun:

   siqiñiq^{NS} / mazaq^{NP} (sun)

4. If your class will be setting up a sunspot viewer, distribute the Build a Sunspot Viewer handout and assist students as they set up the Sunspotter, or build their own sunspot viewer(s). Refer to the handout for set up instructions.

5. Distribute the Sunspot Viewer worksheet and the Solar Viewing Slides. Go outside or to the designated viewing area. If using a sunspot viewer, select a student to carefully trace the circumference of the sun's shape on the viewing screen with a pencil and then carefully fill in any dark areas inside of the circle with the pencil. These are sunspots! Post this tracing in an area of the classroom where everyone can observe and sketch it.

6. Ask students to carefully observe the sun through their Solar Viewing Slide and sketch their observations on their worksheet. Provide guidance as needed. Discuss the locations of the sunspots and the role sunspots play in creating the aurora.

7. Return to the classroom. Ask students to look at the NASA images of the sun on their worksheet. Explain that these images were taken three days apart. Discuss: What is different about the images? Why?

8. Ask students to complete their worksheets. Consider working as a class to measure the sun image and the largest sunspot. Discuss student findings.

Connections and Extensions:

- Cultural Connections! Very bright light can damage your eyes. Iñupiaq hunters have been aware of this for centuries. They developed snow goggles to limit the amount of light that can enter the eye, protecting it from the bright sunlight reflected off of the snow. Create snow goggles using black construction paper, cardboard, leather or other materials. How do the ideas and concepts related to developing snow goggles relate to those used in the sunspot viewer?

- Do it Yourself! Have students work in small groups to make and use their own sunspot viewers. National Geographic has published plans online for building a pinhole sunspot viewer using a box, paper and aluminum foil. Observe the sun on more than one day to see the sun rotate!

- Write About It! Have students write their observations and inferences about why sunspots move the way they do.

- *Challenge* Math Extension! Find the actual diameter of the sun using the scale model as follows.
    - Using one of your sun projections, find the center of the circle by folding the circle twice, making sure the outer edges of the circle line up. Place a dot in the exact center before unfolding.
    - Use a ruler to measure the distance from the center of the circle to one side of the circle in centimeters. This is the radius. Diameter = radius x 2.
    - Use a ruler to measure the distance from the pinhole to the paper in centimeters.
    - Divide the diameter of your sun image by the distance from the pinhole to the paper. Convert this number to kilometers, then multiply it by the distance from Earth to the Sun, approximately 149,600,000 kilometers. This will give you the diameter of the sun.

Build a Sunspot Viewer

WARNING! Do not look directly at the sun. The sun's rays can damage your eyes. Look through a solar viewing slide or use instruments to project an image of the sun onto a piece of paper.

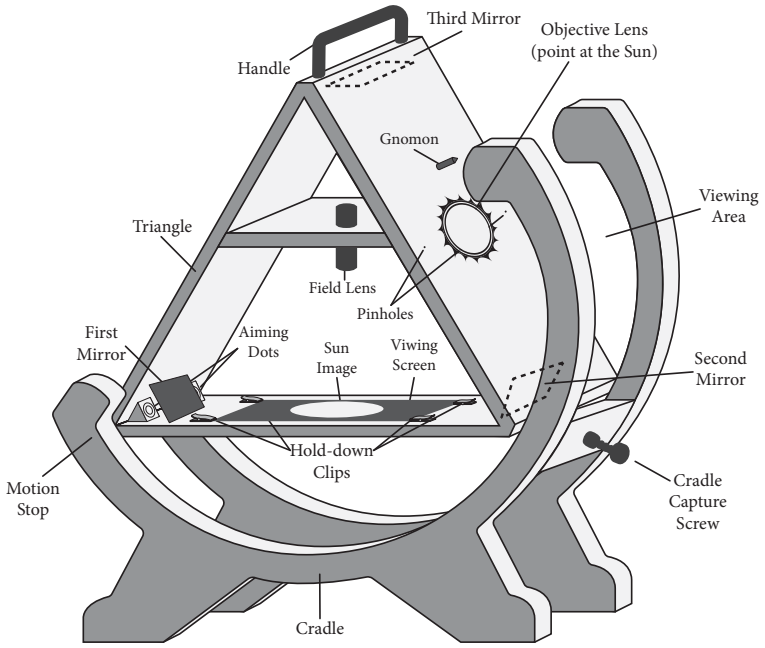
Make it!

Set up your district Sunspotter or make your own sunspot viewer using the steps below.

Use it!

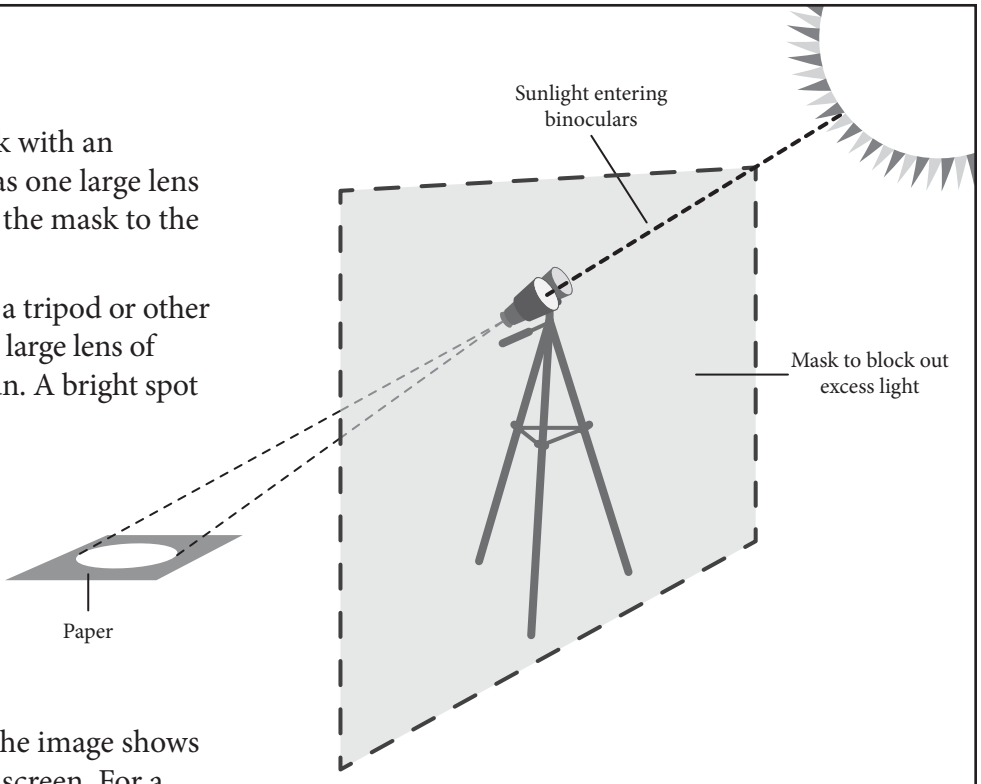
Work with classmates to carefully trace the sun image that appears on the viewing screen. Be sure to include any dark areas that are inside of the circle. These are sunspots!

Sunspotter



Sunspot Viewer Setup

1. Make a cardboard mask with an opening the same size as one large lens of the binoculars. Tape the mask to the binoculars.
2. Place the binoculars on a tripod or other stable surface. Point the large lens of the instrument at the sun. A bright spot should form on the wall or floor.
3. Place a piece of paper where the image of the sun appears. This is your viewing screen. Adjust your instrument until the image shows sharply on the viewing screen. For a clearer image, darken the room, or place the instrument under a draped table.



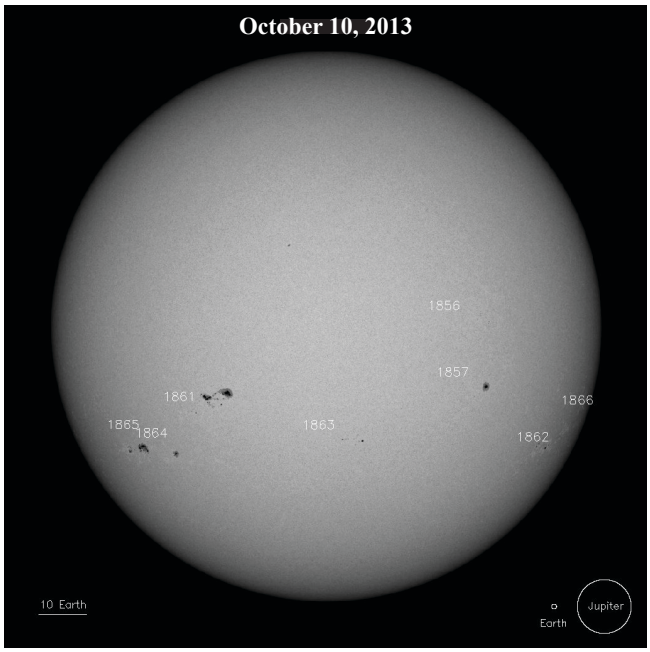
Sunspot Viewer (1 of 2)

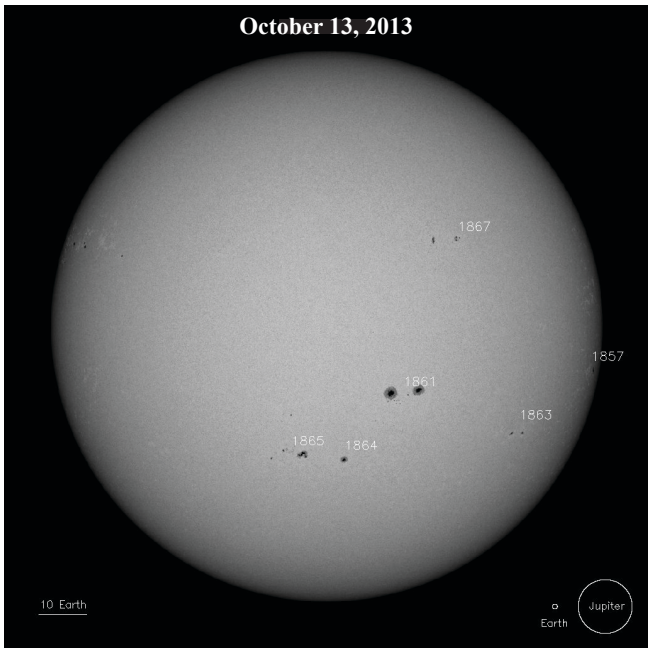
Name: _____

1. Use a sunspot viewer or the solar viewing slide to observe the sun. **Sketch** what you see. **Label** the sun in your drawing in English and Iñupiaq. **Include the date** that the image represents. **Draw arrows** pointing at the sunspots.

Date of observation: _____

2. Study the sun images below from NASA's Solar and Heliospheric Observatory. Compare the images. **Draw an arrow** below the images to show which way the sun is rotating.





3. How do you know which way the sun is rotating?

_____

_____

Sunspot Viewer (2 of 2)

Name: _____

4. Each sun image is a scale model of the sun. The scale can be used to estimate the diameter of the sunspots.

   The sun's actual diameter is about 1,391,000 kilometers (864,000 miles).

   Use a ruler to measure one of the sun images above in centimeters.

   The diameter of the model sun is _____ cm.

5. Find out how many kilometers are represented by each centimeter in your model:

   1,391,000 km ÷ _____ cm = _____ km/cm scale

6. Use a ruler to measure the largest sunspot on the sun image above.

   The diameter of the largest sunspot on the model sun is _____ cm.

7. Estimate the diameter of the sunspot using your scale.

   I estimate the diameter of the largest sunspot I observed is about _____ km.

8. The diameter of Earth is about 12,700 kilometers (8,000 miles). How does the diameter of the sunspot you observed compare to that of Earth?

   _____

   _____

Connect it!

9. How do sunspots relate to the northern lights? Use what you have learned from the student guide and the sun multimedia to help you answer.

   _____

   _____

   _____

   _____

10. What is the Iñupiaq name for the northern lights? _____