**SEVERE WEATHER AND LIGHTENING PREDICTION AND WARNING LESSON PLAN OUTLINE –**

 **GOES-R Education Proving Ground**

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**Severe Weather and Lightening Prediction and Warning through the use of the GOES-R Satellite lesson:**

Students will be introduced to the GOES-R (Geostationary Operational Environmental Satellite R-series) through many different hands on, engaging activities.

**OBJECTIVE:** Students will learn about the advanced capability aboard the GOES-R satellite that will help save lives with earlier and more accurate detection of imminent severe weather. The GLM, Geostationary Lightening Mapper, is the first lightening mapper flown from geostationary orbit. This revolutionary lightening mapper will help predict imminent weather earlier than the due to the total lightening count. Total Lightning responds to updraft velocity and concentration, phase, type of hydrometeors, integrated flux of particles. This data will allow weather trackers to improve the timing, location, and detection of severe weather and will enable them to predict tornados faster than the current national average of fourteen minutes. Preliminary data shows that the warning time can be improved to more than twenty minutes with the data the GLM can collect.

The ABI, Advanced Baseline Imager, will be the primary imager aboard the GOES-R satellite. The ABI’s job will be to image Earth’s weather, climate, oceans, and environment. The ABI aboard the GOES-R satellite is much more advanced than previous ABI’s. It has a capability of 16 spectral bands as opposed to 5 bands the current GOES satellite is equipped with. This will allow for faster and better resolution images than ever before.

Student Activities for the ***Severe Weather and Lightening Prediction and Warning through the use of the GOES-R Satellite*** lesson will include, but are not limited to:

\*Begin lesson by watching the following video: The following video gives a wonderful overview of the GOES-R project capabilities and benefits to the world.

Watchful Eyes-The role of Geostationary Weather Satellites at the following link

 [https://www.youtube.com/watch?v=18RlraTqtGo](https://www.youtube.com/watch?v=18RlraTqtGo%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20%20)

\*Students will be presented with a list of weather related vocabulary. They will engage in a “table-top twitter” activity in groups of 3-4. The students will use their BYOT (bring your own technology) or other devices to look up the definition and an example of each vocabulary term and they will them write it on the poster paper at their station. (\*\*if technology is an issue the teacher can provide a text book or other printed resource for students to use for reference\*\*) Each group will be presented 6-8 vocabulary terms (2 per student). Once they have completed their poster they will hang it on the wall of the classroom, hallway, etc. The students will then be presented with sticky note paper and will then be required to go on a “gallery walk” to add positive reflective comments to each group’s poster. This activity will be followed with an exit ticket assessment.

\*As an enrichment students can play the game Spectrix at <http://scijinks.jpl.nasa.gov/abi> to test their knowledge of severe weather and satellite imaging. This game helps simulate some of the processes the GOES-R satellite goes through to collect weather data. The ABI on the GOES-R satellite will take up to 16 slices of light or wavelengths that tell the story of the weather or approaching storm. The game simulates the slices of light or colored images that would be picked up by the satellites ABI.

**\*End Project/ Summative Assessment** (application of knowledge in a real world situation): Students will have a directed inquiry activity (also known as problem based learning) presented to them in a realistic/real-life format. The students will be presented with a request written in a professional letter from Little League Sluggers Inc. that asks them to look at some weather data and the capabilities of the GOES-R satellite and asks the students to solve a weather related problem and help the requester to look for a solution. (The problem Little League Sluggers Inc. is facing is the concern of dangerous weather during the Little League Championship in Orlando, Florida. They need the students to tell them where to acquire the best satellite information for receiving reliable and accurate weather warnings). In order to help Little League Sluggers Inc. the students will need to consider all information provided; the weather data, satellite capabilities, etc. to develop a solution to the problem. They will work in small groups to complete the task. After they have come up with a solution they will be required to respond in writing to the requestor. The letter must include a step by step plan of action for the problem. This inquiry activity aligns not only with the science standards, but hits common core math, writing, and reading standards as well.

**Aligned Standards:**

**Next Generation Science Standard**

**HS-ESS3-1.**

**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]**

**MS-ESS2-5.**

**Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]**

**ESS2.D: Weather and Climate**

**•Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)**

**•Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)**

**•The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)**

**Common Core State Standards**

**RST.6-8.1**

**Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)**

**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). (MS-ESS2-3)**

**RST.6-8.9**

**Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3),(MS-ESS2-5)**

**WHST.6-8.2**

**Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)**

**WHST.6-8.8**

**Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS2-5)**

**SL.8.5**

**Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-6)**

 These lesson plans are under development by the Florida contingent of the **GOES-R Education Proving Ground** under the guidance of Dr. Paul Ruscher Professor at Lane Community College in Eugene, Oregon. Participating teachers are Charlotte Besse, Middle School Science Teacher and Science Department Chair at Silver Sands Middle School in Port Orange, Florida along with Amy Monahan, STEM Teacher on Assignment, DeLand, Florida.