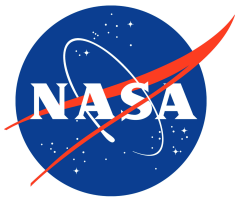


Thermal Energy (Part 1 of 3):

[Adapted from TeachEngineering.org's *What is Energy? Short Demos*.]

What is it?

The Sun is the source of much of the energy on Earth. Without the Sun, we wouldn't be able to live! The Sun's energy reaches us in the form of radiation, and much of that radiation we perceive as heat (Infrared Radiation). As energy leaves the Sun, it must travel through several layers, a process that can take up to a million years! The two regions near the surface of the sun are called the Photosphere and the Corona, but the interface between these two regions is still a mystery. The Interface Region Imaging Spectrograph (IRIS) mission opens a window of discovery into this crucial region by tracing the flow of energy and temperature between the Photosphere and the Corona.

In this activity, students will be introduced to thermal energy and become familiar with how it can affect simple materials.

This activity discusses topics related to National Science Education Standards:

MS-PS3-4: *Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass and the change in the average kinetic energy of the particles as measured by the temperature of the sample.*

- This activity allows students to "see" matter gain energy (thermal) and then release it as kinetic energy.

Materials (per team of 4 students):

Equipment, provided by NASA:

- Red Construction Paper
- String (1-foot section per group)
- Light bulb (incandescent only) and stand (enough provided for teams of 4)

Equipment, not provided by NASA:

- Hole punch
- Scotch Tape
- Scissors

Printables:

- Coiling Snake Template

Materials (per student):

Printables:

- Introduction to Thermal Energy Worksheet

Artifact included in this kit:

- IRIS Protective Blanket and Information Sheet
- IRIS Separation Mechanism and Information Sheet

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit http://speakers.grc.nasa.gov.

Brian Day (IRIS/LADEE Mission Education and Public Outreach Officer, Lunar Science)

John Marmie (Previous Assistant Project Manager for the IRIS Mission, Electral and Computer Engineering)

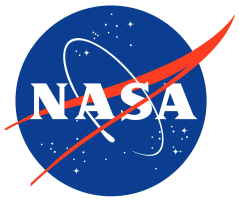
Ryan Mcdaniel (Solar/Thermal Dynamics)

Set-Up Recommendations:

- Prepare copies of **Introduction to Thermal Energy Worksheet** for students
- Prepare copies of the **Coiling Snake Template** for student teams
- Set out materials for each team and turn on lamp (so it can heat up)

Procedure:

1. Introduce the concept of thermal energy with a class discussion. Has anyone ever stood outside and felt warmed by the Sun? The warmth that they're feeling is called Thermal Energy and it is a form of radiation (Infrared Radiation) that we perceive as heat. The Sun emits radiation across the spectrum (Visible, Infrared, Ultra Violet, etc.) and we experience different types of that radiation in different ways (we see Visible light, feel Infrared, and Ultra Violet gives you a sunburn). What is interesting to know is that most of that energy is generated in the core of the Sun and can take up to one million years to escape! When the energy reaches the Photosphere (the part we see), there is a peculiar interaction before that energy reaches the Corona (what you can see during an eclipse, the hottest part of the Sun). The Interface Region Imaging Spectrograph (IRIS) mission is a NASA mission that is trying to determine what this peculiar interaction may be!
2. Introduce the activity. Students will use a coiled snake to learn about how thermal energy can affect the world around us.
3. Pass out the **Introduction to Thermal Energy Worksheet** and ask students to answer question 1.
4. Divide the students into teams (we recommend 3-4 per team) and have the team cut out their **Coiling Snake Template**. Make sure to cut along the lines.
5. Have students draw and cut out a forked tongue (about 1" long) from the red construction paper and tape it onto the head of the snake (use a small amount of tape).



6. Using the hole punch, have students punch a hole either in the head or the tail of the snake and tie their piece of string to the snake through the hole.
7. Have students point their light straight up toward the ceiling and turn it on.
8. Hold the snake by the string over the lamp. As the light bulb heats up, the snake should spin (around 5 minutes). Have students answer question 2 on their **Introduction to Thermal Energy Worksheet**. ***Safety Moment: Do not stare directly into the light bulb!***
9. Explain what is happening: when the light blub turns on, two forms of energy are being released, Thermal Energy and Visible light. When the light releases Thermal Energy, the molecules in the air begin to move faster (hence them having a higher temperature). As the molecules move faster, they begin to rise up through the center of the coiled snake. That thermal energy (which can be described as kinetic energy when thinking about the molecules) is transferred to the coiled snake as kinetic energy, causing it to spin!
10. Have students answer question 3 and 4 on their **Introduction to Thermal Energy Worksheet.**

Helpful Resources:

NASA Space Physics: Heat and Temperature
helios.gsfc.nasa.gov/qa_sp_ht.html

NASA's IRIS Mission:
http://www.nasa.gov/iris/

Safety:

- Please be sure that students do not look directly into the lamp as it can hurt their eyes.
- Please be sure students use proper scissor safety.
- Please be sure that students do not consume the glue.

Name: _____

Introduction to Thermal Energy Worksheet

1. Why is it that you feel warm when you stand in the Sun?

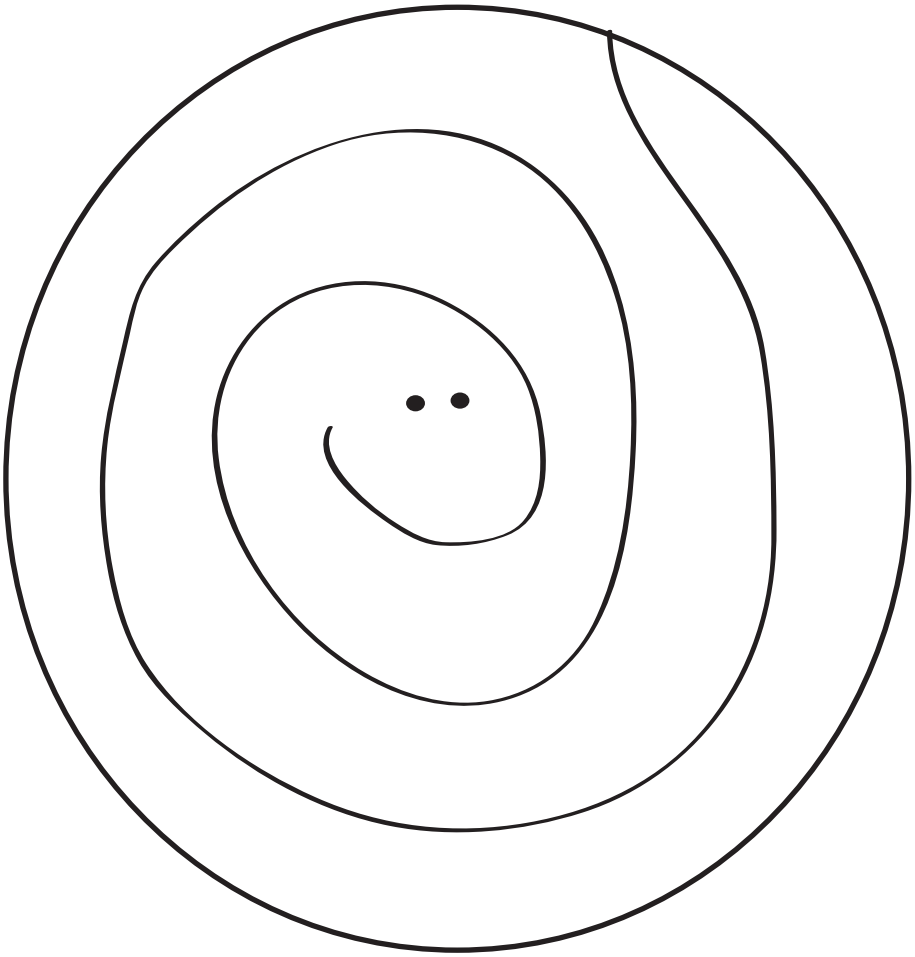
2. What happened when you held your snake over the lamp? Why do you think this happened?

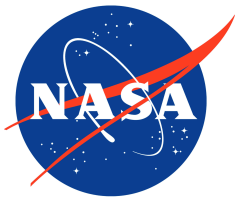
3. What do you think would happen if the snake was a different shape?

4. Using what you learned, try to explain another example of Thermal Energy.

Coiling Snake Template

Carefully cut out your snake along the lines.





Thermal Energy (Part 2 of 3):

[Adapted from NEED's *Energy from the Sun*.]

What is it?

The Sun is the source of much of the energy on Earth. Without the Sun, we wouldn't be able to live! The Sun's energy reaches us in the form of radiation, and much of that radiation we perceive as heat (Infrared Radiation). As energy leaves the Sun, it must travel through several layers, a process that can take up to a million years! The two regions near the surface of the sun are called the Photosphere and the Corona, but the interface between these two regions is still a mystery. The Interface Region Imaging Spectrograph (IRIS) mission opens a window of discovery into this crucial region by tracing the flow of energy and temperature between the Photosphere and the Corona.

In this activity, students will experiment with solar paper to see how the Sun affects different chemicals here on Earth.

This activity discusses topics related to National Science Education Standards:

MS-PS1-2: *Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.*

- This activity encourages students to consider that the Sun's energy (in the form of photons) can change the chemical structure of a material over time.

Materials (per team of 4 students):

Equipment, provided by NASA:

- Colored Construction Paper (darker colors work best)
- Solar Paper

Equipment, not provided by NASA:

- Scissors
- Sunscreen

Materials (per student):

Printables:

- Solar Signs Worksheet

Artifact included in this kit:

- IRIS Protective Blanket and Information Sheet
- IRIS Separation Mechanism and Information Sheet

Recommended Speakers from Ames:
Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit http://speakers.grc.nasa.gov.

Brian Day (IRIS/LADEE Mission Education and Public Outreach Officer, Lunar Science)

John Marmie (Previous Assistant Project Manager for the IRIS Mission, Electral and Computer Engineering)

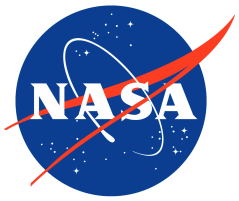
Ryan Mcdaniel (Solar/Thermal Dynamics)

Set-Up Recommendations:

- Prepare copies of **Solar Signs Worksheet** for students
- Set out materials for each team

Procedure:

1. Introduce the concept of thermal energy with a class discussion. Has anyone ever experienced something that had been bleached by the Sun? Not only does the Sun emit thermal energy, but it also emits Visible light. This light can bleach out color from different materials because the sun breaks the bonds of the pigment molecules. Different molecules react differently, and so you could have items of different colors react differently.
2. Introduce the activity. Students will use solar paper and construction paper to observe different chemical reactions.
3. Pass out the **Solar Signs Worksheet** and ask students to answer question 1.
4. Divide the students into teams (we recommend 4 per team). Have them cut two identical shapes out of white paper (i.e. Sun shapes).
5. Tape the shapes to the solar paper and construction paper (one to each). Please note that the tape will act like part of the shape and so we recommend taping it on the back.
6. Put both pieces of paper out in the Sun.
7. After two minutes, collect the solar paper. Soak the solar paper in water and hang up to dry. Have students answer question 2 on their **Solar Signs Worksheet**.
8. For the following four hours, have the students observe their construction paper once per hour. Have students mark their observations on their **Solar Signs Worksheet**.
9. Have a discussion about what is happening. Why did the solar paper react so quickly? The solar paper is designed to have quickly dissolvable bonds in the pigment molecules, but the construction paper does not. Have students answer question 4 on their **Solar Signs Worksheet**.



10. *Optional: Experiment with sunscreen on the solar paper and construction paper. Does the sunscreen break down after several hours? Why might this be?*

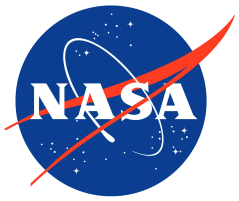
Helpful Resources:

NASA Space Physics: Heat and Temperature
helios.gsfc.nasa.gov/qa_sp_ht.html

NASA's IRIS Mission:
http://www.nasa.gov/iris/

Safety:

- Please be sure students use proper scissor safety.



Name: _____

Solar Signs Worksheet

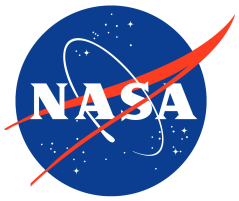
1. What do you think will happen to the solar paper when it is left out in the Sun? What do you think will happen to the construction paper?

2. What happened to your solar paper after 2 minutes? What does the construction paper look like after 2 minutes?

3. Make an observation of your construction paper every hour. Write your observations in the chart below.

Time	Observation
After One Hour	
After Two Hours	
After Three Hours	
After Four Hours	

4. Explain the difference between the solar paper and construction paper.



Thermal Energy (Part 3 of 3):

[Adapted from NASA's *IRIS Challenge: Tracking a Solar Storm*]

What is it?

The Sun is the source of much of the energy on Earth. Without the Sun, we wouldn't be able to live! The Sun's energy reaches us in the form of radiation, and much of that radiation we perceive as heat (Infrared Radiation). As energy leaves the Sun, it must travel through several layers, a process that can take up to a million years! The two regions near the surface of the sun are called the Photosphere and the Corona, but the interface between these two regions is still a mystery. The Interface Region Imaging Spectrograph (IRIS) mission opens a window of discovery into this crucial region by tracing the flow of energy and temperature between the Photosphere and the Corona.

In this activity, students will use their Sun knowledge to make a report on solar storms.

This activity discusses topics related to National Science Education Standards:

MS-ESS3-2: *Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.*

- This activity encourages students to consider the fact that the Sun is not a stable solar object, and changes on its surface and inside of its layers can cause changes here on Earth.

Materials (per team):

Websites:

- NASA Space Weather Action Center Data:
  http://sunearthday.nasa.gov/swac/data.php
- NASA Space Weather Media Viewer:
  http://sunearthday.gsfc.nasa.gov/spaceweather/#
- NOAA Space Weather Prediction Center:
  http://www.swpc.noaa.gov/
- SOHO Space Weather:
  http://sohowww.nascom.nasa.gov/spaceweather
- Space Weather:
  http://www.spaceweather.com
- Geophysical Institute Aurora Forecast:

http://www.gi.alaska.edu/AuroraForecast
- NASA's IRIS Challenge: Student Reports:
  http://irischallenge.arc.nasa.gov/iris_reports.html

Equipment, not provided by NASA:
- Presentation software (PowerPoint, Keynote, etc.) *or* video equipment (smartphone, digital camera, tablet computer)
- Scratch paper
- *Optional: Video Editing Software*
- *Optional: Music Capability*

Artifact included in this kit:
- IRIS Protective Blanket and Information Sheet
- IRIS Separation Mechanism and Information Sheet

Recommended Speakers from Ames:
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Brian Day (IRIS/LADEE Mission Education and Public Outreach Officer, Lunar Science)

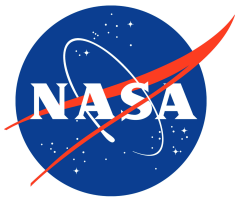
John Marmie (Previous Assistant Project Manager for the IRIS Mission, Electral and Computer Engineering)

Ryan Mcdaniel (Solar/Thermal Dynamics)

Set-Up Recommendations:
- Set out scratch paper for each team
- Connect classroom computers to the above listed websites
- *Optional: Connect to or print out student reports form the IRIS Challenge website (listed above and below).*

Procedure:

1. Introduce the concept of solar storms with a class discussion. The Sun is not always an even temperature across its surface. Because of this, you can look at an image of the Sun and see Sun Spots, or darker regions on the Sun. These darker regions are cooler areas of the Sun, which can cause solar storms, where the sun ejects material toward the Earth. This ejected material has a profound effect on our weather, from creating Aurora (or lights in the sky) to extreme weather.
2. Introduce the activity. Students will create a report on solar storms.
3. Divide the students into teams (we recommend 4 per team).



4. Have students pick 1 – 4 of the above websites to begin their research. They will be reporting on the Sun's weather, and so ask them to pay particular attention to the following items:
    - Sunspot activity
    - Solar flares
5. After significant time for students to study the Sun's weather, have them create a weather report. Using scratch paper, have them sketch out how what their report will cover. *Optional: Refer to previous IRIS space weather reports on http://irischallenge.arc.nasa.gov/iris_reports.html. Please note that these reports were compiled using several weeks of data.*
6. Have students assemble their space report (using PowerPoint, or writing a skit) and present in front of their class.

Helpful Resources:

NASA's IRIS Challenge:
http://irischallenge.arc.nasa.gov/index.html

NASA's IRIS Mission:
http://www.nasa.gov/iris/