Sun and Stars

Supplemental science materials

for grades 2 - 4

Stanford SOLAR Center

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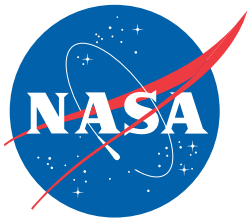

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Teacher Overview

Objectives

- Students will observe how white light can be refracted to form a color spectrum that has a pattern.
- Students will determine that the distance of an object from an observer affects the apparent size of said object.
- Students will see how other careers are connected to the colors of the visible spectrum of the Sun.
- Students will understand how technological design can help scientists to better understand our Earth, our Sun, our solar system and the universe around us.

Science Concepts

1. Our sun is really a star in that it has the same characteristics as the other stars visible in the sky, but because it is the closest star to Earth and the Earth revolves around it, it is also called the Sun.
2. The sun contains different kinds of hot gases that interact in a special way to give off heat, light and other kinds of energy.
3. How does a scientist know about the Sun if it is too hot to go there and they can't touch it to examine it? Scientists can get closer to it by using telescopes. Scientists can examine what the sun gives off in forms of energy. Scientists develop special tools such as a spectroscope to learn more about the sun.
4. The Sun gives off light we can see. It is white light that we can bend or refract. When refracting white light we get colors like in a "rainbow" (ROY G BIV).

Teacher Overview

Correlation to the National Science Standards

This segment of the Webcast *All About the Sun,* "Sun and Stars", is brought to you by a correlation to the National Science Standards for grades 2 – 4 as delineated below.

Grades 2 – 4

Unifying Concepts and Processes

- Evidence, models, and explanation
- Changes, constancy, and measurement
- Form and function

Science as Inquiry

- Abilities necessary to do scientific inquiry
  - Ask a question about objects, organisms, and events in the environment
  - Plan and conduct a simple investigation
  - Employ simple equipment and tools to gather data and extend the senses
  - Use data to construct a reasonable explanation
  - Communicate investigations and explanations
- Understandings about scientific inquiry

Physical Science

- Properties of objects and materials
- Light and heat
- Position of objects

Earth and Space Science

- Objects in the sky

Science and Technology

- Abilities of technological design
  - Identify a simple problem
  - Propose a solution
  - Implementing proposed solutions
  - Evaluate a product or design
  - Communicate a problem, design and solution
- Understandings about science and technology

History and Nature of Science

- Science as a human endeavor

Teacher Overview

Materials List

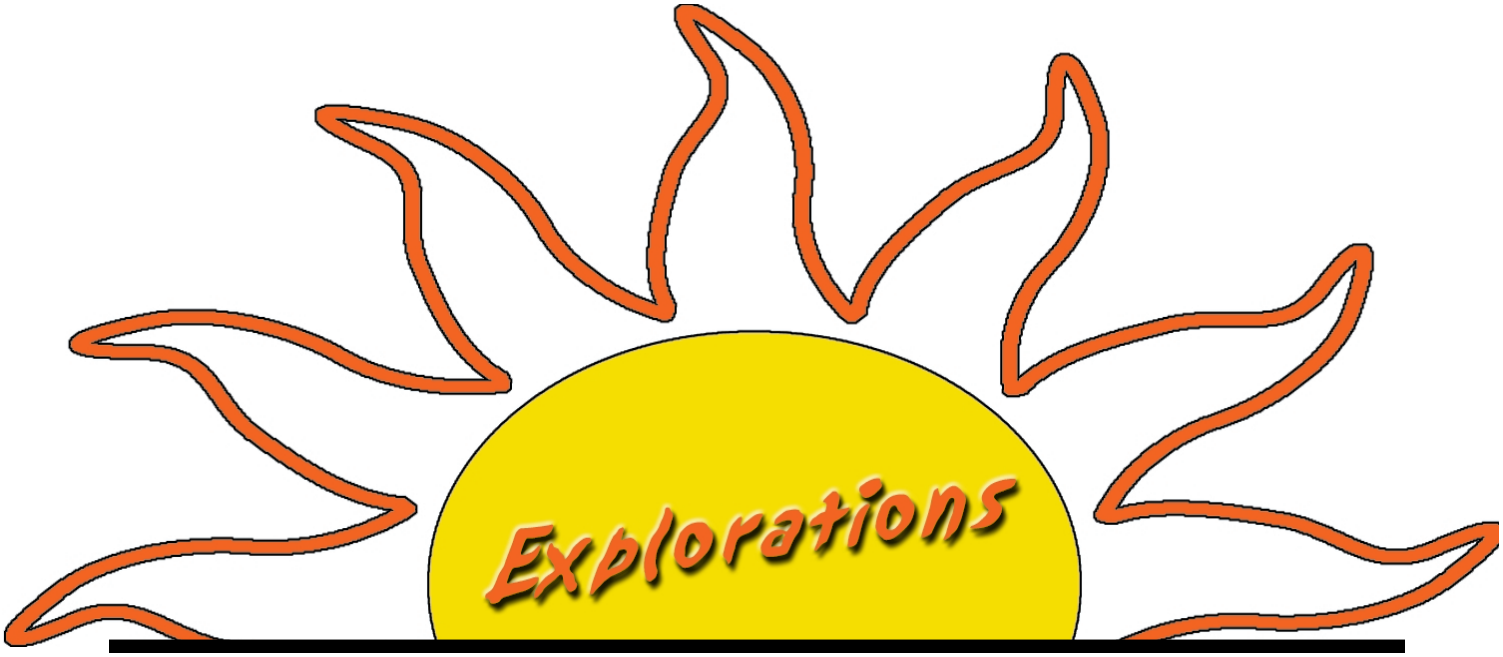
Sizing Up the Stars

Per small group, partner, or small team

- Long, flat surface (table, counter top, sidewalk)
- Two identically sized round objects (tennis ball, rubber racquetball, golf ball, ping pong ball, balled up sheets of paper, marble, bubblegum ball, etc. (These round objects are listed according to size.)
- 1 round object of a slightly smaller size than the other two round objects (For example, if a group has two tennis balls, then the smaller round object should be a rubber racquetball or golf ball.)
- Measuring tape or meter stick (The students will need to be able to mark and measure distances.)
- ruler
- Student Guidesheet: *Sizing Up the Stars*

A Rainbow Connection

- White drawing paper (3 sheets per student)
- Crayons or markers (to include the following colors: red, orange, yellow, green, blue indigo, violet)
- slide projector (or machine which projects a single strong beam of white light)
- prism or diffraction grating or back of a CD (compact disk)
- a white screen-type wall surface
- photos of various rainbows (one per group and not the same photo)



- Science Explorations
  - Sizing Up the Stars (Grades 4 version)
  - Sizing Up the Stars (Grades 2 – 3 version)
  - A Rainbow Connection

- Career Explorations
  - Solar Scientist

Science Explorations

- **Sizing Up the Stars**

Purpose: This activity is designed to get students to observe that two objects of equal size can appear to be of different sizes when placed at a greater or lesser distance from the observer. This is intended to assist students in visualizing that the sun is actually quite a small star compared to other stars, but because our planet is so much closer to the sun than to any other star, the sun appears much larger.

Distribute the student guidesheet *Sizing Up the Stars* (Note: There are 2 versions: Grades 2 – 3 and Grade 4) and review the directions for the activity. Instruct the students to place and hold the round object on the table while measuring from the front edge of the round object emphasizing the importance of consistency in measurement for accuracy. Remind the students that when they are observing they should place their "eyes" in the same place each time, perhaps placing their chin directly on the flat surface.

The questions on the guidesheet will lead the students to develop a procedure similar to what is given below:

- Place the two equal sized round objects 30 cm apart and 90 cm from the observer's eyes (the edge of the flat surface).
- Observe and compare the apparent size of the round objects.
- Leave the round object on the right in its position. Maintaining the 30 cm separation between the two equal size round objects, place the left one at a closer distance to the observer from the one on the right.
- Observe and compare the apparent size of the round objects.
- Leave the round object on the right in its position. Maintaining the 30 cm separation between the two equal size round objects, place the left one at a greater distance to the observer than the right round object is.
- Observe and compare the apparent size of the round objects.
- Repeat the procedure except leave the left round object in place while moving the right round object closer and farther away from the observer.

Science Explorations (continued)

- **Sizing Up the Stars (continued)**

    - Using one small round object and one larger round object, the students will be asked to place the round objects in such a way as to make them appear the same size. Note: Based upon their previous observations, the students should be able to ascertain that to make the smaller round object appear equal in size to the larger object, it must be placed closer to the observer than the larger round object.

    - Using one small round object and one larger round object, the students will be asked to place the round objects in such a way as to make the smaller round object appear larger than the larger sized round object. Note: Based upon their previous observations, the students should be able to ascertain that to make the small round object appear larger it must be placed even closer to the observer than where it was placed previously OR the larger round object will need to be moved farther back than where it had been previously placed.

    - As a whole class exercise covering a greater distance, have the class or teams perform the same exploration using a tennis ball or softball and a basketball. Be prepared for a much greater distance and have them measure it.

- **A Rainbow Connection**

Purpose: Students will observe how white light can be refracted to form a visible color spectrum that has a pattern.

- Break out the crayons and white drawing paper and with limited discussion have the students illustrate a rainbow. Post their drawings without discussion.
- Divide the class into small groups giving each group a different photo of a rainbow
- Ask each group to make 1 to 3 observations about the rainbow in the photo.
- Using a slide projector (powerful flashlight or machine that emits a concentrated beam of white light) and a prism move the discussion into what a rainbow really is: refracted ("bent") white light (sunlight). Discuss how a prism "bends" the light and demonstrate by shining the concentrated beam of light into the prism and having it refract onto a white background.
- Ask the students to accurately draw what they see being careful in how they place the colors in the "rainbow".

Science Explorations (continued)

- **A Rainbow Connection (continued)**

  - Have each student label each color below the color they have drawn. (R=red, O=orange, Y=yellow, G=green, B=blue, I=indigo, V=violet) Note: the last two colors will probably appear to the students as "purple" and the teacher will have to differentiate the color labels. Point out that the colors always follow this order, but that sometimes some of the colors might be missing or not have such a visible band (wide ribbon of color).

  - In the same small groups hand out a different rainbow photo (simply give the photos to different groups this time), and ask the students to compare that rainbow to the one in the classroom.
  - Have the students draw "true" rainbows based upon this ROY G BIV pattern

Career Exploration Guidesheet

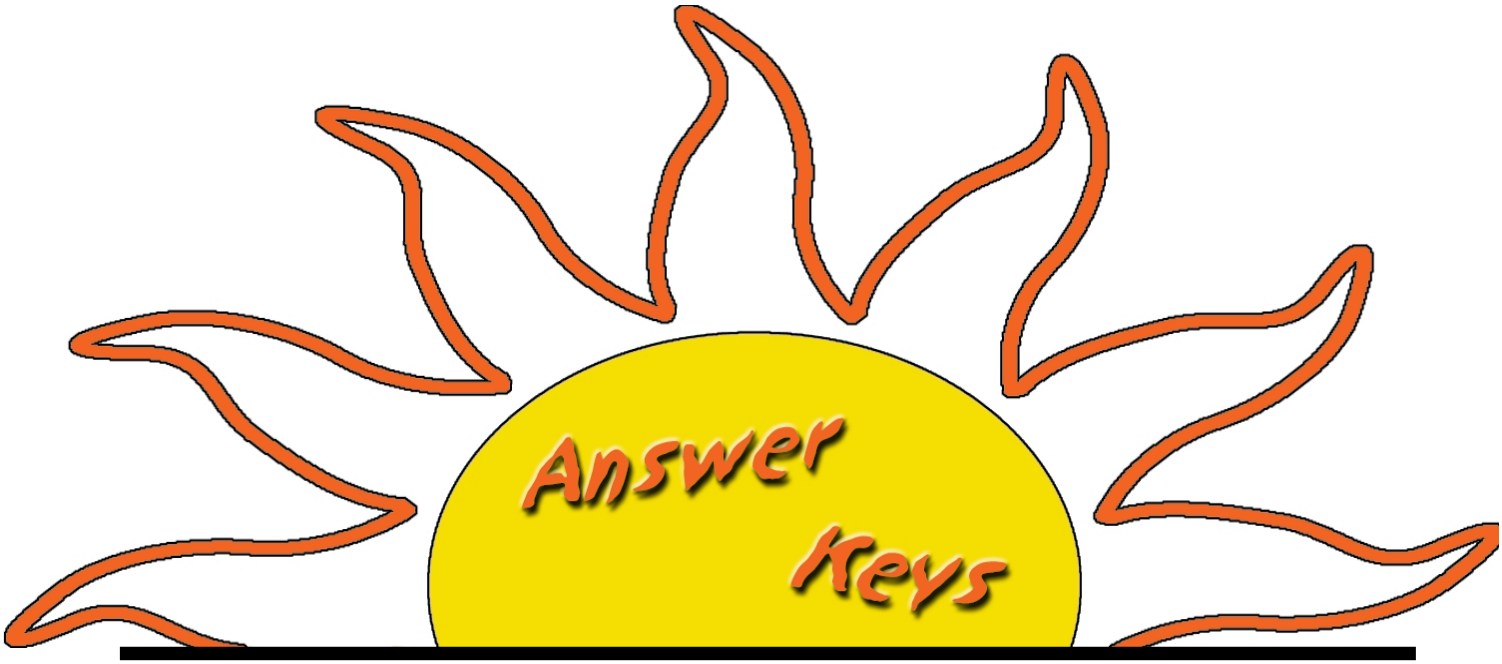
Career Explorations

After viewing the Web cast or after reading a brief introduction to each of the careers for this segment represented on the Web site

http://solar-center.stanford.edu

the students should be able to answer the basic knowledge questions about the following careers represented in the segment: solar astronomer.

See the "Student Handouts" section for the Career Exploration Student Worksheets.



- Student Worksheet: *Our Sun is a Special Star*

Science Exploration Guidesheet

Our Sun is a Special Star- Key

Directions: After reading about the sun, answer the questions.

1. What is a star?

   A star is a ball of hot, glowing gases.

2. What is the sun?

   A star which is a ball of hot, glowing gases.

3. Draw a picture that shows a star, the sun and the Earth if they were placed next to each other in order of largest to smallest.

   Star *Sun* *Earth*

4. We know that the sun is a star. Tell why it does not look like other stars.

   Because it is the closest star to Earth it looks much larger.

5. What kind of energy does the sun give off?

   The sun gives off energy we can see (white light) and energy we cannot see (heat).

6. Draw a color picture of the spectrum. Name each color.

   Red orange yellow green blue indigo violet

7. What does a star's spectrum tell about a star?

   It tells scientists what is inside a star that is, the elements found inside a star.

Grades 2 - 4

- Student Reading: *Our Sun is a Special Star*
- Student Worksheet: *Our Sun is a Special Star*
- Science Exploration Guidesheet (Grade 4): *Sizing Up the Stars*
- Science Exploration Guidesheet (Grades 2 – 3): *Sizing Up the Stars*
- Career Exploration Guidesheet: *Solar Scientist*

Student Reading

Our Sun is a Special Star

Look up at the night sky and what would you see? You would see many small points of light. Those points of light are called stars. A star is actually many times larger than the Earth. A star is a big ball of hot, glowing gases.

During the day, the sun is the biggest and brightest object in the sky. The sun is much larger than the Earth. The sun is also a big ball of hot, glowing gases.

The sun is a star. Even though there are some stars that are smaller than our Sun, the sun is really much smaller than most stars in the sky. It only looks like the biggest and brightest star because it is the closest star to Earth.

The sun gives off lots of energy. It gives off energy we can see and energy we cannot see like hear for example. The energy we can see is called white light. Scientists use this white light to learn more about the sun. By passing the white light through a prism, we see a rainbow. We call this rainbow a spectrum.

The colors in a spectrum always follow the same order: red, orange, yellow, green, blue, indigo and violet. Sometimes a color might be missing from the spectrum, but the colors will always stay in the same order. Other times the spectrum might have more red and less green. That's because each star's spectrum is different. By carefully studying a star's spectrum, scientists can tell what the star has inside. It can tell us what elements are found inside the star.

Even though the sun is the largest object in the sky, it is really a small star. The sun is special to us because it is the closest star to Earth, and gives us light.

Student Worksheet: Our Sun is a Special Star

Directions: After reading about the sun, answer the questions.

1. What is a star?

2. What is the sun?

3. Draw a picture that shows a star, the sun and the Earth if they were placed next to each other.

4. We know that the sun is a star. Tell why it does not look like other stars.

5. What kind of energy does the sun give off?

6. Draw a color picture of the spectrum. Name each color.

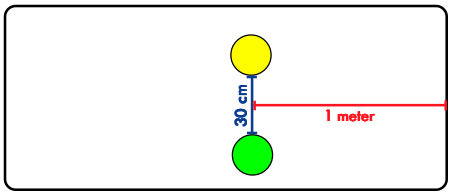
7. What does a star's spectrum tell about a star?

Science Exploration Guidesheet

Sizing Up the Stars (Grade 4)

Directions: Follow each step and answer the questions.

1. Take both round objects your teacher gives you and place them on a table 30 cm apart and 1 meter from the table's edge. See picture below.



1. Placing your eyes at tabletop level to the two round objects, look at the two balls and describe the size of each object. Do they appear to be the same size?

3 Leave the ball on the left in the same place. While you keep your eyes at tabletop level, have your partner move the ball on the right closer to you. Have your partner move the ball on the right until it no longer looks the same size as l the ball on the left. Measure the distance of the right ball from the table's edge. Then, measure the distance of the left ball from the table's edge. Draw a picture of the two round objects on the table and write down the distance for each. Circle the ball that looks larger.

4. Leave the ball on the left in the same place. While you keep your eyes at tabletop level, have your partner move the ball on the right farther away from you. Have your partner move the ball on the right until it no longer looks the same size as l the ball on the left. Measure the distance of the right ball from the table's edge. Then, measure the distance of the left ball from the table's edge. Draw a picture of the two round objects on the table and write down the distance for each. Circle the ball that looks smaller.

Sizing Up the Stars (Grade 4 continued)

Your teacher will now trade one of the round objects for a smaller round object. Use what you have learned from steps 3 and 4 to make a prediction.

5. How could you make the smaller ball look the same size as the larger ball? Make a prediction by drawing a picture in the box below that shows where you would place the larger ball and the smaller ball to make the smaller ball look the same size.

6. Place both round objects so that the smaller ball appears the same size as the larger ball. Measure the distance of each ball from the table's edge. Draw a picture of it in the box. Was your prediction correct?

7. How could you make the smaller ball look bigger than the larger ball? Make a prediction by drawing a picture in the box below that shows where you would place the larger ball and the smaller ball to make the smaller ball look bigger.

8. Place both round objects so that the smaller ball appears bigger than the larger ball. Measure the distance of each ball from the table's edge. Draw a picture of it in the box. Was your prediction correct?

Sizing Up the Stars (Grade 4 continued)

9. Pretend the smaller ball is the sun and the larger ball is a much bigger star. Place them on the table so that the "sun" appears bigger than the larger "star".
   Measure the distance from the sun to the table's edge and from the star to the table's edge.
   Draw a picture in the box and write down the measurements.

10. The sun in our solar system looks much larger than the stars in the night sky. Tell how the sun could actually be smaller in size than some of the stars we see.

Science Exploration Guidesheet

Sizing Up the Stars (Grades 2 – 3)

Teacher-Guided Directions: Give the instructions for each step. Following completion of each individual step, have the students answer each question (or questions) before you, the teacher proceed with the instructions for the next step.

1. Take both round objects and place them on a table 30 cm apart and 1 meter from the table's edge. See picture below.

2. Placing your eyes at tabletop level to the 2 round objects, look at the 2 balls and then answer the questions below:

   A) Describe the size of each object.

   B) Do they appear to be the same size?

3. Leave the ball on the left in the same place. While you keep your eyes at tabletop level, have your partner move the ball on the right closer to you. Have your partner move the ball on the right until it no longer looks the same size as the ball on the left. Measure the distance of the right ball from the table's edge. Then, measure the distance of the left ball from the table's edge.

   A) Draw a picture of the 2 round objects on the table and write down the distance for each. Circle the ball that looks larger.

Sizing Up the Stars (Grades 2 – 3 continued)

4. Leave the ball on the left in the same place. While you keep your eyes at tabletop level, have your partner move the ball on the right farther away from you. Have your partner move the ball on the right until it no longer looks the same size as the ball on the left. Measure the distance of the right ball from the table's edge. Then, measure the distance of the left ball from the table's edge.

   A) Draw a picture of the 2 round objects and write down the distance for each. Circle the ball that looks smaller.

Now your teacher will trade one of the round objects for a smaller round object. Use what you have learned to make a prediction.

5. How could you make the smaller ball look the same size as the larger ball?

   Make a prediction by drawing a picture below that shows where you would place the larger ball and the smaller ball to make the smaller ball look the same size.

Sizing Up the Stars (Grades 2 – 3 continued)

6. Place both round objects so that the smaller ball appears the same size as the larger ball. Measure the distance of each ball from the table's edge.

   A) Draw a picture of it in the box. Was your prediction correct?

7. Before you are given any more instructions answer the next question and then make a prediction.

   A) How could you make the smaller ball look bigger than the larger ball?

   B) Make a prediction by drawing a picture below that shows where you would place the larger ball and the smaller ball to make the smaller ball look bigger.

Sizing Up the Stars (Grades 2 – 3 continued)

8. Place both round objects so that the smaller ball appears bigger than the larger ball. Measure the distance from the table's edge.

   A) Draw a picture of it below. Was you prediction correct?

9. Pretend the smaller ball is the sun and the larger ball is a much bigger star. Place them on the table so that the "sun" appears bigger than the larger "star". Measure the distance from the "sun" to the table's edge and from the "star" to the table's edge.

   A) Draw a picture and write down the measurements.

10. The sun in our solar system looks much larger than the stars in the night sky. tell how the sun could actually be smaller in size than some of the stars we see at night.

Career Exploration Guidesheet

Solar Scientist

Directions: Before you listen to the interview with the Solar Scientist answer question 1 and 2 first.

1. When you picture a solar scientist in your mind, what does the solar scientist look like?

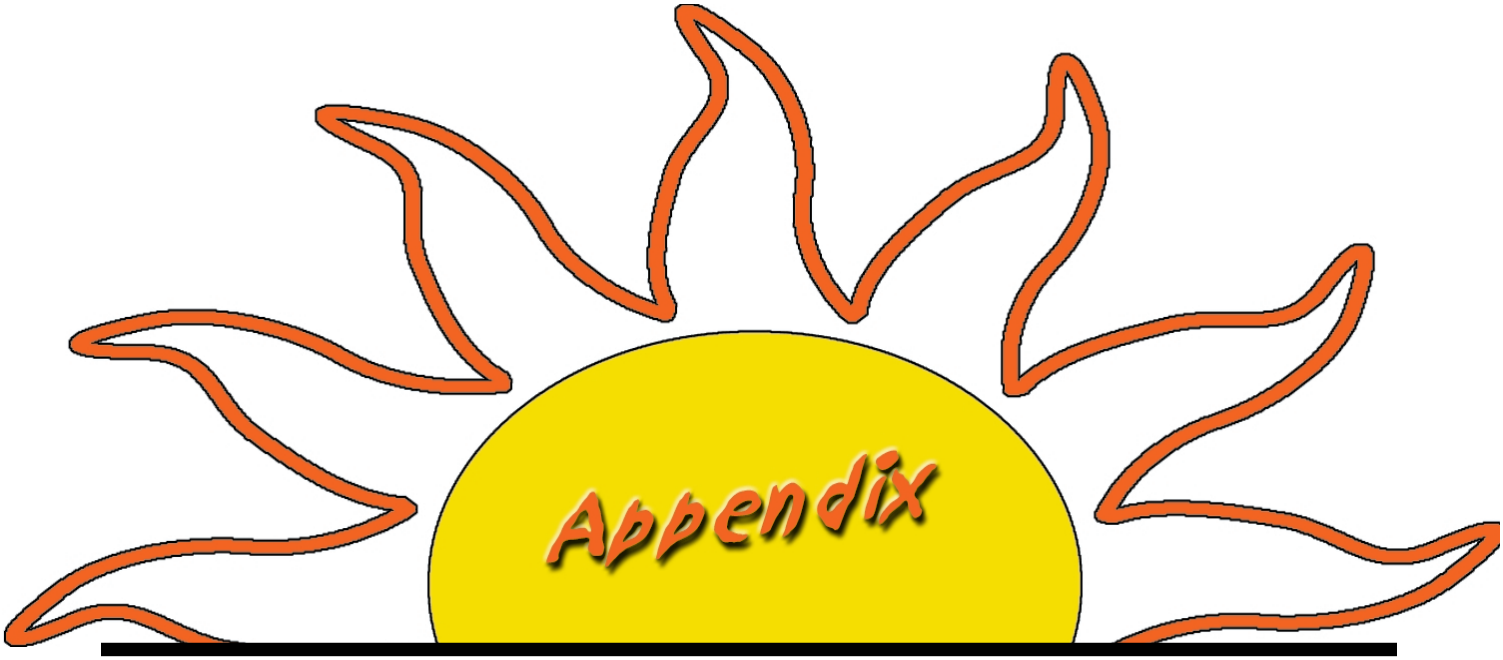
2. What kind of work do you think a solar scientist does?

Directions: After listening to the interview with the solar scientist answer the questions.

3. Name one thing about a solar scientist's job that you think is interesting. Tell why you think it is interesting.

4. If you were working with a solar scientist, what question about the sun would you want answered?

5. How do you think you and the scientist could find the answer to your question?



- Solar Glossary
- Web Work

Appendix

Solar Glossary

energy	power and force found in stars that give off heat, light we can see and other forces that we cannot see
prism	a glass or clear plastic solid object with sides shaped like a parallelogram with ends shaped like triangles. It is used to bend the rays of white light into the colors of a rainbow.
ROY G BIV	An acronym that helps us remember the order of the colors in the light spectrum.
solar scientist	an expert in science who studies the sun
spectrum	bands of color that are formed when rays of white light is bent by passing through a prism or special instrument; The colors of the spectrum include these colors: red, orange, yellow, green, blue, indigo and violet.
star	a large ball or sphere of hot, glowing gases that looks like a distant pinpoint of light in the night sky
sun	the star closest to the Earth that is a large ball of hot, glowing gases and gives off energy to the Earth such as light and heat

Appendix

Web Work

http://solar-center.stanford.edu

This site contains an interactive vocabulary crossword puzzle and word search using the words found in the solar glossary.