

MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment boundary: Assessment does not include the dynamics of the Coriolis effect.]

Practice: Developing and Using Models

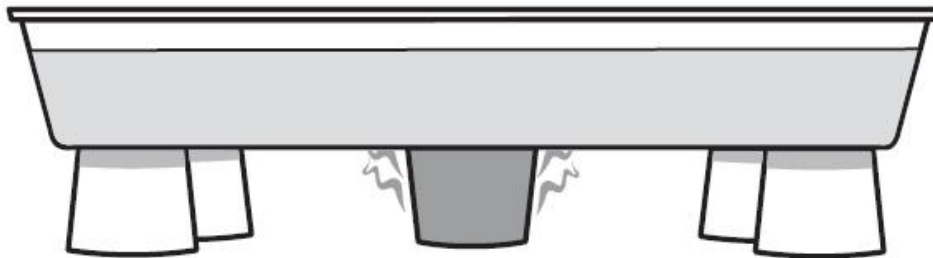
Crosscutting Concept: Systems and System Models

Task 1

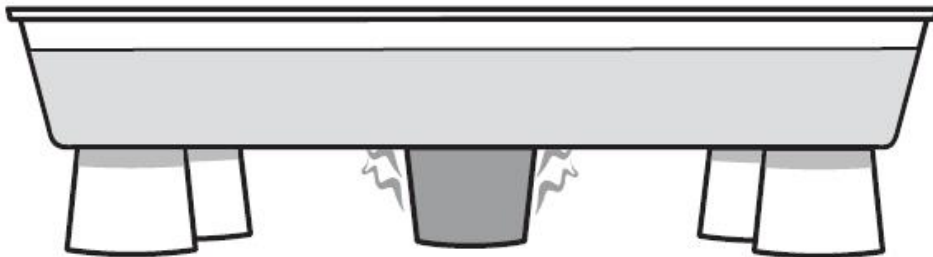
Imagine you are going to conduct the following experiment. Follow the directions below:

How is heat transferred through water?

Before conducting the experiment, predict how heat will spread from the heat source (the red cup) through the water. Draw your prediction directly on the diagram below.



To find out how heat travels through water, you will be using a small cup of hot water placed under a pan of room-temperature water. Food coloring will be used to trace how the water moves during the experiment. Your teacher will place several drops of food coloring at the bottom of your pan. Place a dot on the diagram below to show where the food coloring started. Then slide the cup of hot water under the center of the pan. Watch the food coloring and draw its path on the diagram below.



Task 2

Answer the following questions about regional climate:

1. How could you use an isobar map to predict the wind direction and speed?
2. How could you use an isobar map to predict where the cloud cover would be?
3. Why do areas of lower pressure often have cloud cover?
4. Your cousin from Florida is moving to Michigan and is nervous about the cold temperatures. What advice would you give him/her about where not to move to in Michigan?

Source: http://betterlesson.com/lesson/resource/3250150/weather-forecasting-discussion-questions?from=resource_image

Task 3

1. What causes air currents to form?

- a. Air currents form when cold air rises and warm air sinks.
- b. Air currents form when warm air rises and cold air sinks.
- c. The rising and sinking of air does not create air currents. Air currents form when cold air moves along the surface of the earth toward warmer air.
- d. The rising and sinking of air cannot cause air currents to form. Air currents form only because of the rotation of the earth.

2. Draw a model to explain your answer.

Task 4

Why is the equator hotter than the poles?

- A. The Earth has a spherical shape
- B. The equator is closer to the sun
- C. The Earth produces heat at the equator
- D. The equator has more volcanoes

Source:

<http://geoscienceconceptinventory.wikispaces.com/Earth%27s+Differential+Temperature>

Task 5

Describe how energy from the sun influences global winds. Your response must include the terms radiation and convection cells. Also, include the full influence of these two terms on global wind movement.

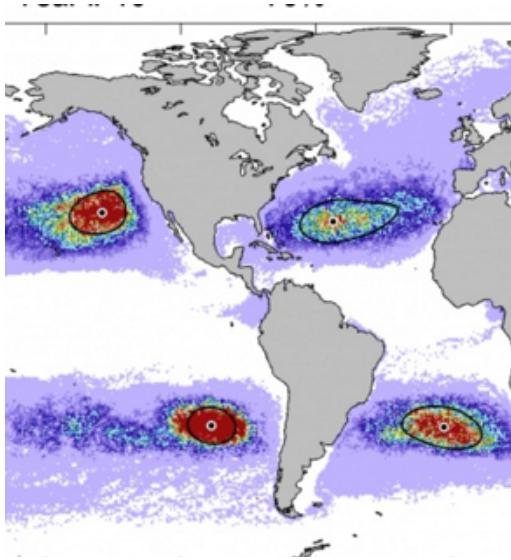
Example response: *Energy from the sun reaches the Earth in the form of radiation. Some of this radiation reaches the surface of the Earth and heats the air. The heated, less dense, low pressure air rises and is replaced by cooler, denser and higher-pressure air. The movement of the cooler and warmer air form cycles at the points of high and low pressure latitudes. This cycling is known as a convection cell. Energy from the sun provides the heat to heat the air and allows for the movement of this air via convection cells.*

Source: <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/72762>

Task 6

How Can You Explain This? The Great Pacific Garbage Patch

In the 1990s scientists began to notice lots of plastic debris in ocean **gyres** around the world. “**Gyres**” are places in the middle of large, circular ocean currents. As scientists began to investigate this phenomenon, they found an exceptionally large area of plastic debris in the North Pacific Gyre and called it the “Great Pacific Garbage Patch.” People around the world want to clean up the garbage patch. In order to do this, they need to know more about how the garbage patch formed.



Low Concentration of Plastic

High Concentration of Plastic

Concentration of Plastic

- Light purple shows areas of **lowest** concentration of plastics. There is not much.
- Dark Red are areas of **highest** concentrations of plastics. There is a lot.

1. Look at the colors in the Northern Pacific. Describe the pattern of where you see the most plastic in the Northern Pacific.

(Task 6 continued)

2. The water currents in the North Pacific Gyre move in a circular, clockwise pattern. Draw a scientific model of how this happens and be sure to include each of these in the model:

- a. The Earth's rotation
- b. The Coriolis effect
- c. Differences in water temperature by latitude
- d. Density of water
- e. Convection currents

Clearly label all model components.



3. Referring to parts of your model as evidence, *explain why* the highest concentration ends up where it does in the center of the Northern Pacific Gyre, according to the map.

(Task 6 continued)

Plastics break down into smaller pieces when they are exposed to sunlight. This is called **photodegradation**. Small pieces of plastic can be eaten by sea life, causing large problems.

4. Thinking about the amount of solar radiation at different latitudes, explain how **photodegradation** would vary between the southern and northern parts of the North Pacific Gyre. Refer to the amount of solar radiation at different latitudes.

5. Based on your answer above, make a claim about whether tropical (southern) or temperate (northern) food webs are more at risk from plastics in the Garbage Patch.