Unit Title: Light Up My Life--Sun 101 **Date Developed/Last Revised:** July 12, 2013 **Unit Author(s):** Maggie Prevenas	**Grade Level:** 6-8 **Time Frame:** 10 45-minute classes **Primary Content Area:** Science, Technology, Engineering, Math and CCSS Literacy

UNIT DESCRIPTION: This is an introductory unit meant to help students of all abilities learn about the Sun. A "Sunspotter" is used as a tool to safely observe the Sun over time. Students address the history of science by comparing their observations with Galileo's drawings and making predictions regarding the rotation of the Sun and Earth. To address multiple learning styles, students create a flip book of sun observations; create a sunspot observation graph comparing student and scientist data; learn vocabulary through an image challenge; sing a song; measure, draw, and paint a model of the Sun and Earth; estimate and calculate size and volume of the Earth and Sun; engineer a magnetometer; read and summarize important information from scientific articles; write an editorial; and draw an editorial cartoon.

Big Ideas (Student Insights that Will Be Developed Over the Course of the Unit):

- Scientists use models to demonstrate ideas, explain observations, and make predictions.
- Scientific explanations are based on evidence gathered from observations and investigations.
- The Sun is the source of energy for most Life on Earth.
- Most objects in the solar system have regular and predictable motion.
- Tracing the history of science can show how difficult it is for scientific innovators to break through accepted ideas and reach unexpected conclusions.
- Technology is commonly used to locate, evaluate, and collect information from a variety of sources.
- Mathematics is important in scientific inquiry.

Essential Questions (Questions that Will Prompt Students to Connect to the Big Ideas):

- How does the Sun impact human life?

	BENCHMARKS/STANDARDS/LEARNING GOALS
Science	**HCPS III** **SC.8.2.1** Describe significant relationships among society, science, and technology and how one impacts the other **SC.8.2.2** Describe how scale and mathematical models can be used to support and explain scientific data **SC.8.8.4** Explain how the sun is the major source of energy influencing climate and weather on Earth
Technology	**HCPS III** **CTE 8.1.1** Design, modify, and apply technology to effectively and efficiently solve problems **CTE 8.2.1** Apply appropriate and safe behaviors for the school, community, and workplace **SC 8.2.1** Describe significant relationships among society, science, and technology and how one impacts the other
Engineering	**HCPS III** **CTE 8.1.1** Design, modify, and apply technology to effectively and efficiently solve problems **CTE 8.2.1** Apply appropriate and safe behaviors for the school, community, and workplace
Mathematics	**CCSS.Math.Content.8.EE.A.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. **CCSS.Math.Content.8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **CCSS.Math.Practice.MP1** Make sense of problems and persevere in solving them. **CCSS.Math.Practice.MP4** Model with mathematics. **CCSS.Math.Practice.MP5** Use appropriate tools strategically. **CCSS.Math.Practice.MP6** Attend to precision.

English Language Arts and Literacy	**CCSS.ELA-Literacy.RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. **CCSS.ELA-Literacy.RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **CCSS.ELA-Literacy.RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **CCSS.ELA-Literacy.WHST.6-8.1** Write arguments focused on *discipline-specific content*. **CCSS.ELA-Literacy.WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. **CCSS.ELA-Literacy.WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.
STEM Competencies	**STEM Competency 2.2:** Collaborates with, helps, and encourages others in group situations **STEM Competency 4.1:** Recognizes and understands what quality performances and products are **STEM Competency 6.4:** Uses the appropriate technologies for communication, collaboration, research, creativity, and problem-solving

LESSON SEQUENCE

	Lesson Title/Description	Learning Goals (What Students Will Know and Be Able to Do)	Assessments	Time Frame
1	**Eyes on the Sky** Students use a Sunspotter to observe changes in the Sun's appearance over a two-week period of time. Students use Galileo's drawings to understand the movement of the Sun and limits of observations.	-Safely conduct a scientific investigation to observe the Sun -Explain changes in appearance occurring on the surface of the Sun -Provide evidence from observations that the Sun rotates -Witness and describe how society, science, and technology are related and how one impacts the other	1. Students work in groups or individually to create a flipbook made from observations that show the Sun's rotation 2. Sunspot Lab Team Report 3. My Sunspot Lab Guide	15 minutes per class over a two week period of time
2	**Sunglish- Four Pictures One Word** Speaking of the Sun. Students learn unit-specific vocabulary through a visual challenge posted on Edmodo.	-Perform basic document editing techniques (create, save, name, edit, insert images, add text, reference sites) with word-processing software such as Microsoft Word -Log-in, navigate, and post replies in a social networking platform (Edmodo) -Work collaboratively in order to create a descriptive collage of a science vocabulary word -Process visual clues in order to recognize and identify science vocabulary -Use appropriate science vocabulary to explain what they are observing	1. Saved doc with appropriate images of vocabulary word, posted and shared by assignment deadline 2. Edmodo postings to class word groups stating appropriate guesses for 'sunglish words' 3. Written test with 80% correct responses to unit vocabulary words	Three 45-minute classes

3	**Sing: The Sun** Song to help students learn that the Sun (our star) is the source of energy and matter for Earth.	-Describe that the Sun (our star) is the source of energy and matter for Earth	1. Participation in song over the length of the unit	15 minutes + 5 minutes on following days
4	**Scale Model: Sun and Earth** Students use a metric ruler to measure and draw a 21-centimeter diameter model of the Sun. Students also estimate the size and distance to Earth. Students can marble the paper using acrylic paint to represent the surface of the sun.	-Measure a scale and mathematical models to support and explain scientific data	1. Measure, draw, cut out and paint an accurate model (within 5 mm) of the sun and earth	45-minute class
5	**Space Math is BIG** Students solve real-life problems about the Sun and space. In doing so, they apply Common Core State Standards for Mathematical Practice.	-Make sense of problems and persevere in solving them -Model with mathematics -Use appropriate tools strategically -Attend to precision	1. Use knowledge of formulas and scientific notation to solve real-world and mathematical problems about the Sun and Earth	45-minute class
6	**Inspector Detector: Mission Magnetometer** Students use the engineering design process to make a device that can pass above a surface and detect magnetic fields. Magnetic fields deflect the damaging radiation of the sun and cosmic rays and are important to life.	-Use the engineering design process to create an instrument (for satellites) that detects information about magnetic fields -Practice STEM competencies related to College and Career Readiness (CCR)	1. As a group, design, modify, and apply technology to effectively and efficiently create a magnetometer (rubric included)	Two 45-minute classes

7	**A Scientific Argument: Be Aware, Not Afraid** Students read articles to learn about problems caused by solar storms, such as the disruptions to communication systems. Using evidence from articles, students write an editorial and draw an editorial cartoon summarizing their point of view.	-Read scientific articles to provide evidence about how society, science, and technology are related and how one impacts the other -Identify problems facing exploration in space -Write an editorial that explains the causes of solar storms and argues the possible effects on human society -Practice communication skills	1. Students write an editorial and draw an editorial cartoon 2. Students assess the effectiveness of the presentation using a rubric	Three 45-minute classes

Unit Title: Light Up My Life--Sun 101 Lesson Title: Eyes on the Sky Date Developed/Last Revised: July 12, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 1 Grade Level: 6-8 Primary Content Area: Science Time Frame: 15 minutes per class over two weeks (minimum of 3 class meetings per week.)

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **SC.8.2.1** Describe significant relationships among society, science, and technology and how one impacts the other
- **CTE.8.1.1** Design, modify, and apply technology to effectively and efficiently solve problems
- **CTE.8.2.1** Apply appropriate and safe behaviors for the school, community, and workplace
- **STEM Competency 2.2**: Collaborates with, helps, and encourages others in group situations

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Safely conduct a scientific investigation to observe the Sun
- Explain changes in appearance that occur on the surface of the Sun
- Provide evidence from observations that the Sun rotates
- Witness and describe how society, science, and technology are related and how one impacts the other

2B. Assessment Tools/Evidence:

Formative:

- Sunspot Lab Team Report (Rubric)
- My Sunspot Lab Guide

Summative:

- Sun Flip Book (Checklist)

3. Learning Experiences (Lesson Plan)

Materials:

- Sunspotter
- 4 x 6 Index Cards (Prepare with circle template), 8 per group. Each group should have a different color of index card.
- Sunspot Observation Graph
- Galileo sunspot drawings
- Computer with internet access (1 per team)
- Sun 101--Vocabulary List-- cut and folded into strips, distributed to each student (list attached)

Handouts:

- My Sunspot Lab Guide (1/student)
- Solar Eruption Flip Book (1/student) from *Windows To The Universe*, http://www.windows2universe.org/teacher_resources/flipbooks/solar.pdf
- Team Lab Folder (1 per group--teacher prepares contents)
    - Sunspot Observation Graph
    - Sunspot Lab Team Report

Other Resources:

- Sunspotter available for purchase from Learning Technologies, Inc.--800-537-8703 (from $300)
- Galileo sunspot drawings from http://galileo.rice.edu/sci/observations/sunspot_drawings.html
- Sunspot daily images from Solar and Heliospheric Observatory Homepage, http://sohowww.nascom.nasa.gov/, April 5, 2013
- This lesson was modified from: Discovering the Sun-Galileo, Sun-Earth Days 2013 –NASA, http://sunearthday.nasa.gov/swac/materials/Discovering_the_Sun.pdf, April 8, 2013
- The Exploratorium and UC-Berkeley Project Website, Sunspots, http://cse.ssl.berkeley.edu/SegwayEd/lessons/sunspots/index.html, April 5, 2013
- Rubric for assessing contribution to team, http://rubistar.4teachers.org/index.php?screen=PrintRubric&rubric_id=1572872&, April 29, 2013

Procedure:

- Arrange students into lab groups of 4. Distribute handouts.
- Introduce Galileo and copies of his sunspot drawings.
    - Tell students drawings were made on consecutive days
    - Drawings are out of order
    - Have students predict correct order (from My Sunspot Lab Guide, “Light Up My Life”)
    - Each group explains order and writes prediction (on My Sunspot Lab Guide)
- Introduce students to SOHO http://sohowww.nascom.nasa.gov/.
    - Project images of sunspots charted for past few days
    - Discuss differences between the sunspots observed by SOHO and the Sunspotter
    - Introduce students to Sunspots Website: http://sohowww.nascom.nasa.gov/data/realtime/hmi_igr/512/
    - All students have a task every class for four classes
        - Sunspotter, SOHOer, and two STEMers
        - Rotate roles each class so all students experience activities
- Each group sends a sunspotter to draw observations of the sun (using Sunspotter) on 4 x 6 card each day.
    - Remind students: **NEVER** look directly at the Sun

- Each group sends a scientist (SOHOer) to internet to draw image of the Sun on separate 4 x 6 cards each day.
- STEMers are responsible for finding definitions of their assigned vocabulary words by the end of the unit.
    - Student writes definition on lab guide
    - Student brainstorms pictures of words on lab guide
    - Students will create flip book from Solar Flare Handout
- Enter/draw information for task and collaborate with team (15 minutes).
- Use team rubric to assess individual and team effort.

Homework Activity (Optional):

- Students may do vocabulary work at home
- Students read TeenBIZ 3000 weekly article (on Heliophysics)

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

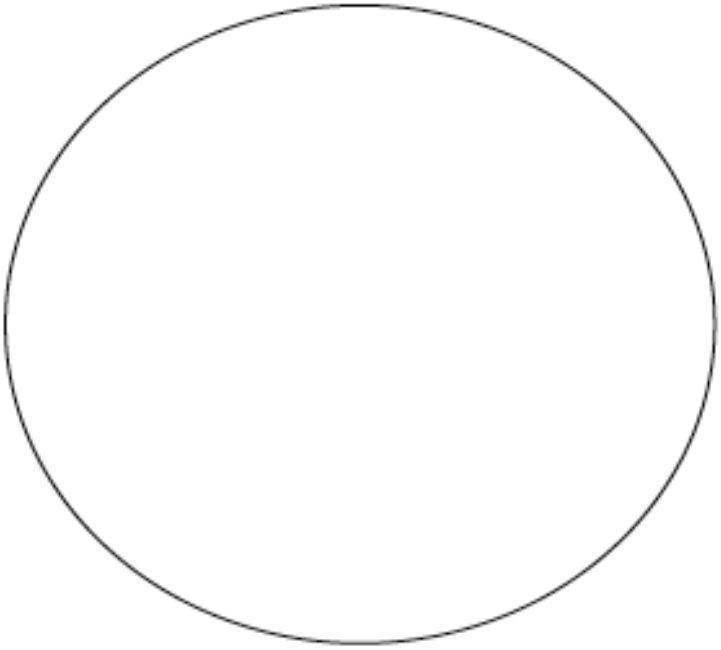
7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

Vocabulary for Sun 101 (suggested)

Astronomy
Solar Prominence
Corona
Coronal Mass Ejections
Solar flare
Plasma
Magnetosphere
Convection
Photosphere
Sunspot
Nuclear fusion
Electromagnetic energy
Solar wind
Scale model
Matter/particle
Shield
Spectrum
Ultraviolet
Astronomical Unit
Aurora
Heliophysics
Chromosphere
Gamma and Cosmic rays
Revolve and rotate
Satellite

Circle Template:

Below is a circle the size of the Sun's image on the Sunspotter®. Copy this image onto the 4x6 index cards before the observations.



Team _____Date_____

Light Up My Life
Sunspot Lab Team Report

Day 1
As a group,

1. Make a prediction: List Galileo's drawings (by letter) in order.

2. What information did your group use to make this decision?

Day 1 Sunspotter's name _____
SOHO's name _____
STEMers' names _____

Vocabulary Words (write name and assigned word)

1. _____
2. _____
3. _____
4. _____

Checklist for Day 1
____ Sunspotter drew observation of Sun on card
____ Sunspotter labeled back of card **with date and observed number of sunspots**
____ Sunspotter placed card in group folder
____ SOHOer drew observation of Sun on card
____ SOHOer labeled back of card **with date and observed number of sunspots**
____ SOHOer placed card in group folder
____ STEMers researched vocabulary word and wrote definition on student's activity guide

____ Team reflected on activities (in space below)

Reflection:

There is something missing on the Sunspot Observation Graph. What is it? Make changes.

Second Meeting of Sunspot Team

Sunspotter's name _____
SOHOer's name _____
STEMers' names _____

____ Sunspotter drew observation of Sun on card
____ Sunspotter labeled back of card **with date and observed number of sunspots**
____ Sunspotter placed card in group folder
____ SOHOer drew observation of Sun on card
____ SOHOer labeled back of card **with date and observed number of sunspots**
____ SOHOer placed card in group folder
____ STEMers researched vocabulary word and wrote definition on student's activity guide

____ Team reflected on activities (in space below)

Reflection:

Third Meeting of Sunspot Team

Sunspotter's name _____
SOHOer's name _____
STEMers' names _____

____ Sunspotter drew observation of Sun on card
____ Sunspotter labeled back of card **with date and observed number of sunspots**
____ Sunspotter placed card in group folder
____ SOHOer drew observation of Sun on card
____ SOHOer labeled back of card **with date and observed number of sunspots**
____ SOHOer placed card in group folder
____ STEMers researched vocabulary word and wrote definition on student's activity guide

____ Team reflected on activities (in space below)

Reflection:

Final Meeting of Sunspot Team

Sunspotter's name _____
SOHOer's name _____
STEMers' names _____

____ Sunspotter drew observation of Sun on card
____ Sunspotter labeled back of card **with date and observed number of sunspots**
____ Sunspotter placed card in group folder
____ SOHOer drew observation of Sun on card
____ SOHOer labeled back of card **with date and observed number of sunspots**
____ SOHOer placed card in group folder
____ STEMers researched vocabulary word and wrote definition on student's activity guide

____ Team reflected on activities (in space below)

Reflection:

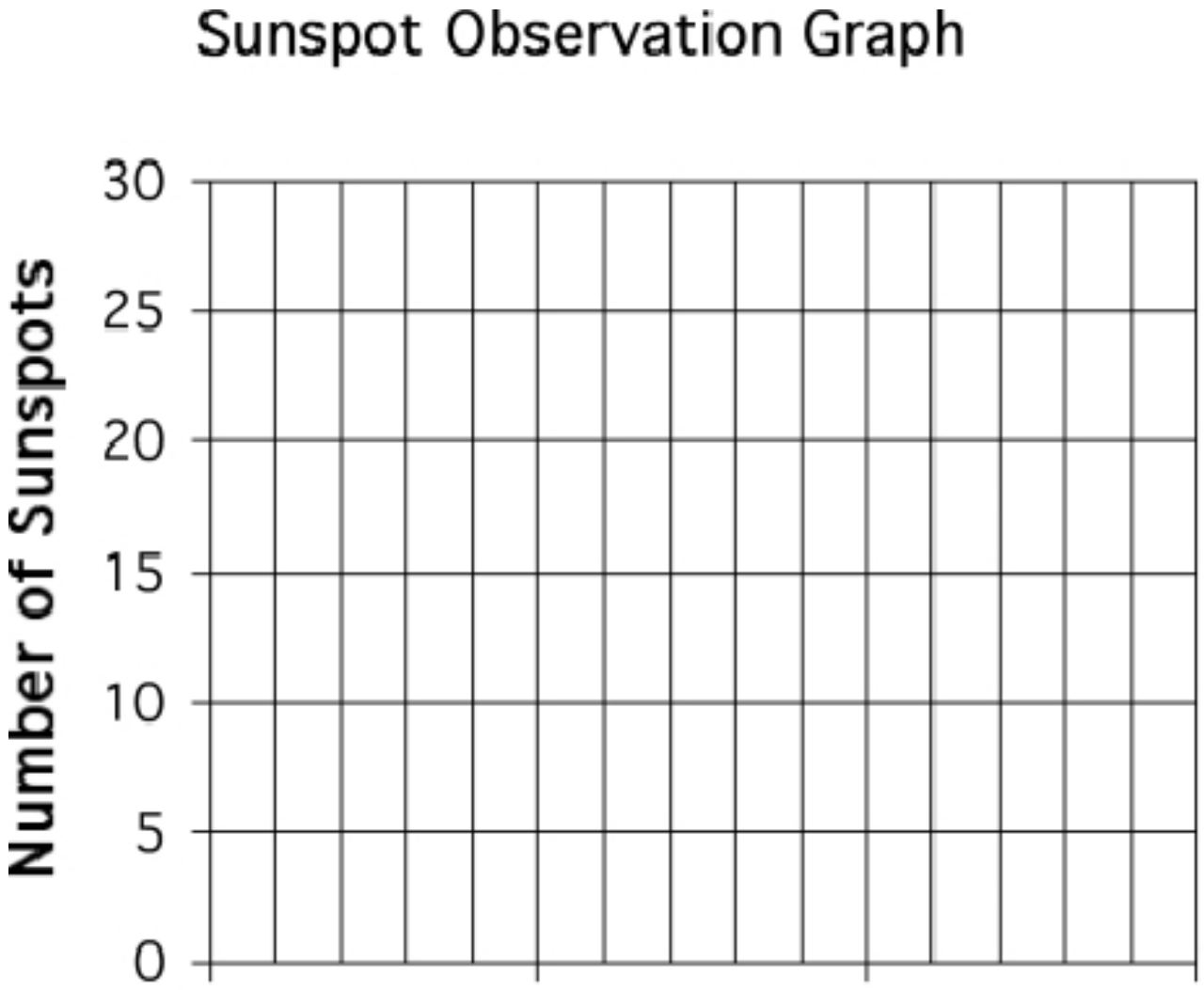
1. Look at your initial prediction of the order of Galileo's sunspot drawings. From what you have learned and observed, make a final prediction. List Galileo's drawings (by letter) in order.

2. List the known order of sunspots. Explain any differences.

3. How do you know that the Sun is rotating?

4. How has technology advanced since Galileo? List 3 examples of how technology influences science.

5. How do you think the new solar telescope on Haleakala will change our knowledge of the Sun?


Sunspot Observation Graph
Number of Sunspots
30
25
20
15
10
5
0

Student name _____Date_____

Light Up My Life
My Sunspot Lab Guide

Make a prediction: List Galileo's drawings (by letter) in order.

What information did you use to make this decision?

Vocabulary Word--Use *ScienceSaurus* or other resources to write a definition of your assigned vocabulary word below.

Vocabulary word: _____ Definition: _____

_____

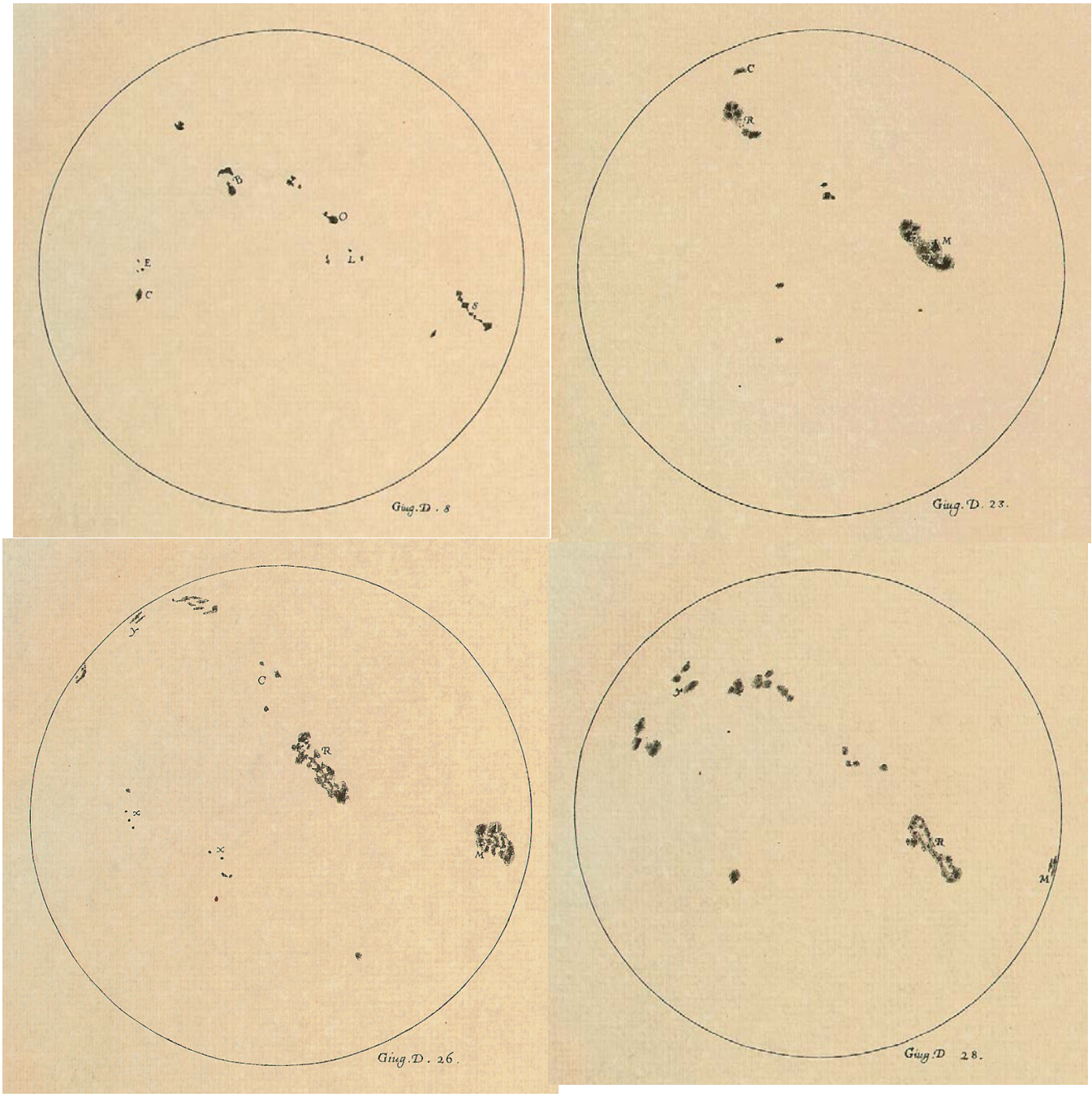
_____

Brainstorm--Use the space below to brainstorm other words or pictures to help you define your word.

Reflect: What is one thing you learned? Explain why it is important for you to know.

Download Solar.pdf from http://www.windows2universe.org/ . It is used to create the student flipbook.

Lesson 1: Galileo Sunspot Drawings



Images from: http://galileo.rice.edu/sci/observations/sunspot_drawings.html

Teachers may choose any four of Galileo's drawings. Please make a note to yourself regarding when they were drawn so you know the correct order ☺.

Unit Title: You Light Up My Life--Sun 101 Lesson Title: Sunglish--Four Pictures One Word Date Developed/Last Revised: 08.20.12/07.12.2013 Lesson Author(s): Charles Souza, Ryan Saito, Maggie Prevenas	Lesson #: 2 Grade Level: 5-8 Primary Content Area: Science, Literacy/Technology Time Frame: Three, 45-minute classes

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **STEM Competency 2.2:** Collaborates with, helps, and encourages others in group situations.
- **STEM Competency 4.1:** Recognizes and understands what quality performances and products are
- **STEM Competency 6.4:** Uses the appropriate technologies for communication, collaboration, research, creativity and problem-solving
- **CCSS.ELA-Literacy.RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- **CCSS.ELA-Literacy.RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- **CCSS.ELA-Literacy.WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- perform basic document editing techniques (create, save, name, edit, insert images, add text, reference sites) with word-processing software such as Microsoft Word
- log-in, navigate, and post replies in a social networking platform (Edmodo)
- work collaboratively in order to create a descriptive collage of science vocabulary words
- process visual clues in order to recognize and identify science vocabulary
- use appropriate science vocabulary to explain what they are observing

2B. Assessment Tools/Evidence:

Formative:

- Saved, shared doc with appropriate images of vocabulary word posted and shared by assignment deadline
- Documentation of image source follows school requirements
- Edmodo postings to class stating appropriate guesses for 'secret vocabulary words'
- Images in shared document reflect understanding of secret vocabulary words

Summative:

- Group presentation of visual vocabulary words
- Written test with 80% correct responses to unit vocabulary words

3. Learning Experiences (Lesson Plan)

Materials:

- Vocabulary words from unit (see lesson 1 suggested vocabulary)
- Suggested vocabulary word list (attached)
- Computer and internet access for entire class

Handouts/Other Resources:

- Teacher creates a wordle of vocabulary words using http://www.wordle.net/ See sample below.

Procedure:

Continue this lesson using the same groups as lesson 1.

- Choose one student per group to create a Word document. The student should name the document 'sunglish first names.'
- Each student uses the same vocabulary word she/he was assigned in lesson 1.
- Students insert four pictures from the internet to represent their vocabulary words without actually writing the word (may also draw original picture, scan, and insert it into document).
- Cite sources of images from the internet on a second page.
- When completed, share the document on Edmodo. Be sure to adjust the settings so that all students in the class can view the document.
- In the time provided, students look at other groups' documents and guess their vocabulary words. In their Edmodo posts, they should state their vocabulary word guesses and a rationale for their guesses.
- Students monitor sunglish posts to see who correctly guesses their group's words.
- After appropriate time, the teacher asks each group to present their visual vocabulary words. Each student defines their word and explains why they chose their images.
- Large wordle is printed and posted on Word Wall while students continue learning from lessons in unit.

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

Vocabulary for Sun 101 (suggested)

Astronomy
Solar Prominence
Corona
Coronal Mass Ejections
Solar flare
Plasma
Magnetosphere
Convection
Photosphere
Sunspot
Nuclear fusion
Electromagnetic energy
Solar wind
Scale model
Matter/particle
Shield
Spectrum
Ultraviolet
Astronomical Unit
Aurora
Heliophysics
Chromosphere
Gamma and Cosmic rays
Revolve and rotate
Satellite

Unit Title: You Light Up My Life--Sun 101 Lesson Title: Sing: The Sun Date Developed/Last Revised: July 3, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 3 Grade Level: 5-8 Primary Content Area: Space Science Time Frame: 15 minutes + 5 minutes on following days

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **SC.8.8.4** Explain how the sun is the major source of energy influencing climate and weather on Earth

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Describe how the Sun (our star) is the source of energy and matter for Earth

2B. Assessment Tools/Evidence:

Formative:

- Kinesthetic and verbal participation in song

3. Learning Experiences (Lesson Plan)

Materials:

- Percussion instruments (not required)

Handouts/Other Resources:

- Handout: Why Does The Sun Shine? (attached)
- You Tube Video: http://www.youtube.com/watch?v=3JdWlSF195Y (optional)
- Rice University has created a fun video in which the song is sung to accompany a brief explanation of the lyrics (quicktime) http://earth.rice.edu/Space_Update/space_weather/data/sun/basics/WhyDoesTheSunShine.mov
- NOTE: The original lyrics state the Sun is a mass of incandescent gas. The Sun is NOT gas but plasma. Relate this to the students and lead a discussion on scientific inaccuracies in the media. ☺ An updated version is found here: http://tmbw.net/wiki/Lyrics:Why_Does_The_Sun_Really_Shine%3F

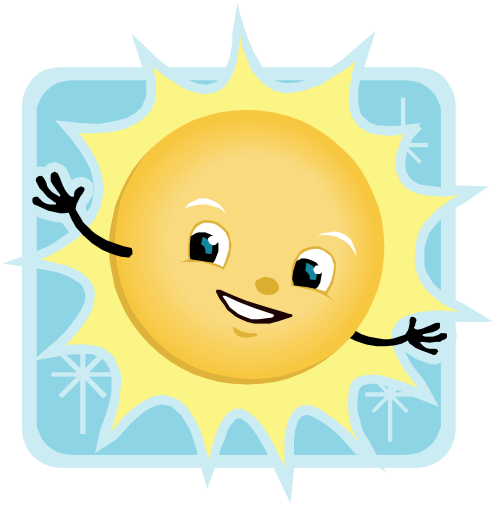
Procedure:

- Tell students you are going to help them keep a rhythm in order to learn about energy transfer from the Sun.
  - Tell students to model what you do. Clap once, they clap, clap once, they clap.
  - Continue to practice clapping until you have added two claps and a slap to the knees (the rhythm is very similar to 'We will, we will, rock you.'
  - After students have the clap slap mastered, start speaking one stanza (The Sun is a mass). Students repeat.
  - Continue adding phrases, line by line, until students can say the entire song.

o The following day, continue with the song to the end. Then repeat. o On subsequent days, sing the song to begin class, or in the middle to energize, or at the end to summarize. o Have students lead the song.
TEACHING & ASSESSMENT (Steps 4, 5, 6, &7) **Completed by teacher after instruction has taken place**
4. Teaching and Collecting of Evidence of Student Learning: Teacher Notes:
5. Analysis of Student Products/Performances - Formative: Teacher Notes:
6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson): Teacher Notes:
7. Teacher Reflection: Replanning, Reteaching, Next Steps: Teacher Notes:

Why Does The Sun Shine?

Chorus
The sun is a mass of incandescent gas
A gigantic nuclear furnace
Where hydrogen is built into helium
At a temperature of millions of degrees



Yo ho, it's hot, the sun is not
A place where we could live
But here on earth there'd be no life
Without the light it gives

We need its light
We need its heat
We need its energy
Without the sun, without a doubt
There'd be no you and me

Chorus

The sun is hot
It is so hot that everything on it is a gas: iron, copper, aluminum, and many others.
The sun is large
If the sun were hollow, a million earths could fit inside and yet, the sun is only a middle-sized star.
The sun is far away
About 93 million miles away, and that's why it looks so small.
And even when it's out of sight
The sun shines night and day
The sun gives heat
The sun gives light
The sunlight that we see
The sunlight comes from our own sun's
Atomic energy
Scientists have found that the sun is a huge atom-smashing machine. The heat and light of the sun come from the nuclear reactions of hydrogen, carbon, nitrogen, and helium.*

Chorus

Written by Hy Zaret and Louis Singer

Unit Title: Light Up My Life--Sun 101 Lesson Title: Scale Model: Sun and Earth Date Developed/Last Revised: July 12, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 4 Grade Level: 5--8 Primary Content Area: Space Science Time Frame: 45 minutes

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **SC.8.2.2** Describe how scale and mathematical models can be used to support or explain scientific data
- **SC.8.8.4** Explain how the sun is the major source of energy influencing climate and weather on Earth

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Describe how the Sun (our star) is the source of energy and matter for Earth
- Measure, draw, cut out, and paint an accurate model (within 5 mm) of the sun and earth

2B. Assessment Tools/Evidence:

Formative:

- Sun/Earth Model: Measure, draw, cut out, and paint an accurate model (within 5 mm) of the Sun and Earth. Assess for accuracy.

3. Learning Experiences (Lesson Plan)

Materials:

- Drawing paper (white, good quality)
- Metric rulers (1/student)
- Shallow (2" deep) flat container with sides, (pour in about 1.5 inches of liquid starch)
- 1 tsp of alum dissolved in 1 cup of water and put in a spray bottle
- Gold, red, yellow acrylic paint
- Cut and measure a 65-inch piece of string. Measure that distance and mark with tape.

Handouts/Other Resources:

- This lesson is a modification of the following NASA activity. Request or print scale model of sun and earth from: Scale Model of Sun and Earth-NASA, http://sunearthday.nasa.gov/2007/materials/solar_pizza.pdf.
- Marble paper instructions from http://www.skiptomylou.org/2008/05/25/marbelizing-paper/ . It is important that you test this out before you do it in a class.

Procedure:

- Show students the printed Sun model. (pdf from: *sunearthday.nasa.gov/2007/materials/solar_pizza.pdf)*
  - Ask them to make observations about the surface of the Sun.
  - Ask them how big the Earth is in comparison to this model Sun.

- Instruct students to use a pencil to measure and draw a circle 23-cm in diameter on their drawing paper.
    - This will represent a scale model of the Sun. They will measure for accuracy.
    - Use scissors to cut out the circle. Use the circle to trace and cut a second Sun.
    - Tell students to draw the Earth on one of the Sun models, using the same scale as the Sun (by estimating, not calculating). Students write their name next to the Earth they drew on the surface of the Sun.
    - Tell them to estimate, using the Sun they measured for scale, the distance the Earth is from the Sun. They need to write this distance underneath their name on the surface of the Sun.
- Marbleizing the Sun circles shows the student a more realistic idea of what the surface of the sun looks like. Model how to marbleize paper using a document projector.
    - Direct them to the lab area to transform the marbling onto their second Sun model. Allow the marbled models to dry.
- Reality time
    - Show students the actual size of the Earth scaled to the Sun.
    - Show students the actual scaled distance of the Sun from the Earth.
    - Allow them to measure and stand opposite each other to represent the distance. (Have them use the pre-measured 65-ft string as a guide)
- Reflect on activity in science journal.
    - What did you learn from measuring and estimating the size of the Sun and Earth?
    - Explain how the distance of the Earth from the Sun influences our climate.
    - Why do scientists use models?
    - How do scientists use scale models, such as the one used today, to study the solar system?

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

Unit Title: Light Up My Life--Sun 101 Lesson Title: Space Math is BIG Date Developed/Last Revised: July 12, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 5 Grade Level: 5-8 Primary Content Area: Space Science Time Frame: 45 minutes

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **CCSS.Math.Content.8.EE.A.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
- **CCSS.Math.Practice.MP1** Make sense of problems and persevere in solving them.
- **CCSS.Math.Practice.MP4** Model with mathematics.
- **CCSS.Math.Practice.MP5** Use appropriate tools strategically.
- **CCSS.Math.Practice.MP6** Attend to precision.

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.
- Use scientific notation and choose units of appropriate size for measurements of very large quantities (e.g., use millimeters per year for seafloor spreading).
- Interpret scientific notation that has been generated by technology.
- Practice the following four Standards for Mathematical Practice:
    1. Make sense of problems and persevere in solving them.
    4. Model with mathematics.
    5. Use appropriate tools strategically.
    6. Attend to precision.

2B. Assessment Tools/Evidence:

Formative:

- Estimating size and how many times as much one is than the other
- Changing very large numbers into scientific notation

Summative:

Use volume formulas to solve real-world and mathematical problems

- Calculate the volume of the Sun and volume of the Earth
- Calculate how many Earths can fit into the Sun

3. Learning Experiences (Lesson Plan)

Materials:

- Computer with Internet Connection
- Projector
- Document Projector
- The Sun--Fast Facts Practice Problems for Teachers (attached)
- Space Math: Sun 101--Activity Guide Teacher Answer Key (attached)

Handouts:

- Space Math: Sun 101--Activity Guide (attached)

Other Resources:

This scientific notation activity was transferred from: NASA--Image Education and Public Outreach, http://image.gsfc.nasa.gov/poetry. There are MANY other activities on space math at this site.
A second and equally valuable site is Space Math@NASA, http://spacemath.gsfc.nasa.gov. The author of both sites is Dr. Sten Odenwald. His work is readily available, and free.
Following the Lesson Plan are practice problems so teachers may provide review and practice of scientific notation.

Procedure:

- Divide students into working groups.
- Review scientific notation by converting/solving space math problems associated with the Sun and the Earth. Sample problems with answers are listed following this lesson plan in the document: 'The Sun-Fast Facts Practice Problems for Teachers.'
- Model scientific notation conversion using document projector. Ask for student volunteers to solve practice problems.
- Distribute 'Space Math: Sun 101- Activity Guide' to all students.
- Ensure students work together to solve 'Space Math: Sun 101- Activity Guide.'
- Use 'Space Math: Sun 101--Activity Guide' to provide a formative assessment of student's ability to solve real-world math problems.

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

The Sun-Fast Facts
Practice Problems for Teachers
Use these large numbers as examples to review scientific notation with students

1. Our Sun is about 28,000 light-years from the center of the Milky Way galaxy. Convert to Scientific Notation.

   Answer: 2.8×10^4 light-years

2. Average distance from Earth to the Sun is 1 astronomical unit (AU). 1 AU equals 149,600,000 km (92,960,000 miles). Convert both numbers to scientific notation.

   Answer: 1.49×10^8 km and 9.296×10^7 km

3. The diameter of the sun is 1,390,000 kilometers (863,700 miles). Convert to scientific notation.

   Answer: 1.39×10^6 km and 8.637×10^5 km

4. Mass of Sun is 1.99×10^{30} kg. Convert this number to a standard number.

   Answer: 1,990,000,000,000,000,000,000,000,000,000 kg

5. You know the diameter of the sun (see 3 above) calculate volume. Convert to scientific notation.

   Answer: 1.4×10^{18} cubic km

6. The diameter of Earth is 12,760 km. Convert to scientific notation.

   Answer: 1.276×10^4 km

7. You know the diameter of the Earth (see 6 above) calculate volume, and convert to scientific notation.

   Answer: 1.1×10^{12} cubic km

8. How many Earths can fit inside the Sun?

Answer : About 1.3 million Earths (theoretically).

Circle Area = $\pi \cdot r^2$ = $\frac{1}{4} \cdot \pi \cdot d^2$

Sphere Surface Area = $4 \cdot \pi \cdot r^2$ = $\pi \cdot d^2$

Sphere Volume = $^4/_3 \cdot \pi \cdot r^3$ = $(\pi \cdot d^3)/6$

Name _____ Date _____

Space Math: Sun 101--Activity Guide

Scientific notation is an important way to represent very big, and very small, numbers. Here is a sample of astronomical problems that will test your skill in using this number representation.

Problem 1: The sun produces 3.9×10^{33} ergs per second of radiant energy. How much energy does it produce in one year (3.1×10^{7} seconds)?

Problem 2: One gram of matter converted into energy yields 3.0×10^{20} ergs of energy. How many tons of matter in the sun is annihilated every second to produce its luminosity of 3.9×10^{33} ergs per second? (One metric ton = 10^{6} grams)

Problem 3: The mass of the sun is 1.98×10^{33} grams. If a single proton has a mass of 1.6×10^{-24} grams, how many protons are in the sun?

Problem 4: The approximate volume of the visible universe (A sphere with a radius of about 14 billion light years) is 1.1×10^{31} cubic light-years. If a light-year equals 9.2×10^{17} centimeters, how many cubic centimeters does the visible universe occupy?

Problem 5: A coronal mass ejection from the sun travels 1.5×10^{13} centimeters in 17 hours. What is its speed in kilometers per second?

Problem 6: Pluto is located at a distance of 5.9×10^{14} centimeters from Earth. At the speed of light (2.99×10^{10} cm/sec) how long does it take a light signal (or radio message) to travel to Pluto and return?

Problem 7: The planet HD209458b, now known as Osiris, was discovered by astronomers in 1999 and is at a distance of 150 light-years (1 light-year = 9.2×10^{12} kilometers). If an interstellar probe were sent to investigate this world up close, traveling at a maximum speed of 700 km/sec (about 10 times faster than our fastest spacecraft: Helios-1), how long would it take to reach Osiris?

Space Math: Sun 101--Activity Guide Teacher Answer Key

Problem 1: The sun produces 3.9×10^{33} ergs per second of radiant energy. How much energy does it produce in one year (3.1×10^{7} seconds)? **Answer:** $3.9 \times 10^{33} \times 3.1 \times 10^{7} = 1.2 \times 10^{41}$ ergs.

Problem 2: One gram of matter converted into energy yields 3.0×10^{20} ergs of energy. How many tons of matter in the sun is annihilated every second to produce its luminosity of 3.9×10^{33} ergs per second? (One metric ton = 10^{6} grams). **Answer:** $3.9 \times 10^{33} / 3.0 \times 10^{20} = 1.3 \times 10^{13}$ grams per second, or $1.3 \times 10^{13} / 10^{6} = 1.3 \times 10^{5}$ metric tons of mass.

Problem 3: The mass of the sun is 1.98×10^{33} grams. If a single proton has a mass of 1.6×10^{-24} grams, how many protons are in the sun? **Answer:** $1.98 \times 10^{33} / 1.6 \times 10^{-24} = 1.2 \times 10^{57}$ protons.

Problem 4: The approximate volume of the visible universe (A sphere with a radius of about 14 billion light years) is 1.1×10^{31} cubic light-years. If a light-year equals 9.2×10^{17} centimeters, how many cubic centimeters does the visible universe occupy? **Answer:** 1 cubic light year = $(9.2 \times 10^{17})^{3} = 7.8 \times 10^{53}$ cubic centimeters, so the universe contains $7.8 \times 10^{53} \times 1.1 \times 10^{31} = 8.6 \times 10^{84}$ cubic centimeters.

Problem 5: A coronal mass ejection from the sun travels 1.5×10^{13} centimeters in 17 hours. What is its speed in kilometers per second? **Answer:** $1.5 \times 10^{13} / (17 \times 3.6 \times 10^{3}) = 2.4 \times 10^{8}$ cm/sec = 2,400 km/sec.

Problem 6: Pluto is located at a distance of 5.9×10^{14} centimeters from Earth. At the speed of light (2.99×10^{10} cm/sec) how long does it take a light signal (or radio message) to travel to Pluto and return? **Answer:** $2 \times 5.98 \times 10^{14} / 2.99 \times 10^{10} = 4.0 \times 10^{4}$ seconds or 11 hours.

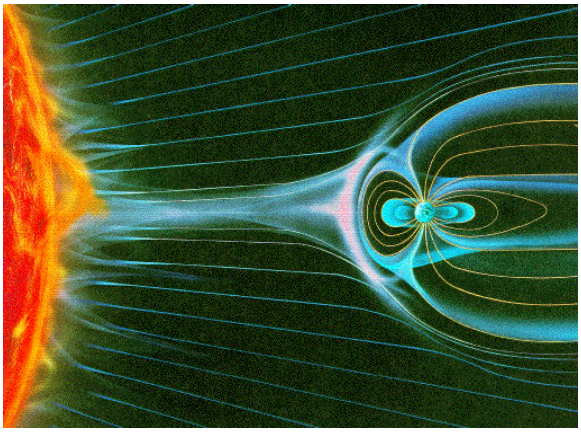
Problem 7: The planet HD209458b, now known as Osiris, was discovered by astronomers in 1999 and is at a distance of 150 light-years (1 light-year = 9.2×10^{12} kilometers). If an interstellar probe were sent to investigate this world up close, traveling at a maximum speed of 700 km/sec (about 10 times faster than our fastest spacecraft: Helios-1), how long would it take to reach Osiris? **Answer:** $150 \times 9.2 \times 10^{12} / 700 = 1.9 \times 10^{12}$ seconds or about 64,000 years!

For additional space math activities, visit: NASA--Image Education and Public Outreach, http://image.gsfc.nasa.gov/poetry

What causes a solar storm?

A solar flare as a violent explosion of magnetic energy on the sun. A Coronal Mass Ejection is a billion-ton cloud of gas exploding from the solar surface. Scientists can detect these 'solar storms' and measure how Earth's environment changes.

What scientists would like to learn is, how do you predict what will happen near Earth by looking at events taking place on the Sun, or in space?



Storms from the Sun sometimes make their way to Earth. Space physicists try to predict what will happen when these storms arrive, and forecast their arrival.

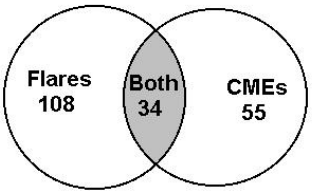
Statistical data can be used to draw conclusions about cause-and-effect relationships, even though the details of the process are unknown.

➢ Venn diagrams help astronomers sort out statistical information.

Here's how to do it!

In 2000, 142 solar flares, and 89 Coronal Mass Ejections were spotted on the Sun. 34 flares happened at nearly the same time as CMEs. What percent of CMEs are not accompanied by solar flares?

Now you try!



$$\frac{89-34}{89} = 0.62$$

or 62 %

1) In the sample problem above, what percentage of solar flares do not happen during CMEs? A news reporter says that solar flares produce CMEs. Is this an accurate statement? Explain.

2) A NASA satellite called ACE measures changes in the magnetism of the gas flowing away from the sun. During 2000 it detects 56 severe magnetic changes. Another satellite called SOHO detects 55 CMEs of which 29 happen at the same time as the ACE disturbances. The IMAGE satellite detects aurora in the polar regions of Earth. A total of 63 bright Aurora are detected during the 56 ACE magnetic 'storms'. There are 31 cases where aurora are seen at the same time as the magnetic disturbances. a) What percentage of CMEs cause magnetic disturbances? b) What fraction of magnetic disturbances lead to major aurora on Earth?

3) Can CME's be reliably used to predict when the next Aurora will occur? Explain.

Source: Sten Odenwald, http://spacemath.gsfc.nasa.gov/

Unit Title: Light Up My Life--Sun 101 Lesson Title: Inspector Detector--Mission Magnetometer Date Developed/Last Revised: July 12, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 6 Grade Level: 5-8 Primary Content Area: Space Science Time Frame: Two 45-minute classes

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **SC.8.8.4** Explain how the sun is the major source of energy influencing climate and weather on Earth
- **CTE 8.1.1** Design, modify, and apply technology to effectively and efficiently solve problems
- **STEM Competency 2.2**: Collaborates with, helps, and encourages others in group situations
- **STEM Competency 4.1:** Recognizes and understands what quality performances and products are
- **STEM Competency 6.4:** Uses the appropriate technologies for communication, collaboration, research, creativity, and problem-solving

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Use the engineering design process to create a quality, innovative instrument (for satellites) that detects information about magnetic fields (magnetometer)
- Work productively and collaboratively in a group
- Present their prototype and experimental evidence to support the mission to their peers

2B. Assessment Tools/Evidence:

Summative:

- Prototype of Magnetometer (Rubric attached)
- Group Presentation (Rubric attached)

3. Learning Experiences (Lesson Plan)

Materials:

(per magnetometer)

- 1 grid map (see instructions under “Get ready ahead of time”)
- Pieces of cardboard or small cardboard box
- 1–2 paper cups (6- to 8-ounce)
- 1 piece copier paper
- A small pile of metal shards (cut off a pad of coarse [i.e., #3 or 4] steel wool)
- String (50 centimeters [20 inches])
- Tape (clear or masking)
- 1 small magnet for testing
- Scissors
- Black marker

(per planetscape)

- 6–10 full sheets of newspaper
- 8–10 strong magnets

Handouts:

- Inspector Detector Magnetometer Mission is from: Mission Solar System, http://pbskids.org/designsquad/parentseducators/guides/mission_solar_system.html, pages 26-31
- Mission: Inspector Detector Activity Guide (attached)
- Performance Assessment Rubric (attached)

Other Resources:

Videos available for download

- Mission Solar System Training Video (for teachers), http://www.teachersdomain.org/asset/mss13_vid_profdev/
- Tracy Drain, Flight Systems Engineer, (for students), http://www.teachersdomain.org/asset/mss13_vid_flighteng/
- How Stuff Works-Magnetometer, http://www.howstuffworks.com/magnetometer-info.htm
- Exploring Magnetism in the Solar Wind, http://cse.ssl.berkeley.edu/segwayed/lessons/exploring_magnetism/in_the_Solar_Wind

Procedure:

Get ready ahead of time

- **Tape magnets.** Tape five to ten magnets to a sheet of newspaper. Make one of these "planetscapes" per lab group.
- **Draw the grid.** On a full sheet of newspaper, use a black marker to draw a 10 x 10 grid. Label the top 1–10 and the side A–J. Make an answer key, noting where the magnets are. Then lay the grid over the newspaper with the magnets.
- **Make the metal shards.** (Use scissors you don't care about.) Cut #3 (coarse) steel wool in small pieces, between an eighth and a quarter-of-an-inch long.
- **Get the videos.** Go to http://pbskids.org/designsquad/parentseducators/guides/mission_inspector_detector.html Download the videos referenced above. Be prepared to project them. If you're unable to show videos, review the handout's overview and steps and tell kids about the NASA work described in the overview and in Step 1.
- **Photocopy.** Copy the Mission: Inspector Detector Activity Guide and Performance Assessment Rubric.

On the day of the mission

- Appoint students to lab groups and distribute Mission: Inspector Detector Activity Guide to each student.
- Introduce students to Inspector Detector Mission. Use video resources to clarify mission (10 min).
    - Introduce magnetometers and how scientists use them to quantify the solar wind
    - Relate it to NASA missions
- Follow the Engineering Design Process
    - Ask and brainstorm (10 min)
        - Show students a magnetic field
        - Identify the problem
        - Offer final tips
    - Build, test, evaluate, and redesign (30 min)
        - Troubleshoot problems by asking questions
        - Teacher guide in Mission: Solar System (video listed under resources) offers suggestions
- Reflect on Mission Inspector Detector
    - Gather around one of the planetscapes (newspaper with magnets attached, and overlying grid)
    - Discover the pattern of magnets
    - Ask students, "Why are scientists interested in magnetic fields?"
- Career Connection (Tracy Drain videos)
    - Show video to students and discuss
- Student reflect on mission
    - Students reflect in science journal using prompts suggested in Mission: Inspector Detector Activity Guide

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

Names_____ Date _____

Mission: Inspector Detector Activity Guide

Use the Engineering Design Process to brainstorm, plan, construct and test an innovative way to detect magnetic fields--a magnetometer. This learning experience requires your group to present the prototype model to the class, using science information to qualify its function and ability to withstand space weather. Throughout this mission, you will work in your lab group. You will receive a grade from your group peers and be judged on the innovation, quality, and strength of the detector.

Your Challenge is to build a device you can pass above a surface to detect magnetic forces.

Research

Answer these questions using the information you have learned in this unit.

1. List 3 invisible energies from the Sun. How do humans detect these?

2. List 3 different devices that detect invisible energy.

3. Why would space scientists need to detect magnetism?

4. Does Earth have a magnetic field? What does it do?

5. Vocabulary for Mission:

magnetic field*:* The area around a magnet where a magnetic force can be detected
magnetometer*:* A device that detects magnetic fields

Identify the Problem and Brainstorm (10 min)

Guiding questions . . .

- How can you make sure that the metal shards stay in your detector and don't fall off?
- How can you make it easy to see when the metal shards move?
- How will you hold the detector as you move it above the surface?

Design, Test and Build (30 min)
After you have made your prototype, test it.

____Use the small magnet to test how well your detector works.

____Slowly pass your detector over the grid one section at a time to find the hidden magnets and plot them on your map.

____Use the grid lines to identify the locations.

____Is the group satisfied with the strength of the magnetometer?

Evaluate and Redesign (15 min)
Think about changing one of your design weaknesses. Here are some suggestions:

- Design a window or remove parts that block your view.
- Weak detector? Check that you have enough metal shards and that nothing blocks how they move.
- Check that you're not holding it too far above the surface. How far from the surface does your magnetometer work best?

Reflect (10 min)
In your science journal:

What did you learn today that is important in ANY career you might choose?
Think about a career as an engineer, like Tracy. What skills do you need to have that you practiced in doing this mission?

Performance Assessment Rubric

	Exceeds	**Proficient**	**Approaching**	**Novice**
Quality of Oral presentation	Group spoke clearly and smoothly in an engaging way. Group showed poise and confidence, interacted appropriately with the audience, and handled unexpected problems effectively. Presentation well-rehearsed.	Group spoke clearly and smoothly, showed poise and audience awareness. Group rehearsed the presentation. The audience could follow and find interest in the presentation.	The audience sometimes lost interest and had difficulty understanding or hearing group members. Group could have rehearsed the presentation more carefully.	The audience had difficulty following the presentation and understanding the group. The group did not practice enough.
Application of Science Knowledge	Explanations by group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations by group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by group members indicate a basic understanding of scientific principles underlying the construction and modifications.	Explanations by group members indicate little or no understanding of scientific principles underlying the construction and modifications.
Quality of Prototype Model	Structure functions extraordinarily well, holding up under atypical stresses.	Structure functions well, holding up under typical stresses.	Structure functions pretty well, but deteriorates under typical stresses.	Fatal flaws in function with complete failure under typical stresses.
Data Collection and Analysis	Data taken three times, then averaged in a careful, reliable manner using units. Clear and accurate understanding of formulas and calculations.	Data taken twice in a careful, reliable manner. Most units labeled. Clear understanding of formulas and calculations.	Data taken once in a careful, reliable manner. Some units labeled. Some understanding of formulas and calculations.	Data not taken carefully OR not taken in a reliable manner. Unclear understanding of formulas or measurement.
Use of Engineering Design Process	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.

Unit Title: Light Up My Life--Sun 101 Lesson Title: A Scientific Argument: Be Aware, Not Afraid Date Developed/Last Revised: July 12, 2013 Unit Author(s): Maggie Prevenas	Lesson #: 7 Grade Level: 6-8 Primary Content Area: Science Time Frame: 2 block periods

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- **SC.8.2.1** Describe significant relationships among society, science, and technology and how one impacts the other
- **SC.8.8.4** Explain how the sun is the major source of energy influencing climate and weather on Earth
- **CCSS.ELA-Literacy.RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts.
- **CCSS.ELA-Literacy.RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- **CCSS.ELA-Literacy.WHST.6-8.1** Write arguments focused on *discipline-specific content*.
- **CCSS.ELA-Literacy.WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.
- **CTE 8.1.1** Design, modify, and apply technology to effectively and efficiently solve problems

2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Independently read scientific articles and draw evidence to support analysis, reflection, or research
- Evaluate evidence and specific claims in informational texts and select relevant points
- Use a graphic organizer to guide thinking processes in outlining a written argument
- Write an editorial to argue the need to protect society from the effects of solar storms
- Support the editorial using evidence from the texts
- Create an editorial cartoon to visually support the editorial

2B. Assessment Tools/Evidence:

Formative:

- Reading guide to highlight evidence and summarize text from two scientific articles
- Graphic organizer for argument (Argument Map)

Summative:

- Editorial
- Editorial Cartoon (with Rubric)
- Teaching Task Rubric (Argumentation)

3. Learning Experiences (Lesson Plan)

Materials:

- Computers with internet access (if students read online articles)

Handouts:

- Student Argument Task Guide
- Teaching Task Rubric (Argumentation), from http://www.literacydesigncollaborative.org (LDC Template Task Collection 1, p. 16)
- Reading Guide (attached--have multiple copies for each student)
- Argument Map (attached)
- Hardcopies of articles
- Student Feedback Form (attached--two per student)
- Classroom Assessment Rubric (Argumentation), from http://www.literacydesigncollaborative.org (LDC Template Task Collection 1, p.17)
- Editorial Cartoon Guide (attached)
- Editorial Cartoon Rubric, from https://docs.google.com/viewer?a=v&q=cache:V3UEs-P4zMoJ:www.ncsl.org/Portals/1/documents/public/trust/Rubric_EditorialCartoon.pdf+&hl=en&gl=us&pid=bl&srcid=ADGEEShJ9I3KknOPzSf8LI6Dc9Eu0qfVhwK_FSMvtRb7hTwXUDMx5scZv8Vx1GMx-FGDe9RNMf-ivTSgLImJH-KDJ7A0UM5ZKCLXFzid7alaFXvxihJPPi0sAKBsdzb14lvSmthmqcgp&sig=AHIEtbTh9DJNpDF_Tm6vAv_z3Rkg7mx_cQ

Other Resources:

- Scientific Articles on Solar Storms Impacts on Humans can be found in pdf, *Solar Storms and You! Exploring the Human Impacts of Solar Activity*, http://spacemath.gsfc.nasa.gov/NASADocs/nasa6.pdf, 03/22/2013
- Nova Sun Lab, Sun 101-Spaceweather, http://www.pbs.org/wgbh/nova/labs/lab/sun/, 03/22/13
- Examples of online scientific articles on effects of solar storms on humans:
  http://www.scientificamerican.com/article.cfm?id=bracing-for-a-solar-superstorm
  http://hesperia.gsfc.nasa.gov/sftheory/spaceweather.htm
  http://www.swpc.noaa.gov/primer/primer.html
  http://sunearthday.nasa.gov/2013/articles/thesun_101.php
  http://spaceplace.nasa.gov/spaceweather/

Procedure:

Solar storms affect human communication satellites, GPS navigation, power grid coordination, water supply (through electric pumps), and a variety of other essential services. This lesson focuses on the fragile nature of human survival in lieu of massive solar storms. What can we do to become aware, not afraid, of our closest star, the Sun? Students will read a variety of scientific articles about the causes of solar storms and their effects on Earth. They can also access on-line multimedia resources to better understand the issues involved. Students write an editorial to explain their point of view, support it by citing relevant passages, and create an editorial cartoon to visually support their main message.

- Students are introduced to danger from solar storms by viewing 3 short video clips from Nova Sun Lab, Spaceweather, http://www.pbs.org/wgbh/nova/labs/lab/sun/2/1/.
- Students are given the Student Argument Task Guide with an activity checklist to help organize research and the argumentation rubric.
- Students select two or more sources to read. They can use a student Reading Guide handout to help organize their research. The handout may be completed in electronic or paper form.
- Students use a graphic organizer (or thinking map) to organize their editorial (argument map handout--optional).
- Students complete editorial rough draft.
- Students exchange editorials and use the Student Feedback Form and the Classroom Assessment Rubric (Argumentation) to evaluate two different peer's editorials.
- Students improve editorial based on feedback comments.
- Students use Editorial Cartoon Guide to create a cartoon for editorial.
- Students exchange cartoons and use Editorial Cartoon Rubric to evaluate cartoon.
- Students and teacher nominate individuals to present editorial and cartoons.
- Have a class discussion of student editorials.

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:

Student Argument Task Guide
Grade 8 Science
Be Aware, Not Afraid

After researching scientific articles and online multimedia resources on impacts of solar activity on humans, write an editorial that explains the causes of solar storms and argues the possible effects on human society. What implications can you draw? Support your editorial with evidence from the resources. Create an editorial cartoon to illustrate the main message.

Activities to accomplish task (Check)

___ 1. Independently read scientific articles and draw evidence to support analysis, reflection, or research

___ 2. Evaluate evidence and specific claims in informational text and select relevant information

___ 3. Use a graphic organizer to guide thinking processes in outlining a written argument

___ 4. Write an editorial to argue the need to protect society from the effects of solar storms

___ 5. Support the editorial using evidence cited from the texts

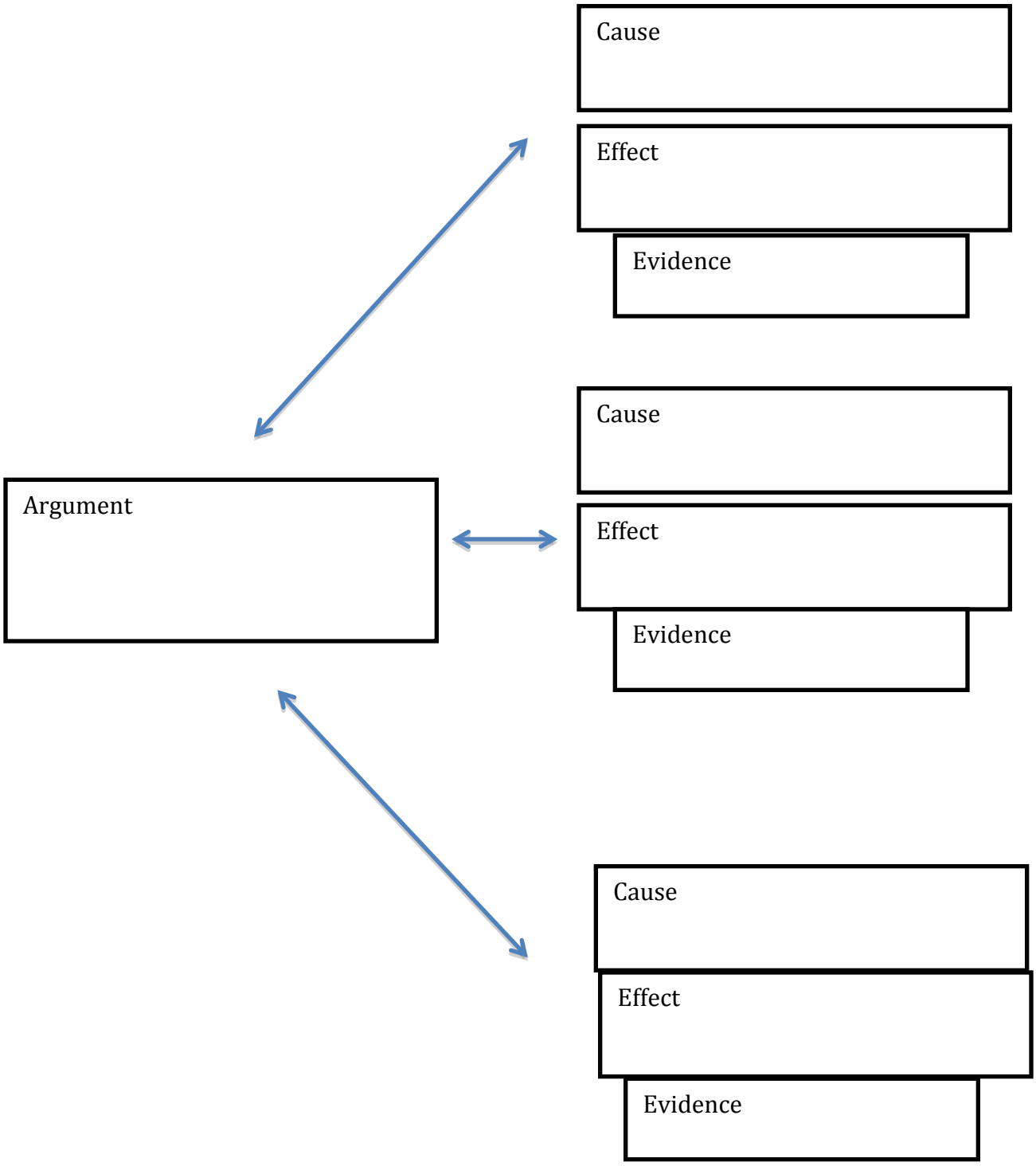
___ 6. Create an editorial cartoon to visually support the editorial

Reading Guide
Grade 8 Science
Student Argument Task
Impacts of Solar Activity on Humans

1. Name of Article: _____
2. Author:_____
3. Date of Publication: _____
4. URL: _____
5. Important information in my own words

6. Direct quotes from the article (resource)

Argument Map



Student Writer Name_____ Student Feedback Provider_____

Student Feedback Form (Editorial Argument)

Use the chart below to provide feedback to the student writer.

Scoring Element	Comments
1. Focus	
2. Reading /Research	
3. Controlling Idea	
4. Development	
5. Organization	
6. Conventions	

Editorial Cartoon Guide
Grade 8 Science

Think about the main message you wrote for your editorial.

- Why should we care about it?
- What should we do about it?
- Why is this important?

Write the main message here:

_____

_____

_____

_____ Think of another way to represent the message using symbols or pictures. Look in your reading guide or notes for words or a concept that summarizes how you feel, or why you care. Ask yourself: What would be an example of something that symbolizes this summary?

_____ Draw your cartoons in a horizontal, not vertical, format

_____ Use one 8½ x 11 white non-lined sheet of paper (you must use the full sheet)

_____ The cartoon must be hand-drawn

_____ Colored (by colored pencils only--no markers, pens, crayons, water colors, etc. . .)

_____ The BACK of the cartoon should have:
Title of cartoon
Name
Date
Class period

It does not have to be one "big" drawing. It can be a comic strip format with multiple panels if you would like.