



Earth System Tour – SOS Explorer (SOSx) Name: _____
Secondary Students' Exploration *Teacher Version*

Instructions:

- Click on the Earth System Tour icon in the lower left corner of SOS Explorer (SOSx) to begin.
- Look for the text below in *italics* to match the text in the SOSx tour. Then, answer the question/prompt that follows on this worksheet below.
- Make sure to interact and think about the questions that are asked in SOSx during the tour. Questions here in this worksheet are deeper thought questions or summaries of the information that is presented to you in the tour.
- During the tour you can press Play or Enter key to move to the next slide, but you cannot go backward.

1. Blue Marble with Real-time Clouds - *In this view of Earth what would change depending on the time of day? What would change depending on the day of the year?*

- Rotate the sphere around and answer the questions while thinking about the themes heat and sunlight.
Some ideas might include: Different places would be lit by the sun or dark depending on the time of day, different amounts of vegetation in places depending on the season or time of year.

2. Sea Surface Currents and Temperature - *Without heat transport by the ocean and atmosphere, the tropics would be warmer and the poles would be colder.*

- In your own words explain/summarize why without heat transport by the ocean and atmosphere, the tropics would be warmer and the poles would be colder.
If there were no ocean currents, there would be less heat transport which would not mix hot and cold water between the poles and equator making them more extreme.

3. Atmospheric Chemistry: GEOS-5 Model - *The atmosphere also plays a large role in the amount of heat that circulates in the Earth system. This is a model that shows the movement of tiny particles that find their way into the atmosphere and around the globe. These particles – called aerosols – often block sunlight from reaching the Earth's surface.*

- Pick an area of the world in the dataset animation where you think there might be less sunlight reaching Earth's surface. Why did you choose that place?

Some might include: Western Africa because of the dust or black carbon, southern Africa because of sulfates, India and SE Asia because of black carbon, China because of sulfates, Saudi Arabia and Middle East because of dust.

4. Layer – Volcanoes, Age of Seafloor – *This animation depicts magma breaking through the surface as lava erupting from volcanoes. This happens as an oceanic plate subducts, slides under, another plate. The west coast of South America is a good example of this type of plate boundary.*

- Instructions: Close the textbox and/or video pop-up in order to search the dataset for another good example of a subduction plate boundary – one where an oceanic plate moves under another plate forming volcanoes.
- Where is your example? (If you're not sure, try clicking on some of the volcanoes to find out the country or area where they occur.)
Some might include: Indonesia, Japan, Philippines, Singapore, Central American countries, U.S., Aleutian Islands, Russia

5. Biosphere: Marine Chlorophyll Concentration and Land Vegetation – *While heat from the Earth's core causes surface crust to change slowly, thanks to sunlight, life on Earth changes rapidly. This satellite view shows on land the amount of vegetation and in the ocean the amount of chlorophyll – a molecule that makes photosynthesis possible. Sunlight drives the seasonal changes you see.*

- Rotate the sphere around to see Africa. Why do you think the black patches are that occur in the ocean west of Africa?
This goes back to the idea of aerosols that block sunlight. These black patches indicate lack of data (satellite instrument can't read the vegetation on the surface) due to smoke and dust that is circulating off of West Africa and Sahara Desert.

6. Biosphere: Marine Chlorophyll Concentration and Land Vegetation – *Look closely at the animation and come up with two good questions you have about this dataset or specific things you notice in the data.*

- What questions do you have?
- Name 3 sources where you might go to find the answer?
Sources might be NASA, NOAA, Wikipedia, Google.

- After reading the dataset description on the website pop-up window (on the next slide), correct your answer for number 5 – what are the black patches? This goes back to the idea of aerosols that block sunlight. These black patches indicate lack of data (satellite instrument can't read the vegetation on the surface) due to smoke and dust that is circulating off of West Africa and Sahara Desert.

7. Sea Ice Concentrations – 1987 – 2013 – *The amount of sunlight hitting Earth that is converted to heat depends on how much of the Earth is white and reflective, snow cover and ice. Watch this animation of Sea Ice Concentrations from 1987 – 2013. You can see both the maximum and minimum sea ice extent for the Arctic and Antarctic.*

- Instructions to control the animation to answer the questions below:
 - o Find month and year in the upper right-hand corner of the screen.
 - o Practice pausing the animation there in the animation control panel.
 - o Practice moving the animation forward and backward one frame at a time by clicking the arrows on either side of play/pause.
- Rotate the sphere around to see the Arctic. In what month are the maximum and minimum ice extents for the Arctic? Why do you think they happen in these months?
Max is in April, due to end of winter months. Min is in September due to end of summer months. It takes all winter to build up the ice and all summer to melt it.
- Rotate the sphere around to see the Antarctic. In what months are the maximum and minimum ice extents for the Antarctic? Why do you think they happen in these months?
Max is in September, due to end of winter. Min is in April due to end of summer. Seasons are opposite from northern hemisphere. It takes all winter to build up the ice and all summer to melt it.

8. Sea Ice Concentrations – 1987 – 2013 – *Each year the Arctic Sea Ice gets thinner allowing it to melt easier. Less ice coverage yields a darker surface allowing more heat to be absorbed. This causes the temperature of the Earth's atmosphere to increase.*

- How might decreasing Arctic Sea Ice affect life in the Arctic?
Conditions are more difficult for polar bears and seal populations, which dramatically affects the ecological food web. Inuit communities experience fewer hunting days per year and igloos – used for hunting shelter - are harder to build. Shifting shape of ice makes reading terrain more difficult making landmarks, used for generations, no longer valid. Also, now with so



much of the Arctic exposed, many countries are vying for the opportunity to drill for oil. Drilling there is dangerous and can cause political disputes.

9. Blue Marble – Real-time Clouds – Summary Slide– *We’ve seen how ocean currents move heat, how volcanoes form and contribute to concentration of particles in the atmosphere, how sunlight affects life as well as how age of sea ice is changing over time.*

What additional connections can you describe between heat and the Earth system?

One example: Earth’s tilt causes the seasons due to changes in the amount of direct sunlight hitting the surface at different latitudes.