Tuesday, December 13

1:15 – 2:45 ***GIS for Earth and Environmental Sciences*** – David DiBiase, Dr. Tom Baker (Esri), and Roger Palmer (Bishop Dunne High School).

GIS for Earth and Environmental Sciences Presenters bios

David DiBiase is Director of Education in Esri's Global Business Development group. He leads an education outreach team that promotes and supports GIS use by educators, students, and campus administrators at thousands of higher education institutions, schools, museums and libraries worldwide. Before joining Esri in 2011, David taught cartography and geographic information science at the Pennsylvania State University for 22 years. He founded the Penn State Online certificate and masters degree programs in GIS, which earned the Sloan Consortium's Most Outstanding Online Program award in 2009. As chairperson of the University Consortium for Geographic Information Science's (UCGIS) Education Committee, he led the effort to complete the first edition of the *GIS&T Body of Knowledge.* He also facilitated and edited the U.S. Department of Labor's Geospatial Technology Competency Model. David led the NSF-funded GIS Professional Ethics project, and still teaches professional ethics part time for Penn State.

Roger Palmer is a science department chair that teaches high school chemistry, physics environmental, and field science. He holds an M.S. in Chemistry and conducts research with students in the use of GIS to model integrated approaches to environmental problems. Through his company, GISetc, Mr. Palmer has conducted countless GIS institutes for teachers and GIS/science camps for students in the USA and in the international arena for the past fifteen years. He is a co-author of the NASA funded *A Birdseye View* primary school curriculum, the American Association of Geographers' *Understanding the Changing Planet* online resource materials, the Carte Diem Press *Going Places with GPS*, *20 Minute GIS for the Early Learner*, *Geotagging Media* and *Tech Enabled Field Studies* books. He was a co-developer and teacher of the online GIS Masters Certificate program for educators as well as current University of Redlands Spatial Thinking masters program courses.

Dr. Tom Baker an instructional designer, science educator, and researcher serving as an education manager in Esri's Global Business Development group where he leads K-12 curriculum development, STEM activities, and educational research efforts. Since teaching middle school science, he has served on the research faculty at the University of Kansas and managed federal and state funded efforts to include technology tools for supporting collaboration and inquiry in STEM classrooms. His prior funded work includes "Extending Scientific Inquiry through Collaborative GIS" (ESIC) and Pathfinder Science, an environment for collaborative scientific investigations among students. His research interests have broadly focused on improving student outcomes with technology, STEM, learning design, inquiry based learning, and geospatial technologies.

North American landforms

Target audience – Earth Science, grades 6-9 **Time required – 15 minutes**

Activity Introduce and explore various types of landforms.

Science Standards **MS-ESS2-3** – Analyze and interpret data on the distribution of fossils, rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
MS-ESS2.B – Plate Tectonics and Large-Scale System Interactions

Learning Outcomes

- Students will work to recognize landforms from small to large scale.
- Students will associate clues from the landscape, describing how they were formed.

Map URL: http://bit.ly/earthgeoinquiry5

Engage

Rough, rugged, or smooth, what landforms cover North America's surface?

- Click Modify Map.
- Click the Show Contents button (on the Details pane).
- Turn on the Landform Marker layer; you will now see an Edit button at the top.
- Click the Edit button and then click Landuse Marker.
- Click and drag the cursor around the map to "sketch" similar continuous regions, based solely on their appearance. (If necessary, zoom in to see more detail.)
- ? How many unique regions did you choose? *[Students should be able to differentiate two mountain regions, and one or two regions of plains along the coast in the south and another in the Midwest/north. Students may also notice differences in flat areas next to mountains in the plateau regions that have deeper river valleys through them.]*
- To stop drawing, click the Edit button.
- If needed, click the button Show Contents (on the Details pane).
- Turn off the World Shaded Relief layer by clicking the checkbox.

Explore

Is there more to landforms than texture?

- Turn on the North American Landforms layer.
- Click the Basemap button, and then click Topographic.
- ? Which areas did you miss? *[Many miss the plateaus, as they are harder to differentiate unless you have a colored elevation layer. They occur along mountains but are smoother and uplifted instead of broken or folded. They are different from plains in that rivers across them generally create much deeper valleys.]*
- ? Which color is used to show the plains? *[They are a light green color.]*
- Click several places across the plains.
- ? Are all plains considered the same? *[No. There are coastal, great, and interior lowland plains.]*
- ? How do you think the plains along the Gulf Coast are separated from the mid-continent plains? *[Coastal plains get more precipitation and are more moderate in temperatures.]*
- ? What evidence might you use to support this idea? *[The imagery should show greener areas, particularly along the Gulf Coast.]*

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Explain

What's elevation got to do with it?

- Click the button, About the map (Details pane). Click the Open Presentation link and view the presentation in a new tab.
- On a whiteboard, group the landforms that are featured in the presentation in a system that makes sense to students (for example, coastal features, river landforms, or hill-type features).
- Close the tab that has the presentation and return to the online map.

Elaborate

Would a bay by any other name, sound the same?

- Click on each bookmark. Ask students to identify and differentiate among various types of landforms as listed below.

? Coastal features *[Cape, Isthmus, Peninsula, Island, Archipelago, Barrier Island.]*
? Freshwater regions *[River, Lake, Flood Plain, Delta.]*
? Ocean bodies *[Strait, Bay, Sound, Harbor.]*
? River-formed landforms *[Valley, Canyon, Divide, Basin, Alluvial Fan.]*
? High elevation terrains *[Volcano, Mountain, Butte, Mesa, Plateau.]*
? Large ice features *[Montane Glacier, Continental Glacier.]*

Evaluate

What landforms do you have around your school?

- Search for any of the landform types found in your local area. Use the Find Address Or Place search tool.
- Explain what the selected landform is and how it differs from similar features (e.g. those in Elaborate).

? If you have chosen a local cape, for instance, how is this different from a barrier island? *[Answers will vary depending on which landforms you choose.]*

EDIT (ADD FEATURES)

- At the top of the map, click the Edit button.
- Click Landuse Marker.
- Click and hold the mouse button to start drawing.
- Move the mouse to draw, then let go of the button to finish.

BOOKMARK

- At the top of the map, click the Bookmarks button.
- Choose a bookmark.
- The map scale and extent will change.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to U.S. public, private, and home schools as a part of the White House ConnectED Initiative. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at http://connected.esri.com.

THEN TRY THIS...

- Log in to your ArcGIS organization account and search for **Elevation Tinted Hillshade**.
- Turn the transparency to about 75 percent for a subtle look that does not obscure place names on other layers.
- In the upper right of the map, in the Find Address Or Place box, search for local landform names.

TEXT REFERENCES

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

- *Earth Science by Glencoe McGraw Hill – Chapter 6*
- *Earth Science by Holt, Rinehart, Winston – Chapter 11*
- *Earth Science by McDougal Littell – Chapter 1*
- *Earth Science by Prentice Hall – Chapter 1*

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ADVANCED ENVIRONMENTAL SCIENCE

Marine debris

Audience – High school environmental science **Time required – 15 minutes**

Activity	Investigate marine debris, the role of ocean gyres, and how humans impact trash accumulation.
Science Standards	**APES: IC.** Global Water Resources and Use **APES: IV.A.** Benchmark: Pollution Types **NGSS: HS-ESS3.** Earth and Human Impacts
Learning Outcomes	• Students will investigate how marine debris becomes trapped by ocean gyres. • Students will predict where marine trash will accumulate in oceans.

Map URL: http://esriurl.com/enviroGeoinquiry9

Engage

What are the major ocean currents?

→ Click the map URL link above to open the map.
→ Zoom and pan the map to see all the ocean currents.
? Why are some currents marked red and some marked blue? *[Temperature differences]*
– Equatorial waters are the warmest and, like air, warm water expands and rises. This results in about a 3-inch-higher water surface elevation in the tropical region than elsewhere.
? What impact does this have on direction of equatorial warm water currents? *[Water flows away from the equator.]*
? What is the cause of this pattern? *[Gravity]*

Explore

Will an ocean current trap marine debris?

→ With the Details pane visible, click the button, Show Contents of Map.
→ Click the checkbox left of the layer, Pacific Markers. Click the Hawaii marker. Click the link to enlarge.
– Gyres are large circular ocean currents that redistribute heat and can trap marine debris.
→ Zoom out and pan the map.
? Where are other gyres, potentially trapping debris? *[North & South Atlantic, South Pacific, Indian Ocean]*

Explain

Where does the trash come from?

– Researchers estimate 80%of trash comes from land and 20% comes from marine sources.
? What are the main sources of land-based trash? *[Litter; industrial discharges, such as microplastics; garbage transport; and landfills]*
→ Click the button, Bookmarks. Select Spokane.
→ From the Details pane, click the button, Show Contents Of Map.
→ Click the checkbox to the left of the layer name, Spokane Downstream Trace.
? How can trash from inland areas, such as Spokane, reach the ocean? *[Trash and litter flow down rivers to the ocean.]*

more ▶

Elaborate

Why are "garbage patches" filled with plastic?

→ Pan the map to see the Pacific Ocean, and click the map marker near the Midway Atoll.
→ In the popup window, click the animation of Trash Accumulation.
– Trash from the United States coastline may take six years to reach the Eastern Pacific Garbage Patch, while Japanese trash takes about one year.
? Why is plastic the main trash found in this area? *[Plastic floats; biodegradable material decomposes while plastic only breaks into smaller pieces but does not decompose.]*
→ Click the Spokane map marker to see one common source of plastic pollution.

Evaluate

What is the impact of marine debris?

→ Turn on the layer, Blue Whale Concentration.
→ Click the Blue Whale area in the map for more information.
? How could the ingestion of microplastics, such as nurdles or other plastic trash, impact whales? *[It can cause malnutrition or intestinal blockage.]*
? How can you prevent additional marine debris? *[Recycle: Reduce plastic that ends up in the waste stream; educate others to prevent coastal pollution; and/or participate in beach cleanups.]*

ZOOM TO A BOOKMARK

- Click the button, Bookmarks.
- Select a bookmark name to zoom to its map location and scale.

TURN A MAP LAYER ON OR OFF

- Press the Details button to turn on the pane.
- Show the table of contents for the map by pressing the button, Show Map Contents.
- Show layers by checking the box next to layer names.
- If a map layer name is light gray, zoom in or out of the map until the layer name is black. The layer can now be turned on.

Next Steps

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THEN TRY THIS...

- Investigate the impact of marine trash on albatross in the story map, *Winged Ambassador*, at http://esriurl.com/Geo551.
- Using an ArcGIS Online organizational subscription for schools, create a cluster map analysis for point locations of garbage in the sea. Explore how the map scale of cluster data informs your data interpretation.

TEXT REFERENCES

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

- *Environmental Science: A Global Concern by McGraw-Hill — Water Use and Management Chapter*
- *Living in the Environment (16th) by Brooks/Cole, Cengage Learning — Global Climate and Biomes Chapter*

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