

Exploring Our World with GIS Lesson Plans

Engage

Title: Exploring Our Nation

Suggested Timeframe:

20 minutes

Management Suggestions:

- *Reserve computer lab in advance
- *Prepare students for what they are going to do prior to going to the lab
- *Have students complete group work prior to going to the computer lab.

Materials:

1. Student Instruction sheets
2. List of themes
3. Computer lab
4. Student Science Journals.

Purpose:

- To introduce students to the use of GIS or other spatial software programs.
- To help students become aware of the climactic and population make up of the United States.
- To give student practice with identifying various states and parts of the U.S.

Guiding Questions:

- What information did you find out from the different themes that your group chose?
- What observations can you make based on the information you gathered?
- What conclusions can you draw based on your observations?

Definitions:

Theme: a layer or set of information about a certain topic, place, event, etc.

Procedure:

1. Give students the list of themes to choose from. In groups of 3-4 give student 5 minutes to choose 3 to 5 themes that they are interested in finding out information about. 2. In the computer lab students will individually create a map by following the instructions on their instruction sheet. These instructions are summarized for you below.
2. Have students open up the website <http://nationalatlas.gov/natlas/natlasstart.asp>
Tell students that using this site and the themes they selected in their groups they will create a map on the computer. First, they need to view the items listed under each heading on the right hand side of the website. In order to view the list of items under each heading they will need to left click once on the "+" button next to the heading. For example, if they want to view the items under "Basic Maps" (cities and towns; roads; streams and waterbodies; and counties) they will need to left click once on the "+" to the left of "Basic Maps". After they left click on it they will see a "-" to the left of the heading where the "+" used to be.
3. To select the 3 to 5 themes they chose as a group, students need to left click once in the box next to the theme they chose. For example, if they chose "crops" under the "Agriculture" heading, students need to left click once in the box to the left of the word "crops". Once they have done this they should see a check mark in the box indicating that they have selected that theme. If they accidentally chose the wrong theme all they have to do is left click once in the box again and the check mark should go away indicating that theme is no longer selected. **NOTE:** Some themes do

not have a box to click in. Instead, they have a drop down menu box. These boxes are immediately under the themes they go with. To select these themes students need to click on the arrow of the drop down menu box and then click on their selection from that menu.

4. Once students have checked the boxes of the 3 to 5 themes they chose they need to click the button that says “redraw” . Next, have students click on the “map key”  button to make a key for their map.
5. Give student 5 minutes to choose another blue button to use, such as zoom in or zoom out. If you do not want them to print their map tell them not to choose the blue “print map” button.
6. While still at the computer, or back in the classroom if necessary, have students list in their science journal 5 things that they learned from the activity, one thing they liked about the activity, and one thing they would like to do to make the activity better next time.

List of themes to choose from:

- **Basic Maps:**
 - Cities and towns
 - Roads
 - Streams and waterbodies
 - Counties
 - States
- **Agriculture:**
 - Crops
 - Farms
 - Land
 - Livestock
 - Value
- **Climate:**
 - Average annual precipitation
 - Major landfalling US hurricanes
- **People:**
 - Crimes in 2000
 - Median family income
 - People under age 18 in 2000

Explore

Title: Using GIS

Suggested Timeframe:

45 minutes

Management Suggestions:

*Reserve computer lab in advance

*Prepare students for what they are going to do prior to going to the lab

*Copy Questions and Instructions pages

*This activity can be done on the same day as the engage activity.

Materials:

1. Student Instruction sheets
2. Computer lab
3. Students' Science Journals

Purpose:

- Introduce students to how to use GIS or other spatial software programs.
- Help students become aware of the climactic and population make up of the United States.
- Give student practice with identifying various states and parts of the U.S.

Guiding Questions:

- What kind of information does this site give you about the states, counties, and cities on this map? Accept all reasonable answers. Ex: information about population, climate, etc.
- What is one reason that people might want to use this site? Accept all reasonable answers.

Definitions:

Theme: a layer or set of information about a certain topic, place, event, etc.

Procedure:

1. Have students open up the website <http://nationalatlas.gov/natlas/natlasstart.asp>
Tell students that this time the class will all make the same map and then answer questions about it.
2. Have students left click once on the “+” button next to the “Basic Maps” heading and then click once in the box next to the “cities and towns” and “states” themes. Follow these same steps to choose from the “Climate” heading the “average precipitation” and “major landfalling US Hurricanes – 1990s” themes. Follow these same steps to choose under the “People” heading the “under age 18 - 2000” theme.
3. Tell students to click the blue button that says “redraw”. This button is in a list of buttons going down the page on the right hand side of the map. This will draw the map using the 5 themes that you told students to select in step #2.
4. Next, have students click on the blue “map key” button to make a key for their map. This will give the map a legend.
5. Tell students to answer questions 1 and 2 on their question sheet.
6. Click on the blue button that says layers. Under the “Climate” heading unselect the “Average Annual Precipitation” theme by clicking on the box to the left of it. There should no longer be a check mark in this box. Next, under the themes “Major Landfalling US Hurricanes” scroll up to the top of the list and choose “None Selected”. Click on the blue button that says “redraw”. Click on the blue “map key” button.
7. Have students answer questions 3 through 5 on the question sheet.
8. Have students click on the “Zoom in” button. Click on the county that makes up the most western part of Texas (where El Paso is). Click on the blue identify button. Click on this county again and answer questions 6-8.
9. Tell students to close their “identify” box by clicking on the “x” in the upper right corner of the identity box. Click on the southern most county in Texas and answer questions 9 through 11 on the question sheet.
10. While still at the computer, or back in the classroom if necessary, have students list in their science journal 2 things that they learned from the activity, one thing they liked about the activity, and one thing they would like to do to make the activity better next time.

Use the map and the map key that you created on the *National Atlas* site to help you answer the following questions.

1. Name 2 states that gets, on average, more than 60 inches of rain per year in part of the state. (Alabama, California, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oregon, Washington)
2. In the map key, the average annual precipitation was found using information from which years? (1961-1990)

Click on the blue button that says layers. Under the “Climate” heading unselect the “Average Annual Precipitation” theme by clicking on the box to the left of it. There should no longer be a check mark in this box. Next, under the themes “Major Landfalling US Hurricanes” scroll up to the top of the list and choose “None Selected”. Click on the blue button that says “redraw”. Click on the blue “map key” button.

3. Which state has the most area covered by people under the age of 18? (Alaska).
4. Which part of the country (East, West, or in the middle) has the highest percentage of people under the age of 18? (West).
5. Based on this information, where would you like to live if you wanted to be with lots of people your age?

Click on the “Zoom in” button. Click on the county that makes up the most western part of Texas (where El Paso is). Click on the blue identify button. Click on this county again and then answer the questions below.

6. What is the name of this county? (Hudspeth)
7. What percentage of this county is made up of people under the age of 18? (34.1%)
8. In 2000, what was the population of this county? (3,344)

Close your “identify” box by clicking on the “x” in the upper right hand corner of the identify box. Click on the southern most county in Texas, and use the information to answer questions 8 through 10.

9. What is the name of this county? (Cameron)
10. What percentage of this county is made up of people under the age of 18? (33.8%)
11. In 2000, what was the population of this county? (335,227)

Explain 1: Volcanoes

Title: Volcanoes of the World

Suggested Timeframe:

45 minutes

Management Suggestions:

*Reserve computer lab in advance

*Prepare students for what they are going to do prior to going to the lab

Materials:

1. Student Instruction sheets
2. Computer lab
3. Student science journals

Purpose:

- Help students identify where volcanoes exist.
- Help students draw conclusions about why volcanoes exist.
- Help students make connections between volcanoes and plate tectonics.

Definitions:

Plate tectonics: Theory that the earth is made up of continental and oceanic crusts that float around on the molten magma of the Earth's mantle

Procedure:

1. Open up the website <http://spatialdata.ees.utsa.edu>. Click once on "Volcanoes_of_the_World." Students will use the map on this site to answer various questions. It might take a few minutes for the map to be seen fully. Students may begin answering the questions on the questions page while they are waiting for instructions. **Walk students through steps 2 through 9 in the instructions.** Their instructions are similar to the teacher's instructions.
2. Tell students that the screen shows them where the plate boundaries are and where many of the volcanoes in the world are. Have students answer question #9 on their questions page.
3. On the right hand side of the screen is a map key. Click in the empty box to the left of "Cities of the World". You should now see a check mark there. It will take a minute or so for the map to redraw itself. Click once on the words "Cities of the World." This makes "Cities of the World" the active layer. That means that this is the only layer (topic) that you can ask the computer questions about.
4. Tell students that the dark gray dots represent where people live in the world. The larger and darker grey the dot the more people that live there. Have students answer question #10 on their questions page.
5. On the left hand side of your screen is a list of buttons that you can pick. Click on the button that has a question mark on it. This button will allow you to ask the computer questions. A box titled "query builder" should pop up on your screen.
6. In the query builder box, double click on population. You will get a message that says, "There are more than 100 values in this field. Do you want to display all the values?" Click "yes." Click once on the \geq sign. On the right hand side, under "values" scroll down until you get to "1005000." Double click on 1005000. Click once on the button that says execute. You will get another message that says, "There are more than 100 records selected. Do you want to see all records?" Click "yes." Click on the "x" in the right hand corner of the query builder box.
7. On the map you will see a bunch of yellow circles. Tell students that these represent all of the cities in the world that have \geq 1,005,000 people living in them. Have students answer questions 11 and 12 on the questions sheet.
8. On the left hand side of your screen, click on the button that has an "i" on it. Next, click on one of the bright yellow circles that is close to or on a volcano. A box will pop up that says, "Identify results." If the box pops up empty, click the "x" in the right hand corner and try another yellow dot that is on or next to a volcano. Have students answer questions 13 and 14 on the questions page. Click on the "x" in the upper right hand corner of the identify box. Have students repeat clicking on the yellow dots (cities) as often as desired.
9. On the right hand side of your screen scroll down until you get to "World Data by Country." Click in the empty box to the left of "World Data by Country." Click once on the words "World Data by Country ." Have students answer question 15 on the questions page. If you do not know the name of the country, click on it and the identify box will tell you the name of the country.

Explain 2: Earthquakes

Title: Earthquakes of the World

Suggested Timeframe:

45 minutes

Management Suggestions:

*Reserve computer lab in advance

*Prepare students for what they are going to do prior to going to the lab

Materials:

1. Student Instruction sheets
2. Computer lab
3. Students' science journals

Purpose:

- Help students identify where volcanoes exist.
- Help students draw conclusions about why volcanoes exist.
- Help students make connections between volcanoes and plate tectonics.

Procedure:

1. See students' instruction page.

Explain 1 Answer Key

1. Do you think that the Earth's surface is changing? *Yes*
2. Does the Earth's surface change quickly or slowly? Give examples to support your theory. *Both. Ex: quickly – volcanoes and earthquakes. Slowly: weathering, ocean floor spreading. Accept all reasonable answers*
3. Why do you think the Earth's surface looks different all over the world? *Accept all reasonable answers*
4. What forces cause the Earth's surface to change? *Heat from the interior of the Earth and gravity. Gravity causes less dense rock to rise to the surface where it becomes more dense and gravity causes it to sink back down again.*
5. Can you see the continental plates move? *Yes*
6. What evidence is there to show that the plates are moving? *Ex: fossil evidence, plate movement, volcanoes, earthquakes, etc.*
7. Which plate is the largest of all of the plates?
8. Is there a continent or an ocean on that plate? If so, what is it?
9. How are plates similar to continents? *The shape of some plates (continental plates) is similar to the continent on them.*
10. How are plates different from continents? *ex: people don't live on plates they live on continents.*
11. Plate boundaries form where? *When two plates meet*
12. Do any volcanoes form away from plate boundaries? If so, why? *Yes. Ex: subduction zones.*
13. Most volcanoes form on or near what? *Plate boundaries*
14. Why are there so many volcanoes where the North American and Asian plates meet? *These plates are moving towards each other and one is subducting under the other*
15. Not all volcanoes occur along plate boundaries? Give at least 2 examples of volcanoes that do not occur along plate boundaries. *Ex: Hawaii,*
16. Are there any islands made from volcanoes? *Yes*
17. Name two groups of North American islands formed by volcanoes. *Alaskan and Hawaiian islands*
18. The famous line of volcanoes in the Pacific Ocean is called what? *The Ring of Fire*
19. The lava that explodes from a volcano comes from where? *The magma in the Earth's mantle*
20. Volcanic eruptions help the earth's interior get hotter or cool off? *Cool off*

21. Look at the plate that South America is on. Which plate(s) do you think the South American plate is bumping into? Sliding past? Pulling apart from? How can you tell? *Accept all reasonable responses*

Explain 2 Answer Key

1. North America, most earthquakes occur where? *Western part of the continent*
2. In which U.S. state do most American earthquakes occur? *Alaska*
3. The strongest earthquakes seem to occur where? Why do you think this is? *Near the edge of continents, not in the ocean.*
4. What pattern do you notice for where earthquakes occur? *Along plate boundaries. There are some areas with no earthquakes at all. Many occur on the shores of the Pacific Ocean.*
5. What factors do you think might affect how much damage an earthquake causes? *Accept all reasonable answers. Ex: population density, magnitude of earthquake, the way that buildings are constructed/built; etc.*
6. Have earthquakes become more or less deadly over time? *more deadly. Why? The world is more densely populated, including the places where earthquakes occur.*
7. What can be done to make earthquakes less deadly? *Accept all reasonable answers. Ex: People could not live in areas prone to earthquakes (ex: California and Japan); buildings could be built to withstand earthquakes; scientists could find better ways of predicting earthquakes and warning people; etc.*
8. California and Alaska both have violent earthquakes, but Alaska has more earthquakes than California. Given this information, why do you think that the earthquake risk is higher in California than in Alaska? *Less people live in Alaska than in California, so fewer people are in danger in Alaska than in California.*
9. When two continental plates move away from each other we call this sea floor spreading. The newest crust/land is found where? *In the center of where the two plates are spreading apart.*

Elaborate

Title: Volcanoes and Earthquakes of the World

Suggested Timeframe:

45 minutes

Management Suggestions:

*Reserve computer lab in advance

*Prepare students for what they are going to do prior to going to the lab

Materials:

1. Student Instruction sheets
2. Computer lab
3. Students' science journals.

Purpose:

- Help students identify where volcanoes and earthquakes exist.
- Help students draw conclusions about why volcanoes and earthquakes exist.
- Help students make connections between volcanoes, earthquakes and plate tectonics.

Procedure:

1. Open up the website <http://spatialdata.ees.utsa.edu>. Click once on "Earthquakes_and_Volcanoes_1_04." You will use the map on this site to answer questions. It

might take a few minutes before all of the map shows up on the screen. Please wait for instructions.

2. The screen shows you where the plate boundaries are and where many of the volcanoes and earthquakes in the world are. Answer questions 1 through 4 on your questions page.
3. On the right hand side of your screen is a map key. Click in the empty box to the left of “Cities of the World”. You should now see a check mark there. Click in the empty box to the left of “Countries of the World.” You should now see a check mark there. It will take a minute or so for the map to redraw itself. Click once on the words “Cities of the World.” This lets you ask questions about “Cities of the World.”
4. The dark purple dots represent where people live in the world. The larger and darker purple the dot the more people that live there. Answer questions 5 through 11 on the questions page.
5. On the left hand side of your screen is a list of buttons that you can pick. Click on the button that has a question mark on it. This button will let you ask the computer questions. A box called “query builder” should pop up on your screen.
6. In the query builder box, double click on population. Click once on the \geq sign. On the right hand side, under “values” scroll down until you get to “1020000.” Click on 1020000. Click once on the execute button. You will get another message that says, “There are more than 100 records selected. Do you want to see all records? Click “yes.” Click on the “x” in the right hand corner of the query builder box.
7. On the map you will see a bunch of yellow circles. This represents all of the cities in the world that have \geq 1,020,000 people living in it. Answer questions 12 and 13 on the questions page.
8. On the left hand side of your screen, click on the button that has an “i” on it. Next, click on one of the bright yellow circles that is on or near the “Ring of Fire.” A box will pop up that says, “Identify results.” If the box pops up empty, click the “x” in the right hand corner and try another yellow dot that is on or next to a volcano. Answer questions 14 through 18 on the questions page. Click on the “x” in the upper right hand corner of the identify box.
9. On the right hand side of your screen scroll down until you get to “World Data by Country.” Click in the empty box to the left of “World Data by Country.” Click once on the words “World Data by Country.” Answer question 15 on the students questions page. If you do not know the name of the country, click on it and the identify box will tell you the name of the country.

Evaluate

Title: Post Test

Suggested Timeframe:
45 minutes

Management Suggestions:
*Copy student tests

Materials:
Students’ Tests

Purpose:

- To evaluate students’ knowledge of the system of plate tectonics and its impact on where volcanoes and earthquakes occur.

Procedure:

1. Administer student tests.
2. Grade and review answers to test.