Solar Dynamics Observatory

Activity Name	Grades	Suggested Activity Time	Materials
Camilla Space Weather Project Forecast	5 - 12	15-20 min	Internet access, computer(s)

Objectives- Students will be able to:

- Analyze real-time data taken by Solar Dynamics Observatory (SDO) instruments
- Identify sunspots, active regions, and other solar features on SDO images
- Predict the probability of a space weather event using SDO data

Description:

Using the online *Camilla Space Weather Project* Forecast Submission Form, students will learn about and identify solar features, and predict the chances that a space weather event will occur in the next 24 hours. In Part A, they will locate sunspots and learn how their position on the Sun is important. In Part B, they will examine a magnetogram image, and study the position and intensity of magnetic fields on the Sun. In Part C, they will identify solar active regions and learn how these relate to space weather events. In Part D, students will interpret data from a line graph that shows changes in the brightness of the Sun over time. In Part E, they will learn how to identify coronal mass ejections (CMEs) and determine if they are heading to Earth. In Part F, students will determine what the probability is of a space weather event occurring in the next 24 hours, based on their findings from Parts A-E.

How to Prepare:

If filling out the Submission Forecast Form as a class, make sure the computer you are using has an Internet connection. If students are going to be completing the form in small groups or individually, you may need to reserve a computer lab. Bring up the Forecast Submission Form (http://sdo.gsfc.nasa.gov/swx/forecastform.php) on the computer(s) you are using. If you want to build prior knowledge about space weather and solar features before doing this activity, visit the links listed in the Resources section on page 2.

Background Information:

The Solar Dynamics Observatory (SDO) was launched on February 11, 2010 from Cape Canaveral, Florida. It is the first mission to be launched for NASA's Living With a Star Program, a program designed to understand the causes of solar activity and its impacts on Earth. SDO studies how solar activity is created, how it affects space weather, and how it influences life on Earth and humanity's technological systems.

Space weather not only can interfere with power grids, and communication and navigation systems on Earth, but it can also harm astronauts and satellites in space. If scientists can learn how to predict when space weather events are going to occur, it could help prevent these problems. Predicting space weather is a relatively new science and much is still being learned about the process.

This activity allows students to forecast space weather events just as a scientist does; they will be accessing and analyzing real-time data just as scientists do. After students submit their forecasts, they will immediately receive feedback about how their forecasts compare to other forecasters' submissions. At the end of the week, students can see how accurate their forecasts were by checking back to the *Camilla Space Weather Project* Home page under the Space Weather News section for a weekly report.

Vocabulary: (see Resources section below for NASA SOHO glossary of terms)

- active region
- coronal mass ejection (CME)
- Halo CME
- LASCO
- magnetogram
- Solar Dynamics Observatory (SDO)
- SDO instruments: AIA, HMI, EVE
- space weather
- sunspot

Directions:

1. Introduce the topics of space weather and solar activity to students if they are not already familiar. To familiarize students with the concepts involved in this activity, visit the Resources section on page 2 for information and lesson plans. You can also find helpful space weather information and an informative video on the Home page (http://sdo.gsfc.nasa.gov/swx) that you can share with students prior to doing this activity.
2. Make sure students have the Forecast Submission Form up on their computer screen. Point out the video links (at the top of Parts A, B, C and E) and information buttons on the form. Encourage students to use these to help them answer questions.
3. Have students answer numbers 1-18 on the form and then submit their forecasts.
4. After submitting their forecasts, students will arrive at a results page. If desired, you can have them save this data by downloading it at the bottom of the page.
5. At the end of the week, check back to the *Camilla Space Weather Project* Home page (http://sdo.gsfc.nasa.gov/swx) under the Space Weather News section for a report of how accurate the students' forecasts were. Discuss with students how their forecasts compared to the actual space weather activity that occurred.

This activity…

- Addresses national science, math, and technology standards (see next page)
- Allows students to analyze real-time data to make predictions just as NASA scientists do
- Enables you to save student data to use for extension activities (i.e. graphing, creating reports)
- Can be used as a platform for teaching about and reinforcing key science concepts (i.e. the Sun is the center of the solar system, magnetism, electromagnetic spectrum)
- Can be tailored to fit your needs! Contact Wendy Van Norden at wendy.m.vannorden@nasa.gov to find ways to utilize this activity in your classroom

Resources:

General information:

- NASA—SOHO Glossary of solar terms: http://sohowww.nascom.nasa.gov/classroom/glossary.html

- NASA—Solar Dynamics Observatory: http://sdo.gsfc.nasa.gov
- National Earth Science Teachers Association—What is Space Weather? http://www.windows2universe.org/space_weather/sw_intro/what_is_sw.html
- Stanford Solar Center—Solar Magnetograms: http://solar-center.stanford.edu/solar-images/magnetograms.html

For related lessons:

- NASA—Camilla Space Weather Project classroom page: http://sdo.gsfc.nasa.gov/swx/classroom.php
- NASA—Sun-Earth Day, Magnetic Storms lessons: http://sunearthday.nasa.gov/2010/getinvolved/ed.php
- NASA—Sun-Earth Day, Space Weather Action Center lessons: http://sunearthday.nasa.gov/swac/educators/activities.php

Standards addressed:

A. National Science Education Standards

I. All Grades:
- A1: Abilities necessary to do scientific inquiry
- A2: Understanding about scientific inquiry
- E2: Understanding about science and technology

II. Grades 5-8:
- B3: Transfer of Energy
- D3: Earth in the Solar System
- F3: Natural Hazards
- F5: Science and Technology in Society
- G1: Nature of Science

III. Grades 9-12:
- B4: Motions and Forces
- B6: Interactions of Energy and Matter
- D1: Energy in the Earth System
- F5: Natural and Human-Induced Hazards
- G2: Nature of Scientific Knowledge

B. National Educational Technology Standards for Students (NETS-S):

- 3.a. Students use technology tools to enhance learning, increase productivity, and promote creativity.
- 5.a. Students use technology to locate, evaluate, and collect information from a variety of sources.
- 5.b. Students use technology tools to process data and report results.
- 6.a. Students use technology resources for solving problems and making informed decisions.

C. Mathematics Standards (NCTM):

- Data Analysis and Probability:
  - Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
  - Develop and evaluate inferences and predictions that are based on data
  - Understand and apply basic concepts of probability
- Process:
  - Connections: Recognize and apply mathematics in contexts outside of mathematics
  - Representation: Create and use representations to organize, record, and communicate mathematical ideas