

Investigating biodiversity

from the Esri GeoInquiries™ collection for Environmental Science

Audience – Advanced environmental science

Time required – 15 minutes

Activity	Examine species richness to gain insight to evolutionary selection factors that encourage greater diversity.
Science Standards	APES II A. Biological communities APES II. C. Ecosystem diversity APES VII. C.1. Loss of biodiversity
Learning Outcomes	<ul style="list-style-type: none">• Students will identify biological factors that encourage speciation by examining centers of high biodiversity.• Students will prioritize regions globally for conservation with maximum species and minimal cost to set aside.

Map URL: <http://esriurl.com/enviroGeoInquiry15>

Engage

What does biodiversity look like?

- ? If you were invited to go on a big-game wildlife tour, what locations come to mind? *[Answers may include a Jeep tour in the African Serengeti, a boat tour in the Amazon, or a hike in the Papua New Guinea hills.]*
- Click the map URL above to open the map.
- Humans have made the most extensive use of the planet's surface in history. Which areas have lost the greatest amount of species diversity? *[Dark orange/brown areas]*
- Click on these dark areas of the map to find out what biomes these areas represent.
- ? What biomes have we changed most extensively? *[Grasslands and bordering deciduous forests]*
- ? Why have we changed these particular areas so extensively? *[Grains or feed for cattle grow in these regions.]*
- From the Details pane, click the button, Show Contents of Map.
- Turn off the Global biomes layer, by checking the box to the left of the layer name.

Explore

How does speciation relate to biodiversity?

- Predation drives speciation in plants.
- Check the box to the left of the layer name, Vascular Plant Diversity.
- ? Where is the highest variety of vascular plants? *[Near mountainous edges, Andean or Himalayan]*
- Check the box to the left of the layer name, Flowering Plant Diversity.
- ? Why would flowering plants have subtle differences in distribution from other vascular plants? *[Flowering plants spread through fruits, seeds, & pollen carried by animals, winds, & currents. Central America originated as island chains & provided isolation - allowing flowering plants to migrate & speciate.]*

Explain

Where are the hot spots for mammalian diversity?

- Turn on the two mammal diversity layers.
- ? Upon visual inspection, where is the center of highest mammal diversity? *[Amazon rainforest]*
- ? What mammals can take advantage of these big areas of flowering plants and trees? *[Bats add to the great diversity of animals in the Amazon. Africa has a large contingent of hoofed animals but more than 900 types of bats pollinate the rich diversity of flowering plants.]*

Elaborate

What factors support predation?

- ? What places have you heard of that have a lot of predators in the wild? *[Africa, based on students' experiences from movies, or zoo visits with their large African cats, hyenas, snakes, and so on]*
- ? What is it about Africa that has allowed it to contain such a rich variety of large mammals? *[Herd animals can migrate easily through grasslands with abundant seasonal food sources.]*
- ? Would this influence the numbers of mammalian carnivores? *[Open grassy habitats help young blend in, and abundance of food species from which to diversify, thus avoiding competition and potential conflict.]*

Evaluate

How does species density relate to species diversity?

- ? What are the species densities of all mammals in hot spot areas? (Hint: Use the legend.) *[~217]*
- ? How do these numbers compare to the mammalian carnivores? *[Six times larger or more]*
- ? Is that expected based on trophic energy availability? *[Yes, typically it takes 10 times the number of prey to keep the next trophic level fed.]*
- ? Do the numbers of species act as a proxy for total animals? *[Perhaps as an estimate. There will always be fewer predators in a system than prey species.]*

IDENTIFY A MAP FEATURE

- Click any feature on the map, and a pop-up window will open with information.
- Links and images in the window are often clickable.
- An arrow icon in the upper-right of the window indicates that multiple features have been selected. Click the button to scroll through the features.

TURN A MAP LAYER ON AND OFF

- With the Details pane visible, click the button, Show Contents Of Map.
- To show a map layer, select the check box next to the layer name.
- Hint: If a map layer name is light gray, zoom in or out on the map until the layer name is black. The layer can now be turned on.

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...

- Use an ArcGIS Online organizational account for schools to test hypotheses about mammal carnivore density. Examine factors such as elevation data, primary productivity, human impact, and habitat fragmentation.
- Explore *A Tapestry of World Ecosystems* with a story map at <http://esriurl.com/Geo517>.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these texts.

- *Sustaining Biodiversity* by Miller — Chapter 11
- *Conservation Biology* by Campbell — Chapter 38
- *Conservation of Biodiversity* by Friedland/Relyea — Chapter 18
- *Ecosystem Structure and Function* by BSCS — Chapter 24