Fluid Earth: winds and currents

from the Esri GeoInquiries™ collection for Earth Science

Target audience – Earth Science learners **Time required – 15 minutes**

Activity	Explore the relationship between air and water currents.
Science Standards	**NGSS: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.
Learning Outcomes	• Students will use the maps and pop-ups to characterize ocean currents. • Students will use remote sensing to identify warm and cold currents.

Map URL: http://esriurl.com/earthgeoinquiry12

Engage

Why do temperatures fluctuate around the earth?

- → Click the link above to launch the map.
- → Click the four pins, from west to east.
- ? How many more times will solar rays hit the area between 0-30 degrees than between 60-90? *[four times]*
- ? If the earth at the equator is heated more efficiently than other latitudes, what will happen to the air above it? *[It will heat up, expand, get less dense, and rise.]*
- ? Which way will the wind blow to replace the rising air? *[It will blow toward the equator.]*
- ? Click the button, Bookmarks. Select Polar Winds.
- ? What will happen to the air at the poles if it is cool? *[It will cool, become denser, and sink.]*
- ? Which way will air move as it piles up above the poles? *[It will flow toward the equator.]*

Explore

How does the planet work to distribute heat?

- → Click the button, Bookmarks. Select Equatorial Winds.
- ? What happens to the tropical air after it has risen to the upper atmosphere? *[It spills outward to complete the convection cycle at 30 degrees north and south.]*
- → Click the Mid Latitude Winds bookmark. Compare them to an average day's winds at mid-latitudes.
- ? If the winds are blowing outward from this latitude, where is that air coming from? *[This is the air from the tropical region after it has cooled and lost its moisture as precipitation falling back to the earth.]*

Explain

How are ocean and wind currents tied to each other?

- → With the Details button underlined, click the button, Show Contents of Map (Content).
- → Click the link in the upper-right corner, Modify Map.
- → Turn on the layer, Spring Ocean Surface Temperature.
- ? What color are the cold water currents? *[They are the bluish green regions of the ocean intruding toward the equator.]*
- → Add Map Notes to draw in cold ocean currents. (See the Tool Tip for instructions.) *[Note: There should be strong colder currents on the western coasts of most continents.]*
- → Add Map Notes to draw in warm ocean currents extending toward the poles. *[Note: Two notable warm currents are the Gulf Stream off the east coast of North America and the Japanese Current off to the east of the Philippines, China, and Japan.]*
- → To confirm your drawings, turn on the layer, Ocean Currents.

more ▶

Elaborate

How do wildlife respond to wind and water currents?

– Cold water currents are usually drawn up from deeper depths when warm surface water is blown away from the continent.
? On which side of a continent do you usually find cold currents? *[They are typically on the west side.]*
– These deep water cold currents are rich in nutrients and feed abundant plankton. Fish and birds abound in these areas, but the cold water provides very little evaporation for rainfall on the neighboring continent.
? Which type of lands are next to these cold currents worldwide? *[many deserts]*

Evaluate

What if global winds ceased flowing?

– The Peruvian Current is a strong cold current.
→ Turn on the layer, Prevailing Winds.
? What would happen if the prevailing surface wind were to slow down? *[This condition is known as El Nino. The warm water would spread back across the Pacific, causing much higher rainfalls for western, Central, and South America. Along northern Australia and the surrounding islands, much cooler waters remain, so they would normally experience drought.]*
? The Gulf Stream is a major current moving toward the poles, so if the prevailing winds here slowed, how might this affect the climate of western Europe? *[A weaker Gulf Stream could cause western Europe to have much colder winters. It would also reduce precipitation in these areas.]*

ADD MAP NOTE

- Click Add, click Add Map Notes, and then click Create.
- Click Freehand Line to draw each current.
- Click Change Symbol > Color and choose orange or blue.

BOOKMARK

- At the top of the map, click the Bookmarks button.
- Choose your bookmark; the map will take you there.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at http://www.esri.com/schools.

THEN TRY THIS...

•Log in to your ArcGIS organization account. Add data, choose Browse Esri Map Layers, and choose the Earth Observations premium maps.

•Add the Current Wind and Weather Conditions layer from the Living Atlas.

•Compare weather-driven winds to the long-term prevailing winds discussed in this lesson.

TEXT REFERENCES

This GIS map has been cross-referenced to material in the atmospheric and oceanic currents sections of chapters from middle-school texts.

- *Earth Science by Glencoe McGraw Hill – Chapters 16, 17*
- *Earth Science by Holt – Chapters 14, 15*
- *Earth Science by McDougal Littell – Chapters D2, D3*
- *Earth Science by Prentice Hall – Chapter 16*

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