



# Climate change

from the Esri GeoInquiries™ collection for Earth Science

Target audience – Earth Science learners

Time required – 15 minutes

**Activity** Find areas that are predicted to change because of climate change.

**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 describe changes in global temperature and precipitation amounts and infer their consequences on current bioregions.

Map URL: <http://esriurl.com/earthgeoinquiry15>

## Engage

### How can we determine very slow changes in the environment?

- Click the link above to launch the map.
- Ask students if they have heard somebody older speak about when the first snowfall occurred when they grew up, when leaves started to change, or which months were the rainiest as they grew up. *[Answers vary but often include: first snow was before Halloween, or it was usually rainier in the fall.]*
- With the Details button underlined, click the button, Show Contents of Map (Content).
- ? What was the winter of 2014 like where you live?
- Turn on the four seasonal anomaly layers that show how different the temperature was in 2014 from the 30-year average (1950-1980) in Celsius.
- Click the button, Show Legend.
- ? How can 2014 be the hottest year on record when most of central and eastern North America experienced the very cold “polar vortex” during the winter season?

## Explore

### What’s the big deal with a few-degree increase in temperature? 10-50 degrees?

- A 3° Celsius increase in temperature can make a big difference. The last ice age ended because of a 4° C rise.
- ? What regions of the planet had the greatest increases in temperature during 2014? *[the polar extremes]*
- Turn off the four seasonal anomaly layers.

## Explain

### Why would some areas of the earth warm more than others?

- ? If the sun is not brighter and the sun-to-earth distance has not decreased, where does this extra heat come from? *[Less light energy is reflected (less snow/ice to reflect light), and more is absorbed and re-radiated as infrared. Infrared light is more easily absorbed by the atmosphere, thereby heating up.]*
- ? Where are the areas farthest above the normal? *[The areas toward the poles are farthest above the normal.]*
- ? Why would areas normally covered in snow and ice experience much higher than normal temperatures? *[If the snowfall starts later and melts earlier, then the dark earth absorbs more sunlight.]*

more ►

## Elaborate

### How would warmer conditions affect precipitation?

- Click the button, Bookmarks. Select North America.
- Turn on the layer, Climate Shifts Koeppen-Geiger.
- The data set allows for global, time-based animation of climate patterns from 1900 to 2100. The default display show only the last 100 years, using an increment of 5 years. (This can be modified with the Configure button.)
- Press the Play button.
- ? What happens to the dark green warm temperature zones? (These are wetter, forested areas.) *[Most move toward the poles and expand.]*
- ? What happens to the dry climate zones of desert and neighboring grasslands in the U.S.? *[Arid grasslands expand and move northward. The deserts expand north through the western Plains states.]*
- ? What economic activity do grasslands provide in North America? *[farming, especially wheat]*

## Evaluate

### Can the concepts in North America be extended to other continents or regions?

- ? Which countries would appear to have the most concern about losing their grassland food production areas (tan) to desert (brown)? *[Countries on Africa's southern Saharan border continue to lose grassland grazing to poor grazing practices, combined with climate changes. Australia's eastern crescent area contains large areas of grain farms and would be very susceptible to warmer, drier conditions.]*
- ? Do you think the Steppes (prairies) of Asia in southern Russia and Kazakhstan have as much to worry about with grassland loss as the southern Great Plains of North America? *[No. They do not appear to be affected in the same way.]*

#### TIME SLIDER

- Click the time slider, and drag it to the right or left (this works only on certain layers).
- Click the Configure button (the wrench icon) to change the slider's settings, including speed.

#### 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...

- Create Map Notes, and choose the Line tool to draw around the northern border of a climate zone.
- Change the time slider to 2100, and then use the Measure tool to see how much area will experience this warming trend.

## TEXT REFERENCES

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

- *Earth Science by Glencoe McGraw Hill – Chapter 17*
- *Earth Science by McDougal Littell – Chapter 4*
- *Earth Science by Holt – Chapter 17*
- *Earth Science by Prentice Hall – Chapter 18*