Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

1 University Station C9000
Austin, TX 78712
(512) 471-5847
www.esi.utexas.edu

Star-Spangled Stars

Lesson plan for grades: 3-5
Length of lesson: 1-2 class periods
Adapted by: Jesús Aguilar-Landaverde, Environmental Science Institute, February 7, 2012
Authored by: Austin Independent School District (AISD) Kindergarten Science Curriculum

SOURCES AND RESOURCES:

- AISD Lesson plan, "Stars": http://www.austinschools.org/curriculum/science/el/k/documents/Sc_GrK_2nd_9Wks_Weather_and_Space_Sun_Earth_Moon_Portf_1112.pdf
- A wonderful photograph via NASA of Orion, useful for the **Engage** section: http://apod.nasa.gov/apod/ap030207.html
- An elementary guide to stellar classification from Zoom Astronomy http://www.enchantedlearning.com/subjects/astronomy/stars/startypes.shtml

POTENTIAL CONCEPTS & TEKS ADDRESSED THROUGH THIS LESSON:

§112.14.b. Astronomy, Grade 3: (8B)
§112.15.b Astronomy, Grade 4: (8)
§112.15.b Astronomy, Grade 4: (5A)
§112.16.b Astronomy, Grade 5: (5A)
§112.16.b Astronomy, Grade 5: (8D)

PERFORMANCE OBJECTIVES:

Students will be able to:

- Discover and retain facts about stars including their composition
- Create their own constellations
- Explain differences in stellar temperatures based on color (in this lesson: red, blue, and white)
- Report at least two reasons for stars' relative size in the sky
- Develop knowledge and understanding of the Sun as a star

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MATERIALS (per group of four):

- Book: "Our Stars," by Anne Rockwell
- Chart paper
- Approximately 40 white or yellow hole-punch 'holes'
- 4 sticks of chalk or white crayons
- 4 sheets of black construction paper
- 2 sheets of each of the following colors of construction paper: white, red, blue
- 4 pairs of safety scissors
- 4 bottles of non-toxic glue or glue sticks

Safety: The instructor should supervise the use of scissors and glue regularly during the exploration section.

CONCEPTS:

Stellar classification: Astronomers have noticed that stars naturally can be grouped together according to their color (temperature), age, mass, size, or brightness. These qualities not only help people tell various stars apart from each other, together they are responsible for making the night sky look the way it does.

Stellar composition: Stars are made of very hot gas.

Gas: Imagine a glass of ice. We call this ice in the glass **solid** because it does not flow and it has its own shape (often in the shape of cubes). Say we leave the ice on the counter and come back after going to the playground. Now, we might find only water in this glass. We call the water **liquid** because it takes the shape of the glass, and it *does* flow. Finally, if we put this glass of water outside on a hot day and come back after a day of school, we might not see any water left! This is because water can become a **gas** under the right conditions. We don't see the gas, or *vapor,* because if we don't keep it in a closed container, the gases can flow freely. They also flow and do not have their own shape outside of a container (like an inflated balloon).

Stars are made of a hot form of gas called **plasma.**

BACKGROUND:

Within the last two hundred years, physics has given humans great insight into how the things we see in the night sky came to be. The formal study of the interaction between matter and energy, spectroscopy, has allowed astronomers to derive masses, temperatures, and radii, and of distant stars. From these studies and other physical phenomena follows the modern theory of stellar evolution.

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PREPARATION:

Black construction paper (1 per student) should be prepared. Also, each student will need 10 hole-punch 'holes' (preferably a contrasting color on black such as yellow). The instructor should have these prepared as well before the lecture. Also, the teacher will need a copy of the book, *Our Stars,* by Anne Rockwell.

ENGAGE: (Day 1)

The instructor will read aloud brief selections the book "Our Stars" to the students.

Ask:

Describe critical questions you will ask students in great detail: These should be asked as the topics are met in the literature. The new facts about stars that students learn should be recorded by the instructor on the chart paper.

- What objects do you see in the sky at night?
- What is a star?
- What is the star we all see every *day?*
- What are stars made of?
- Why do we see stars at nighttime but not during the day?
- Which do you think would be hotter, a red star or a blue star?
    - Note to instructor: Here is a common division between the sciences and art. Although blue may be considered a "cool" color and red a "warm" one by aesthetic conventions, in astronomy a bluer color is indicative of a hotter temperature than red.
    - One common analogy to explain this is a stove: When a stove (electric) is turned on, the burners start off as red, and then become orange, then yellow. If this continued, it would get bluer, brighter, and hotter (but the material would have long melted!).
    - The constellation **Orion** is a brilliant visual example for this concept. The top left "shoulder" of Orion is a Red Giant Star called Betelgeuse, and his bottom right "foot" is the Blue Giant Star Rigel. The surface temperature of Rigel is over three times as hot as Betelgeuse's.
    - Also, there exist white stars which are the **hottest** from among blue, red, and white.

Note to teachers:

Common misconceptions

- Stars are not the same size and shape; no two stars are exactly identical
- Stars are (for the most part) spherical in nature, not pentagrams
- Stars do not stop shining during the day
- Stars are extremely far away (trillions of miles)!

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EXPLORE: (Day 1)

1. Each student will receive a 1 chalk stick/crayon, 1 sheet of black construction paper, and 10 'stars' (hole-punch holes).
2. Every two students will share 1 sheet of each of the following colors: red, white, and blue
3. The students will be using the hole-punch holes as stars
    a. Bring their attention to the color of these holes, especially if they are yellow. Ask the students which is hotter from among yellow, blue, and red [yellow is the coolest of all].
4. The student will be cutting out up to 10 stars of approximately circular size from the R/W/Bl construction paper
    a. The instructor may need to help the students in a suitable technique for cutting out these shapes
    b. These cut-outs should be varied in size and color, with a maximum of a 1" diameter
5. While supervising the students' use of glue, have them paste their stars onto the construction paper. Encourage them to cover as much surface area as possible for the next step.
6. The students will then "connect the dots," creating their own constellation. Have them come up with a title or name for their new constellation.
    a. The instructor should guide them by informing them that in the process of creating a name for the constellation, they should ask themselves if their constellation's shape reminds them of anything, and name it appropriately.
    b. The teacher can disclose at this time that people all around the world (e.g. Egypt, South America, India, Greece) did exactly the same thing when deriving their own constellations hundreds of years ago. In fact approximately half of the modern, official constellations set by the International Astronomical Union (IAU) were first recorded by a Greek man named Hipparcos (Hipparchus) nearly 2,000 years ago!
    c. Also, probe the students as they work by asking things such as
        i. Which one is your biggest star? Why is it the biggest one? Is it just really close to us?
        ii. How many ____ stars did you cut out?
        iii. Which one is your hottest star? Is it cooler or hotter than this one next to it? How do you know?
7. As time allows, have the students present their creation to the class, pointing out their largest stars and their relative temperatures to the other stars they cut out.

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EXPLAIN: (Day 2)

From the reading and the activity, review with the students the questions of the 'engage' section. It may help at this point to have a visual aid such as an image of the night sky with illustrated constellations and names.

- What is a star?
    - Why do we see different sizes of stars in the sky at night? [Remind or encourage the students that distance is not the only right answer here. They physical sizes of stars also come into play here]
    - What are they made of? [key words include matter, gas, light, energy, *not* fire]
    - How big do you think they are? [the Sun, for scaling, is ~100 times larger (in radius) than the Earth; that is, one Solar radius is 100 Earth 'units' or 'cubes' as I have seen in first grade classrooms. Of course there exist larger stars which are measured to be up to hundreds of times larger than our sun]
    - If not already introduced, feel free to mention (after initially asking the students)
        - Temperatures of stars
            - "The flame on a candlestick is ~2000 degrees Fahrenheit. (The Sun is 10,000 degrees Fahrenheit!)
        - Energy
            - From the United States Census 2012 Statistical Abstract on energy consumption for the year 2009:
                - The sun is so hot and so bright, that it at its source, it could provide electricity for America for almost 30 million years! (Here, I have used the sun's *total* luminosity in the calculation. The total amount of energy that actually reaches earth from the sun could *still* power the Earth's electricity for over 280,000 years!
- What are these (referring to illustrations of constellations in the book) pictures in the sky called? [to introduce or reinforce the definition of constellation]
- How do you think people came up with these patterns in the sky?

ELABORATE: (Day 2)

1. The purpose of this section is to stimulate students into relating a star's perceived size in the sky to **both** its distance from the Earth and its physical size in space.
    a. Why do some stars look bigger at night?
    b. The sun is actually in the middle of the temperature range of known stars, the sun is large to us because it is closer to us than any other star
    c. Are there are stars out there that are much, much bigger, hotter, brighter, and more massive than the sun?
    d. Which is larger, the Sun or the Moon?
        i. Which is closer to us?
        ii. Which is larger?

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iii. Are the Sun and the (full) Moon the size in the sky?
iv. This is to illustrate to the students how distance can also change an objects angular size. It may help here to show the students a picture of a total solar eclipse. The two objects appear to us as almost the same size.

2. From what you already know about stars, what is the sun made of? [students should use formal vocabulary as presented earlier in the lesson by the instructor]

EVALUATE: (Day 2)
Take-home activity: Have the students write a letter in their journals or on construction paper on the following prompt (feel free to modify).

"Imagine that one day you are walking to recess at school. Suddenly, a friendly visitor from outer space calls your name. Her name is Arina. She is not from Earth, but she wants to about the Sun and why it is so hot. In your journal, write a letter (three) to Arina telling her why the Sun might so hot based what you've learned."