Delaware Model Unit

This unit has been created as an exemplary model for teachers in (re)design of course curricula. An exemplary model unit has undergone a rigorous peer review and jurying process to ensure alignment to selected Delaware Content Standards.

Unit Title: Building Global Mental Maps

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District: Red Clay Consolidated School District

Content Area: Social Studies/ Geography Standard 1a
Grade Level: 6

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Summary of Unit

The standard addressed in this unit requires students to *demonstrate* mental maps of the world and its sub-regions. Each individual will develop a unique mental map. The only true assessment of a mental map is to monitor change and growth. The role of the teacher is to provide opportunities for students to use, correct, and build upon their personal mental map.

This unit exposes students to a variety of mapping techniques, types, and applications with an underlying purpose of building personal mental maps. The techniques, types, and applications are implemented using a world or global perspective. Once mastered, teachers can then apply the techniques, types, and applications to a more regionalized scale, while examining issues related to those regions.

This unit is comprised of five lessons that are scaffolded to build upon students' mental maps through exposure and varied learning modalities or styles. Evidence of a student's mental map is collected through the Performance Task, found in Stage 2 of this unit. **Teachers will collect a record of each student's mental map of the world *prior to initiating the unit,* and a second record will be collected at the conclusion of the unit.*** The Performance Task is simple to administer but difficult to assess as mental maps continue to develop throughout our lifetimes and at varying degrees. This should be kept in mind when assessing a student's mental map in terms of quantity of characteristics and accuracy of location. This unit will provide students with the tools needed to build their personal mental maps well beyond the conclusion of instruction.

* Teachers should also consider collecting records of mental maps throughout an instructional period to compare or benchmark against the original mental map that was produced by the student.

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Stage 1 – Desired Results
(What students will know, do, and understand)

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Delaware Content Standards

- **Geography Standard 1a 6-8:** Students will demonstrate mental maps of the world and its sub-regions which include the relative location and characteristics of major physical features, political divisions, and human settlements.

Big Idea

- Mental Mapping

From the Social Studies Clarifications:

At this grade level, what changes is an expansion of the areas covered by mental maps to sub-regions of the world beyond North America, and finally to the world as a whole. In other respects, there is no difference between the objectives and purposes of the 4-5 and 6-8 benchmarks. Once again, the level of detail of the mental map components for the world's sub-regions is similar to that of the United States. The South American continent provides an example. A mental map would recognize the long Andes mountain chain that runs across the north and down the west side of the continent, separated in Bolivia by a high plateau containing Lake Titicaca. To the east of the Andes lie the Guiana Highlands and Brazilian highlands, separated by the Orinoco and Amazon River systems. The southern Brazilian highlands are drained by branches of the Parana-Paraguay river system that terminates in the Río de la Plata. Inland from Buenos Aires lies the flat pampas and, to the south, the arid plateau of Patagonia. Climatically, most of South America east of the Andes experiences tropical weather—warm temperatures throughout the year with wet and dry seasons. To the west, from northern Peru to Central Chile lies the dry Atacama Desert. A major concept embedded in human adaptation to the natural environment is the role of altitude that modifies the tropical climate otherwise expected at low latitudes and allows raising mid-latitude crops in small micro-ecologies found at higher elevations. Argentina, Uruguay, and Chile are the only South American areas of temperate, mid-latitude climate. Chile is like the U.S. west coast, and Argentina and Uruguay like the eastern U.S. seaboard. South Americans live disproportionately in major cities. A mental map of the sub-region would include at a minimum Caracas, Rio de Janeiro, Sao Paulo, Buenos Aires, Montevideo, Santiago, Lima, and Bogotá.

Again, it must be stressed that while mental maps carry factual details, these are best learned in the context of examining issues related to those regions. For instance, the travels of early explorers can be traced and the diversity of findings made understandable. Alternatively, areas most likely to appeal to tourism could be hypothesized.

Familiarity with sub-regions allows speculation about future connections. How might the economies of Africa and South America or Africa and India be better linked? Is there a basis for trade (exchange) between these connections? What are the obstacles to greater economic unity among South American countries? Is the lack of interior rail connections across country borders a factor?

Unit Enduring Understandings

Students will understand that:
- Mental maps summarize differences and similarities about places. These differences and similarities lead to conflict or cooperation and the exchange of goods and ideas between peoples.
- Mental maps change as the scale moves from local to global. We know more about our home area than more distant places, and these differences affect how we feel and behave towards places that are distant versus those that are close.
- Mapped patterns are analyzed and used help solve societal problems.
- Maps can be used to distort or introduce bias into the information they portray.

Unit Essential Questions

How do personal mental maps effectively change and develop?
- What are mental maps? How can mental maps be created and used effectively?
- Why do maps have distortions?
- How have cartographers minimized distortions?
- When should a certain map projection be used over another?
- How can we help build our mental maps through visual association?

Knowledge and Skills

Students will know...
- Relative location of world regions and sub-regions.
- Characteristics (e.g., political, physical, human settlements) of world regions and sub-regions.

Students will be able to...
- Demonstrate how their personal mental maps have been expanded through instruction that focuses on gathering, extending and refining, and applying knowledge of characteristics essential for accurate mental maps.

Stage 2 – Assessment Evidence
(Evidence that will be collected to determine whether or not Desired Results are achieved)

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Performance Task

Essential Question Measured by the Performance Task
- How do personal mental maps effectively change and develop?

Prior Knowledge	Before beginning this unit, your mental map of the world was different than it is now. Mental maps are personal and unique. Mental maps develop, grow, and change as we are asked to access or use our mental maps.
Problem	How can we effectively change and develop our mental maps? Prior to the start of this unit, you were asked to record your mental map of the world. Now you will record your present mental map so a comparison can be made.
Role/ Perspective	As you record your present mental map, think about the activities that were part of this unit. Did you learn the location of new places? Can you identify and place more physical features "on" your mental map? What information, fact, or data did you learn that now is part of your mental map? How did the activities in this unit add to your mental map?
Product/ Performance	Before starting this unit, you were asked to produce your mental map of the world. For this task, your current mental map of the world will be compared and evaluated for growth and accuracy.
Criteria for Exemplary Response	We all develop our personal mental maps at different rates and will continue to develop them throughout our lifetimes. Your teacher may ask you to produce another version in the future. The criteria for an exemplary response is always the same, by answering the essential question, "How do personal mental maps effectively change and develop?"

Mental Maps				
This rubric is to be used to assess the growth of a student's mental map. The criteria listed below can be used as a guide for producing a mental map.				
	3	**2**	**1**	**0**
Map Elements	All essential map elements are demonstrated accurately.	Most essential map elements are demonstrated accurately.	Compared to the original mental map, a few more essential map elements are demonstrated accurately.	Original map had no or a few essential map elements, with little or no growth noted.
Relative Location	Locations of physical/cultural features are accurate and relative to other features.	Most locations of physical/cultural features are accurate and relative to other features.	Compared to the original mental map, a few more locations of physical/cultural features are accurate and relative to other features.	Original map had no or a few accurately placed physical/cultural features, with little or no growth noted.
Political Divisions	All major political divisions are identified accurately.	Most major political divisions are identified accurately.	Compared to the original mental map, a few more major political divisions are identified accurately.	Original map had no or a few major political divisions identified, with little or no growth noted.
Physical Features	All major physical features are identified accurately.	Most major physical features are identified accurately.	Compared to the original mental map, a few more major physical features are identified accurately.	Original map had no or a few major physical features identified, with little or no growth noted.
Human Settlements	All major human settlements are identified accurately.	Most major human settlements are identified accurately.	Compared to the original mental map, a few more major human settlements are identified accurately.	Original map had no or a few major human settlements identified, with little or no growth noted.

Above the Standard: 15 to 11
Meets the Standard: 10 to 5
Below the Standard: 4 to 0

Teachers are encouraged to repeat the Performance Task at a later date and repeat the Performance Task as new regions are introduced to students through the planned curriculum.

Student Self-Assessment and Reflection

> When students are required to think about their own learning, to articulate what they understand and what they still need to learn, achievement improves.

– Black and William, 1998; Sternberg, 1996; Young, 2000.

How a teacher uses the information from assessments determines whether that assessment is formative or summative. Formative assessments should be used to direct learning and instruction and are not intended to be graded.

The Checks for Understanding at the end of each instructional strategy should be used as formative assessment and may be used as writing prompts or as small-group or whole-class discussion. Students should respond to feedback and be given opportunities to improve their work. The rubrics will help teachers frame that feedback.

An interactive notebook or writing log could be used to organize student work and exhibit student growth and reflection.

As the strategies used to create this unit are implemented, students can keep an outline map of the region being studied and add to the map as the unit progresses. With repeated exposure to and opportunities to work with maps, the more quickly and accurately mental maps will develop.

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Lesson One – Tear Maps

Essential Questions
- What are mental maps?
- How can mental maps be created and used effectively?

Background

> Differentiation allows students multiple options for taking in information, making sense of ideas, and expressing what they have learned. A differentiated classroom provides different avenues to acquiring content, to processing or making sense of ideas, and to developing products so that each student can learn effectively.

> – Carol Ann Tomlinson, 2001

Before beginning this lesson, have students create a representation of their mental map of the world.[1] Tell students to give as much detail as possible. Explain that this map will be compared to a similar map that will be created at the end of the unit. Teachers should share the Performance Task and rubric with students prior to beginning this lesson.

After a brief mental mapping activity, students will work in groups of 3-4 students to create a construction paper tear map of the world. Students will receive instruction on the Essential Map Elements and place those elements on the map created by the group.

Instructional Strategies

Strategy 1: Gathering Information
Think-Pair-Share

Begin this lesson by asking students to create a definition of a mental map with a partner. Have students share their definitions.

To test the student definitions, tell students to close their eyes. Ask, "How many windows are in this room?" Ask, "How did you find the answer?" Accept responses that refer to visualizing the room and the windows. Adjust definitions as needed. Ask students to close their eyes again and ask, "How many windows are there in your bedroom?" Ask, "Which room was easier to visualize and recall the correct number of windows?" The expected answer is that students will recall more accurately the number of windows in their bedroom. Why? We are more familiar with places that we have more association with or exposure to. Tell students that this unit will help them to develop more accurate and detailed mental maps.

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[1] All world maps should be removed or covered for this activity.

❖ What is a mental map? Explain why some of our personal mental maps more detailed than others.

Rubric
2 – This response gives valid definition with an accurate and relevant explanation of why personal mental maps vary.
1 – This response gives valid definition with an inaccurate, irrelevant, or no explanation of why personal mental maps vary.

Strategy 2: Gathering Information
Mnemonic

In order to help students remember the Essential Map Elements, share the mnemonic at Handout 1-A.

Essential Map Elements

T – Title: What does the map represent?

O – Orientation: Often, world maps do not have a compass rose, and it is assumed that North is at the "top" of the map.

D – Date

A – Author or publisher

L – Legend or key

S – Scale

Scale can be represented in many ways. This example is from the University of Colorado at http://www.colorado.edu/geography/gcraft/notes/cartocom/elements.html. Distance or scale must always be indicated or implied, unless the audience is so familiar with the map area or distance is of such little relative importance that it can be assumed by the audience. Distance and scale can be indicated in a variety of ways on a map in **verbal, numeric, or graphic form**.

In using computer systems, the graphic form of representing scale is often preferred. With computers, maps are often drafted at different scales than they are printed. In using verbal or numeric scales, the cartographer must be certain that the map is printed at precisely the scale indicated. If a graphic scale is inserted in a digital map, it will always maintain its relative size with respect to the digital map no matter how it is printed.

Remember, scale varies significantly across the area of some maps. If this is true of yours, be sure to note the adjustments required.

Verbal, numeric, and graphic means
of representing scale

1 inch equals 1 mile   1:63,500

0   5   10   15
miles

SLC 4/96
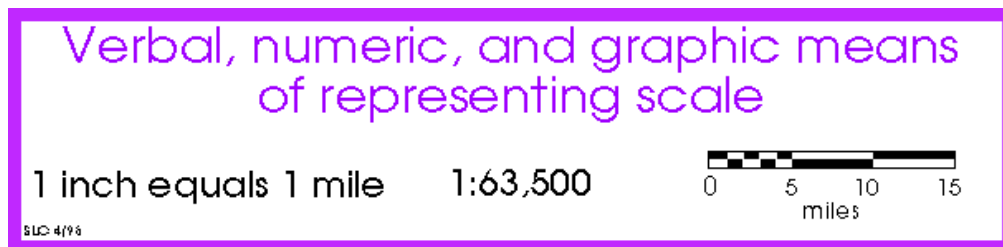
Have students identify the Essential Map Elements from any map.

> ❖ What are the Essential Map Elements?
> ❖ What purpose do the elements serve?

Rubric
2 – This response gives valid description with an accurate and relevant purpose.
1 – This response gives valid description with an inaccurate, irrelevant, or no purpose.

Strategy 3: Extending and Refining
Making Comparisons[2]

Have students complete Handout 1-B, Directions and Map of the World, including the questions on the directions sheet.

Check for Understanding

> ❖ Why are individual personal maps unique? Explain your answer with an example.

Rubric
2 – This response gives valid explanation with an accurate and relevant example.
1 – This response gives valid explanation with an inaccurate, irrelevant, or no example.

Strategy 4: Application
Cooperative Group Participation[3]

In this strategy, students should be divided into groups of no more than 4 students. Teachers can assign roles for this activity, such as materials manager, quality control manager, timekeeper, and presenter.

Materials needed:
- Glue sticks/glue
- Markers/colored pencils
- Large paper – 1 sheet per group
- Construction or copy paper – ideally 7 sheets of different colors per group

Each group is to tear (no scissors!) out the shape of each continent and glue the continents to the large paper. Have students label the continents and as many features as they can from memory (equator, prime meridian, cardinal directions, bodies of water, etc.). This activity should be done without the aid of maps of other geo-graphics.

Have the students present their maps to the other groups.

Optional: Have students use a rubric to evaluate maps from other groups. See Rubric 1-C for an example.

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[2] Adapted from an activity from the Delaware Geographic Alliance, which can be accessed at:
http://www.udel.edu/Geography/DGA/Web2009/CurriculumMaterials/Asia/MentalMapExerciseDirections.doc

[3] Prince George's County (MD) has a brief guide to Cooperative Learning at:
http://www.pgcps.pg.k12.md.us/~elc/learning1.html

❖ Why are the maps from each group different? In which ways are the maps the same?

Rubric

2 – This response gives valid differences with valid similarities.
1 – This response gives valid differences OR valid similarities.

Lesson Two – Map Projections

Essential Questions
- Why do maps have distortions?
- How have cartographers minimized distortions?
- When should a certain map projection be used over another?

Background

See Handout 2-A for background information on map distortions.

The most common distortions of maps are changes in scale, area, distance, and shape. Some maps have all distortions, some only a combination of distortions, but ALL map projections have some form of distortion. Because all maps have distortions, some map projections are preferred over others. The United States is often shown in a conic projection. A conic projection has minimal distortion of areas located in the mid-latitudes. Polar projections are often used for maps of Antarctica. For a more detailed explanation of map projections, read *Map Projections: From Spherical Earth to Flat Map* from the National Atlas, found at http://www.nationalatlas.gov/articles/mapping/a_projections.html.

This lesson examines distortion and the ways in which cartographers have tried to minimize distortion by creating maps of different projections. Students will look at four common map projections and identify the distortion or advantage of each map.

Instructional Strategies

Strategy 1: Gathering Information
Making Predictions

Have students read Handout 2-A. Have students work in pairs to make predictions about what happens when a 3-dimensional object (like a model of the Earth) is depicted as a 2-dimensional object.

Record students' predictions. Show students Handout 2-B. Ask students to verify or modify their predictions.

Ask students to identify the four common types of distortions found on the "Bernie Map."

Check for Understanding
- ❖ Why do map distortions occur?
- ❖ What are the most common forms of distortions?

Rubric
2 – This response gives a valid reason with valid forms of distortion.
1 – This response gives a valid reason OR valid forms of distortion.

Strategy 2: Extending and Refining
Paired Predictions – Graphic Organizer

Divide students into pairs. Provide Internet access to
http://egsc.usgs.gov/isb/pubs/MapProjections/projections.pdf or distribute Handout 2-C.
Distribute Handout 2-D to each student. Provide time for students to complete the graphic
organizer.

Answer Key to Handout 2-D – Graphic Organizer

Type of Projection/ Model	Distortion	Advantages	Disadvantages	Uses
Globe	None	No distortion	Difficult to carry and store. Small scale. Costly to update.	To find the shortest distance between two points.
Mercator	Distance Area Shape	Direction is true	Highly distorted at poles.	Navigation along the Equator.
Robinson	Distance Area Shape Direction	Some distance/scale is true.	Highly distorted at poles.	Often used in classrooms.
Conic	Distance Area Shape Direction	Distance is true on longitudes.	Area, shape, and direction distortions are minimized.	Used to show areas in the middle latitudes such as the United States.
Peters	Distance Area Shape Direction	Area distortion is minimized.	Has an unfamiliar "look." Not respected by many cartographers.	Sometimes to represent data. See Peters Map website for additional samples: http://www.petersmap.com/table.html

Check for Understanding
❖ Which map projection do you prefer? Explain your answer.

Rubric
2 – This response gives a valid choice with an accurate and relevant explanation.
1 – This response gives a valid choice with an inaccurate, irrelevant, or no explanation.

Strategy 3: Application
Map Evaluation

After students have been exposed to the major types of distortion (distance, area, shape
and direction), they will evaluate a map for its distortion and describe the best use for this
map.

Distribute A New Map–Handout 2-E. This application can be used as an assessment of
students' ability to apply knowledge to a new situation (transfer).

A short (5-second) video is available online that demonstrates how a Polar Map is made
http://www.amnh.org/education/resources/rfl/web/antarctica/polar.html.

Check for Understanding

- ❖ When have you used a map? Explain which map projection is best for this application.

Rubric

2 – This response gives a valid use with an accurate and relevant explanation.
1 – This response gives a valid use with an inaccurate, irrelevant, or no explanation.

Lesson Three – Visual Association

Essential Question

- How can we help build our mental maps through visual association?

Strategy 1: Gathering Information
Think-Pair-Share

This initial activity is designed to get students thinking about how boundaries are formed and the shapes that political regions have. Ask students how they know they have gone from one neighborhood or town to another. How do they know when they have left their town or city? Students may share such responses as seeing signs or business names that include the name of the town.

Explain to students that towns, states, and countries all have boundaries. Boundaries between countries are political boundaries. Some political boundaries are determined using physical features, like a mountain range or river. Other boundaries may seem random, but somewhere a legal political body determined the boundaries.

Distribute Handout 3-A and Handout 3-B to students. With colored pencils, have students draw over the straight political boundaries, and with another color, draw over political boundaries that are made from rivers and/or mountain ranges. Without a more detailed map or without an atlas, students will have many boundaries that are not marked with the colored pencils.

Ask students to summarize this activity by asking, "Where do you see more straight political boundaries? Where do you see more physical boundaries"?

Think-Pair-Share: What problems might occur when boundaries are based on physical features like a river?

(Answers might include: The course of a river can change. Tectonic action can shift the location of mountains and other landforms.)

Check for Understanding

❖ How are political boundaries determined? Give an example of a political boundary that uses physical features.

Rubric
2 – This response gives a valid explanation with an accurate and relevant example.
1 – This response gives valid explanation with an inaccurate, irrelevant, or no example.

Strategy 2: Extending and Refining
Visual Association[4]

Explain to students that our mental maps of the world can be extended if we associate the political boundaries to objects. To demonstrate how this is done, distribute Handout 3-C to each student. Create an overhead of Handout 3-C for your use. As you read the poem on

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[4] This strategy is based on a lesson from the Delaware Geographic Alliance and can be found at http://www.udel.edu/Geography/DGA/Web2009/CurriculumMaterials/Asia/AngelOfTheEast.pdf.

Handout 3-D to students, outline the Angel on the map. Then, have students label each of the countries using Handout 3-E as a guide.

❖ Demonstrate your mental map of the Middle East region. Label as many countries as you can.

Rubric
2 –Students can produce an outline of the Middle East region and label countries.
1 - Students can produce an outline of the Middle East region, but are unable to label the countries.

Strategy 3: Application
Groups/ Modified Jigsaw

Divide students into heterogeneous groups. Five or more groups would be best for this strategy. Distribute maps of a single continent to each group. The following continent maps are included in this unit:
- Handout 3-B – Africa
- Handout 3-F – Asia
- Handout 3-G – Europe
- Handout 3-H – North America
- Handout 3-I – South America

Provide colored pencils. Ask groups to identify shapes that they see in each continent. Ask if they see any shapes that will help them to remember the continent itself.

For example:
- Africa – looks like a giant pork chop
- Italy– resembles a boot
- China – a profile of a rooster
- Cuba – an upright vacuum cleaner, Hispanola – a "dust buster" and the remaining islands are crumbs that the vacuum and handheld will pick up.

Do not give students too many examples as they are to brainstorm and discuss the shapes in their groups. When completed, have each group share their ideas. If possible, have the students draw the shapes onto a poster-size world map.

❖ How can we help build our mental maps through visual association? Explain your answer with examples.

Rubric
2 – This response gives a valid explanation with an accurate and relevant example.
1 – This response gives a valid explanation with an inaccurate, irrelevant, or no example.

Lesson Four – Physical Maps

Background

Geography Standard One requires students to demonstrate the characteristics and location of physical features. This lesson requires students to locate different physical features of the world. As students continue studying geography through a regional analysis, additional physical features of the region being studied should be taught.

Instructional Strategies

Strategy 1: Gathering Information
Location of Physical Features

Copy Handout 4-A and Handout 4-B for each student. Have students use an atlas or online source, such as those provided below, to locate major physical features in the world's sub-regions.

National Geographic's April 2010 online blog has an interactive river map at: http://ngm.nationalgeographic.com/2010/04/water/water-animation

Have students locate the major rivers using this source or other geographic sources.

Identify and label the following 16 major rivers:

Mississippi	Yellow	Parana
Danube	Darling	Congo
Yangtze	Indus	Brahmaputra
Murray	Amazon	Paraguay
Colorado	Nile	
Volga	Ganges	

Have students locate the following 8 mountain ranges:
http://maps.howstuffworks.com/world-mountain-ranges-map.htm

Rockies	Ural
Alps	Great Divide
Himalaya	Andes
Appalachian	Atlas

Have students locate the 5 oceans: http://www.worldatlas.com/aatlas/infopage/oceans.htm

Atlantic

Pacific

Indian

Arctic

Southern[5]

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[5] In 2000, the International Hydrographic Organization created the fifth and newest world ocean—the Southern Ocean—from the southern portions of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. The new Southern Ocean completely surrounds Antarctica.

Strategy 2: Extending and Refining Visual Association[6]

Students will create a 3-D map of the world, highlighting physical features. You may want students to work in heterogeneous groups of 3-4 students.

This strategy may take several class periods depending on the amount of detail required.

Distribute one copy of Handout 4-C, 3-D Map Instructions, per student.

Rubric
2 – This response gives a valid relationship with an accurate and relevant example.
1 – This response gives a valid relationship with an inaccurate, irrelevant, or no example.

Strategy 3: Application

For this strategy, the best application of "demonstrating mental maps" is to have students assess either their own maps made or assess others. A quantitative rubric has been provided. See Handout 4-D, Physical Map Rubric.

Materials
You may substitute some of these. Gather materials prior to the lesson and divide the sand, beans, rice, peas, etc., for each group of students into the small paper cups or plastic bags.

Note the amount listed is the total quantity for that item.
- 12 x 18 colored paper (for base map) one sheet per student
- 9 x 12 sheets of colored paper (variety of colors)
- Small paper cups (for the beans, peas, rice, sand, etc.)
- Glue
- Scissors
- **Atlases or online access**
- Sand (~ 2 cups)
- Pinto beans (or other brown beans) ~ 2 cups
- Rice (white or brown) ~ 1 cup
- Dried green peas ~ 1 cup
- Blue yarn ~ 1 skein
- Cotton balls 1 per student
- Plain paper for labels for the physical features (or 2-3 address labels per student which they can cut into small strips)

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[6] This strategy is adapted from "3D Map of South America," by Cynthia A. Baker, Indian River School District http://www.sscde.org/lessons/files/G_68_LES_3DMapofSouthAmerica.pdf

Lesson Five – Mapping Data

Background

Demography is the study of the characteristics of human populations, such as size, growth, density, distribution, and vital statistics. For this strategy, students will explore the types of demographic data that is available and how choropleth and cartograms are used to display demographic data in map form. Students will also look at how other data, such as climate and elevation data can also be mapped.

Instructional Strategies

Strategy 1: Gathering Information
Brainstorming – Bubble Map/Webbing

Explain to students that data needs to be sorted, categorized, and compared in order to be analyzed. One way to analyze data is by mapping the data. Demography, a special sub-group of data, is the study of the characteristics of human population, such as size, growth, density, distribution, and vital statistics.

Have students look through their textbooks or online at fact websites like CIA World Factbook at https://www.cia.gov/library/publications/the-world-factbook/index.html for data that could be mapped. Using the broad categories of people, economy, geography, communications, and transportation have students complete a web or other graphic organizer that shows the different types of data that is collected and can be mapped.

Provide one copy of Handout 5-A for each student. Have students share their webs.

Answers may include:
- People – male/female, birth rate, death rate, growth, ages
- Economy – income, import/export amounts, GDP, labor
- Geography – rainfall, temperature, elevations, renewal water, fresh water, irrigation
- Communications – radio, television, internet, newspapers, telephones, cell phones
- Transportation – airlines, railways, roadways, waterways, pipelines

Check for Understanding
❖ Why is data mapped? Give an example to support your answer.

Rubric
2 – This response gives a valid reason with an accurate and relevant example.
1 – This response gives a valid reason with an inaccurate, irrelevant, or no example.

Strategy 2: Extending and Refining
Mapping Data

One way to display data in mapped form is by using a choropleth map. The Population Reference Bureau has a short description of choropleth mapping at: http://www.prb.org/pdf/ChoroplethMap_Instructions.pdf.

Show students Handout 5-B. Explain that the prices of Big Macs are collected and published periodically by *The Economist* magazine. One way to analyze the Big Mac data is to sort the prices from highest to lowest. Another way is to create a choropleth map of the data.

Distribute Handout 5-C and Handout 5-D to each student. With colored pencils, have students create a choropleth map of the Big Mac data. Students should use colors or shading that gradually changes in color. The greater the density of color, the greater the density or value represented.

When completed, ask students to draw conclusions about the mapped data.
- Where are Big Macs with the highest prices sold? (Above the Equator, Europe, north of 40N, etc.)
- Where are the Big Macs with the lowest prices sold? (Mostly in Asia)
- Where do we not have a lot of data? Why?

Handout/Answer Key 5-E has been provided. This map was created using Microsoft Paint.

Teacher Tip: Any data can be used. A choropleth map using any world or regional map can be substituted for this strategy.

Check for Understanding

❖ How can mapping data help us to analyze the data? Give an example to support your answer.

Rubric
2 – This response gives a valid explanation with an accurate and relevant example.
1 – This response gives a valid explanation with an inaccurate, irrelevant, or no example.

Strategy 3: Application
Cartograms

Provide students with Handout 5-F and have them follow the instructions. Cartograms are visual ways of displaying statistical geographic information. They are a hybrid of a graph and a map. Because of their visual nature, these charts make it easier for students to understand statistical geographical data.

Share with students that cartograms are chart maps that present statistical information. On a cartogram, sizes of geographic areas are changed to show the statistical information. For example, on a cartogram about rainfall, an area that gets more rain would be bigger than one that gets less rain.

Show students different cartograms that have been created. Worldmapper.org has over 600 different cartograms to share with students.
http://www.worldmapper.org/textindex/text_index.html

Check for Understanding

❖ How can mapping data help us to analyze the data? Give an example to support your answer.

Rubric
2 – This response gives a valid explanation with an accurate and relevant example.
1 – This response gives a valid explanation with an inaccurate, irrelevant, or no example.

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Mulcahy, Karen A.; Clarke, Keith C., "Symbolization of Map Projection Distortion: A Review", Cartography and Geographic Information Science, magazine, July 1, 2001 found at: http://www.geog.ucsb.edu/~kclarke/Papers/mulacahyclarkecagis.pdf

Tschirren, Bernard, Honours Research Proposal on Simulating the Appearance of Hair in a Realtime Facial Animation System. Found at: http://facestyler.btschirren.net/html/index.html

Peters, Arno, website The Peters Map http://www.petersmap.com/table.html

National Geographic printable maps: http://www.nationalgeographic.com/resources/ngo/education/xpeditions/atlas/

National Geographic Geography Games: http://kids.nationalgeographic.com/kids/games/geographygames/

Differentiation
- Stage 2 and 3 allow students to demonstrate understanding with choices, options, and/or variety in the products and performances without compromising the expectations of the Content Standards.
- Instruction is varied to address differences in readiness, interest, and/or learning profiles.
- Accommodations and differentiation strategies are incorporated in the design of Stage 2 and 3.

Technology Integration
The ability to responsibly use appropriate technology to communicate, solve problems, and access, manage, integrate, evaluate, and create information

8th Grade Technology Literacy – the ability to responsibly use appropriate technology to communicate, solve problems, and access, manage, integrate, evaluate, and create information to improve learning in all subject areas and to acquire lifelong knowledge and skills in the 21st Century (SETDA, 2003)

National Atlas Project: http://www.nationalatlas.gov/natlas/Natlasstart.asp

National Geographic Xpeditions http://www.nationalgeographic.com/resources/ngo/education/xpeditions/atlas/

National Geographic Geography Games: http://kids.nationalgeographic.com/kids/games/geographygames/

Online Geography features identification games: I Like 2 Learn http://www.ilike2learn.com/

WorldMapper.org – cartogram website http://www.worldmapper.org/textindex/text_index.html

Essential Map Elements

High-quality maps always contain essential map elements that help the reader understand and correctly interpret the information displayed.

At a minimum, all maps should have:
- Title
- Orientation (or Compass Rose)
- Date
- Author
- Legend (or Key)
- Scale (or Distance)

Mental Mapping

On the world map provided, locate and identify the following:

1. Label the United States of America (USA).

2. Represent your present location by drawing a happy face there. 🙂

3. Draw and label the Equator.

4. Label all seven continents (Africa, Antarctica, Australia, Asia, Europe, North America, and South America).

5. Label a place you would like to visit with a plus sign (+).

6. Place a star (☆) on the furthest place from your present location you have visited.

7. Add a symbol in the legend to represent mountains. Using your symbol for mountains, locate major mountain ranges.

8. India and China have large populations. Label them on the map.

9. Saudi Arabia's oil is important to the world. Label Saudi Arabia.

10. Mount Everest is the highest point on Earth (8,848 m or 29,029 ft). Place a triangle (△) on the location of Mount Everest.

11. Label the Pacific Ocean and Atlantic Ocean.

12. Label one important river system on each continent.

Compare your map to the maps created by your fellow students. In what way is your map similar to other student maps? In what way is your map different? Why do you think every map is unique?

_____

_____

_____

_____

_____

_____

Rubric

Were the following features and locations on the map?

Continents:

_____ All seven continents represented

_____ Spelling of continents is correct

_____ Relative size and location of continents

Essential Map Elements:

_____ Title

_____ Orientation

_____ Date

_____ Author(s)

_____ Legend

_____ Scale or distance

Other features:

_____ Oceans labeled correctly

_____ Physical features labeled correctly (mountains, deserts, rivers, lakes, etc.)

_____ Political divisions labeled correctly (countries, states, sub-regions)

One thing our group really liked about your map was...

One thing your map had that our map did not was ...

All Maps Have Distortion

"**C**artographers have been portraying our globe on flat surfaces for approximately 2,000 years (Snyder 1993). The results have been far from perfect. It is impossible to depict rounded objects, such as the globe, on flat surfaces with complete fidelity. Thus, all maps are flawed in some way. The somewhat flawed and flattened geospatial products that result take forms such as maps printed on paper, virtual maps on computer screens, or virtual maps in computer databases. These flat map products cannot be true representations of our globe.

As the globe is flattened, areas may expand or contract, distances may change, and angles may be bent out of shape. The amount and types of distortion introduced may be controlled through the selection of appropriate map projections. Choosing the best projection for a map or map product is a task that has haunted cartographers for ages. The secret lies in choosing an appropriate projection that will allow the final product, in whatever form, to retain the most important properties for a particular use. Cartographers have measured, categorized, and organized various distortion characteristics resulting from the transformation of the globe to the flattened map. The most common types of distortion that are measured include **changes in scale, distance, area, and [shape]**."

From: Mulcahy, Karen A.; Clarke, Keith C., "Symbolization of Map Projection Distortion: A Review", Cartography and Geographic Information Science, magazine, July 1, 2001

Think about taking a three-dimensional object, like a grapefruit or basketball, and flattening it so you can see the entire object without turning it. What would happen to the object? How difficult would it be to peel an orange so that the peel remains in one piece? This is what happens when you take a model of the Earth, a globe, and try to show the Earth as a flat 2-dimensional object.
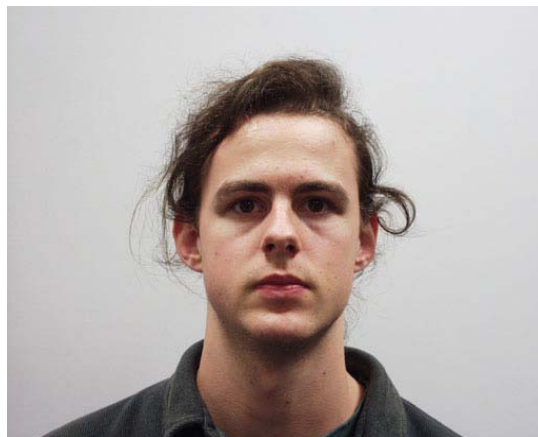
This is what Bernie looks like without distortion.

What would Bernie look like if we could make him into a 2-dimensional map? What types of distortion would you see?

Handout 2-B

Map Projections

Adapted from http://egsc.usgs.gov/isb/pubs/MapProjections/projections.pdf

A map projection is used to portray all or part of the round Earth on a flat surface. This cannot be done without some distortion.

Every projection has its own set of advantages and disadvantages. There is no "best" projection.

The mapmaker must select the one projection that is best suited to the purpose for the map, reducing distortion of the most important features.

Mapmakers and mathematicians have devised almost limitless ways to project the image of the globe onto paper. Scientists at the U.S. Geological Survey have designed projections for their specific needs—such as the Space Oblique Mercator, which allows mapping from satellites with little or no distortion.

This document gives the key properties, characteristics, and preferred uses of many historically important projections and of those frequently used by mapmakers today.

The Globe

Directions – True
Distances – True
Shapes – True
Areas – True

Great circles – The shortest distance between any two points on the surface of the Earth can be found quickly and easily along a great circle.

Disadvantages:
- Even the largest globe has a very small scale and shows relatively little detail.
- Costly to reproduce and update.
- Difficult to carry around.
- Bulky to store.

Mercator

Used for navigation or maps of regions near the Equator. Any straight line on the map is projected as true. **Directions** along a single line are true between *any* two points on map, but that line is usually *not* the shortest distance between points.

Distances are true *only* along Equator, but are reasonably correct within 15° of Equator; special scales can be used to measure distances along other parallels (latitudes). Two particular parallels can be made correct in scale instead of the Equator.

Areas and shapes of large areas are distorted. **Distortion** increases away from Equator and is extreme in polar regions. A Mercator map is **often used for USGS topographic maps**.

Equator and other parallels are straight lines (spacing increases toward poles) and meet meridians (longitudes that are equally spaced straight lines) at right angles. Poles are not shown.

Presented by Mercator in 1569.
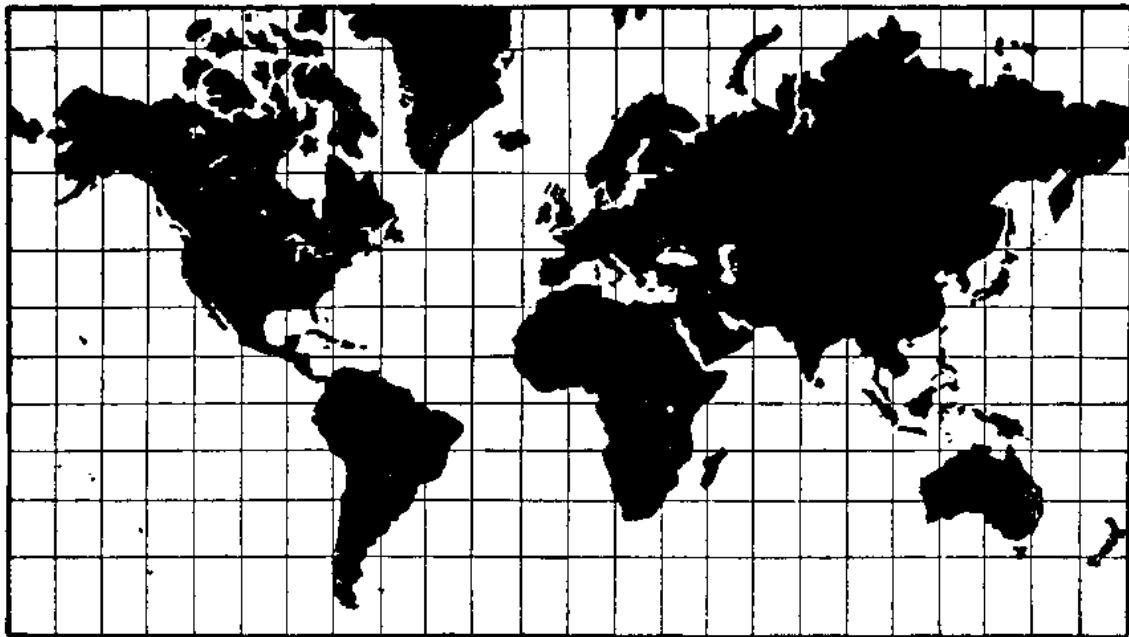
Robinson

The Robinson map was specifically created in an attempt to find a good compromise to the problem of readily showing the whole globe as a flat image. The Robinson map has a better balance between **size and shape** of high-latitude lands than in Mercator map. Russia, Canada, and Greenland are truer to size, but Greenland compressed.

Directions are true along all latitudes and along central longitudes. **Distances** are constant along Equator and other latitudes, but scales vary. **Scale** is true along 38° N & S, constant along any given latitude, and the same along North & South latitudes from the same distance from the Equator. **Distortion**: All points have some. Very little distortion along the Equator and within 45° of center. Greatest distortion occurs near the poles.

Used in *Goode's Atlas*, adopted for *National Geographic's* world maps in 1988, appears in growing number of other publications, may replace Mercator in many classrooms.

Presented by Arthur H. Robinson in 1963.
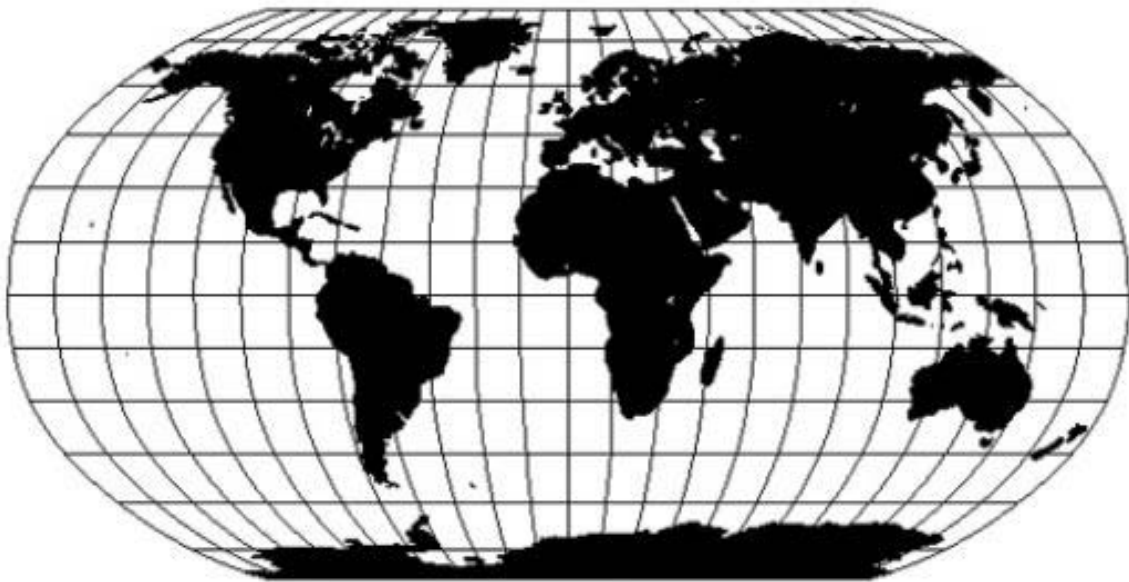
Conic

Used in atlases to show areas in the middle latitudes. Good for showing regions within a few degrees of latitude and lying on one side of the Equator. Conic maps are often used to show areas of the United States.

Distances are true *only* along all longitudes and along one or two standard latitudes. **Directions**, **shapes**, and **areas** are reasonably accurate, but **distortion** increases away from standard latitudes.

The first version of a conic map may have been by Ptolemy, in 150 A.D.

Peters

A Peters map **has all distortions** but minimal distortion of area. Arno Peters, German historian and journalist, called a press conference in 1973 to announce his "new" map projection that treated each country fairly by representing area accurately. Most cartographers do not support the Peters map, because they feel it does not represent the science of cartography. However, Peters maps are used to **represent data.** The map below is a Peters map.
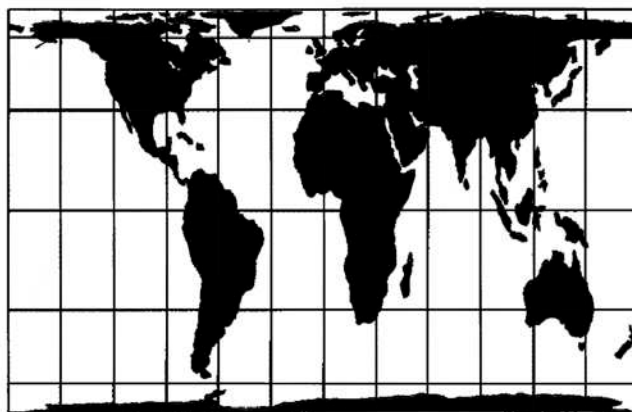
Handout 2-D

Graphic Organizer

Use *Map Projections* from the U.S. Geological Survey (USGS) to complete the chart.

Type of Projection/Model	Distortion	Advantages	Disadvantages	Uses
Globe				
Mercator				
Robinson				
Conic				
Peters				

Which projection do you prefer? Why?

Handout 2-E

A New Map

Now that you have learned about a few different map projections and map distortions, you are ready to apply your knowledge to a new situation.

Use the map below to answer the questions that follow.

What map distortion(s) does this map have?

How might this map be used? Explain why this is the best map projection to use.

Africa Political/Physical

Africa Physical – Africa Political – http://geology.com/world/africa-physical-map.shtml

Africa Political Map

ASIA

Atlantic
Ocean

Arabian
Sea

SOUTH
AMERICA

AFRICA

Indian Ocean

0   800 mi
0   800 km

© 2003 National Geographic Society
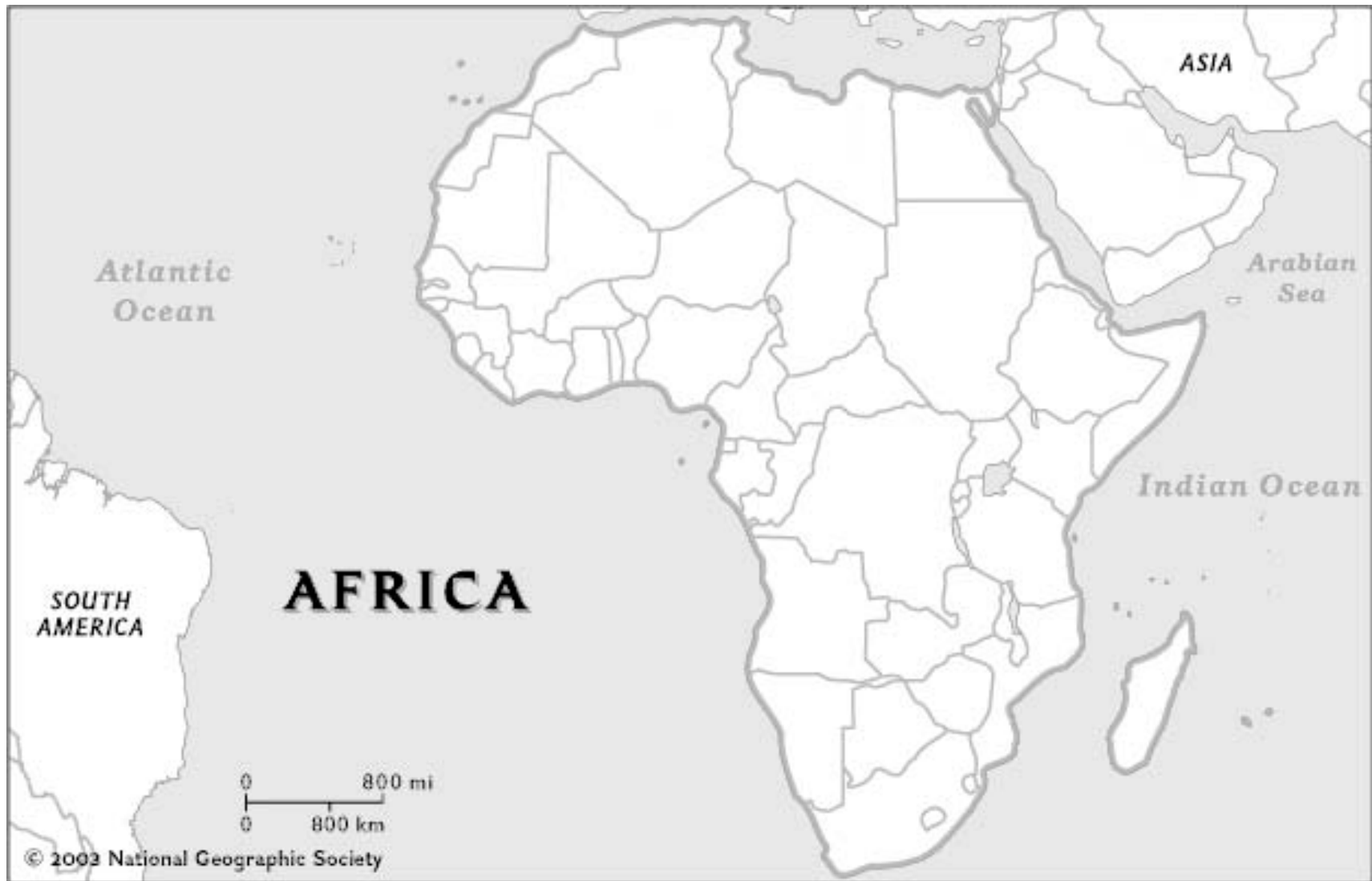
Middle East Region Political/Physical Map

The Angel of the East

THE ANGEL OF THE EAST
by
Rebecca Scott

If you could look east
      across the United States,
     over the Atlantic Ocean and
      the Mediterranean Sea
to a place between
      Asia, Africa and Europe.
You might see an angel --
      an angel in the east --
resting on a sea of blue.
Her head hangs heavily,
    bowed towards her chest
      as she holds her hands
together in prayer
     facing west.
A tear has fallen
    from her cheek.
Her heart aches;
      the heart of three religions.
She would like to be
      the angel for all people,
   but it seems remote
     on this southwest peninsula.
She is battle-worn
    and war-torn,
     this angel in the east --
      praying someday for
     a new world order and peace.
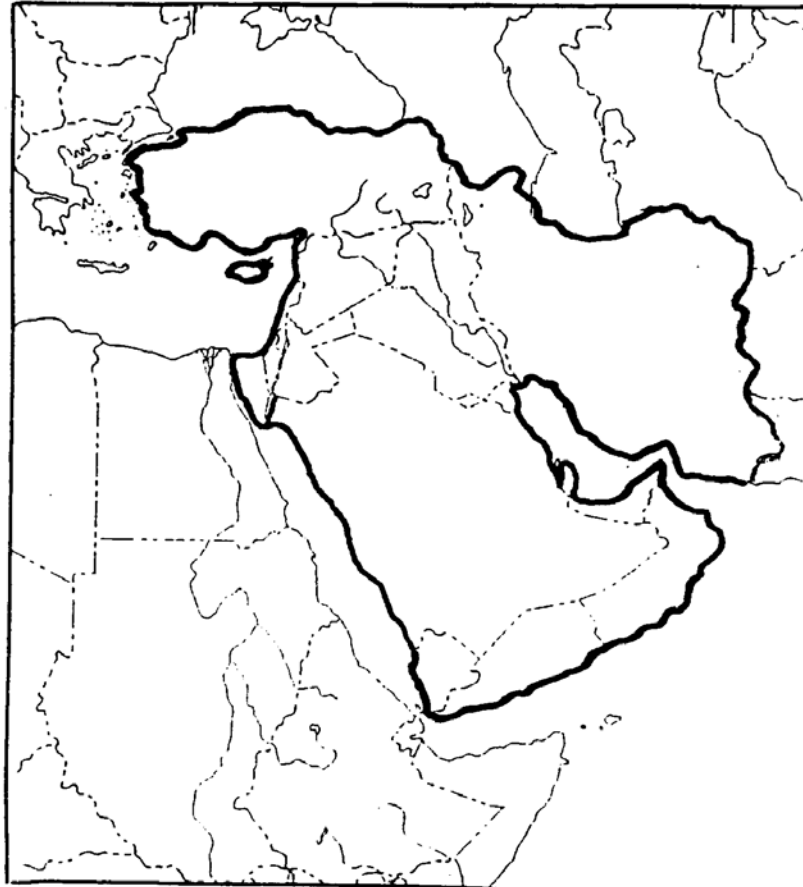
The Angel of the East

Directions: Using your map (Handout 3C – Middle East Region Political/Physical Map), label each of the political regions those make up "The Angel of the East."

ANGEL'S HEAD	Turkey (her face, looking down is the Taurus Mountains); the northern coast is her hair flowing back.
HER TEAR	The island of Cyprus
CHEST	Syria
RIGHT SHOULDER	Lebanon
RIGHT ARM	Israel
LEFT SHOULDER	Iraq
LEFT ARM	Jordan
HANDS IN PRAYER	Sinai Peninsula
FLOWING GOWN	Saudi Arabia (Arabian Peninsula)
BOTTOM OF GOWN TRIMMED IN LACE	Yemen, Oman, United Arab Emirates, Qatar
TWO BUTTONS AT BACK OF GOWN	Kuwait (at the upper part); Bahrain (loose button)
WINGS	Iran
HER HEART	Jerusalem

Asia Political Map

ASIA

0   1,000 mi

0   1,000 km

© 2003 National Geographic Society

Europe Political Map

NORTH
AMERICA

EUROPE

Atlantic
Ocean

ASIA

Norwegian Sea

North
Sea

ASIA

Caspian
Sea

Black Sea

500 mi

500 km

Mediterranean Sea

AFRICA

ASIA

© 2003 National Geographic Society

North America Political Map

Arctic Ocean

NORTH
AMERICA

Atlantic
Ocean

Pacific Ocean

0   1,000 mi

0   1,000 km

© 1998 National Geographic Society

South America Political Map

NORTH
AMERICA

AFRICA

Pacific Ocean

Atlantic Ocean

SOUTH AMERICA

0   1,000 mi

0   1,000 km

© 1998 National Geographic Society

Lesson 4 – Physical Features

Identify and label the following 16 major rivers:

Amazon	*Ganges*	*Parana*
Brahmaputra	*Indus*	*Volga*
Colorado	*Mississippi*	*Yangtze*
Congo	*Murray*	*Yellow*
Danube	*Nile*	
Darling	*Paraguay*	

Identify and label the following 8 mountain ranges:

Alps	*Great Divide*
Andes	*Himalaya*
Appalachian	*Rocky*
Atlas	*Ural*

Identify and label the following 5 oceans:

Arctic
Atlantic
Indian
Pacific
Southern

The World Map

THE WORLD

LEGEND

0   2,000 mi

0   2,000 km

© 2003 National Geographic Society
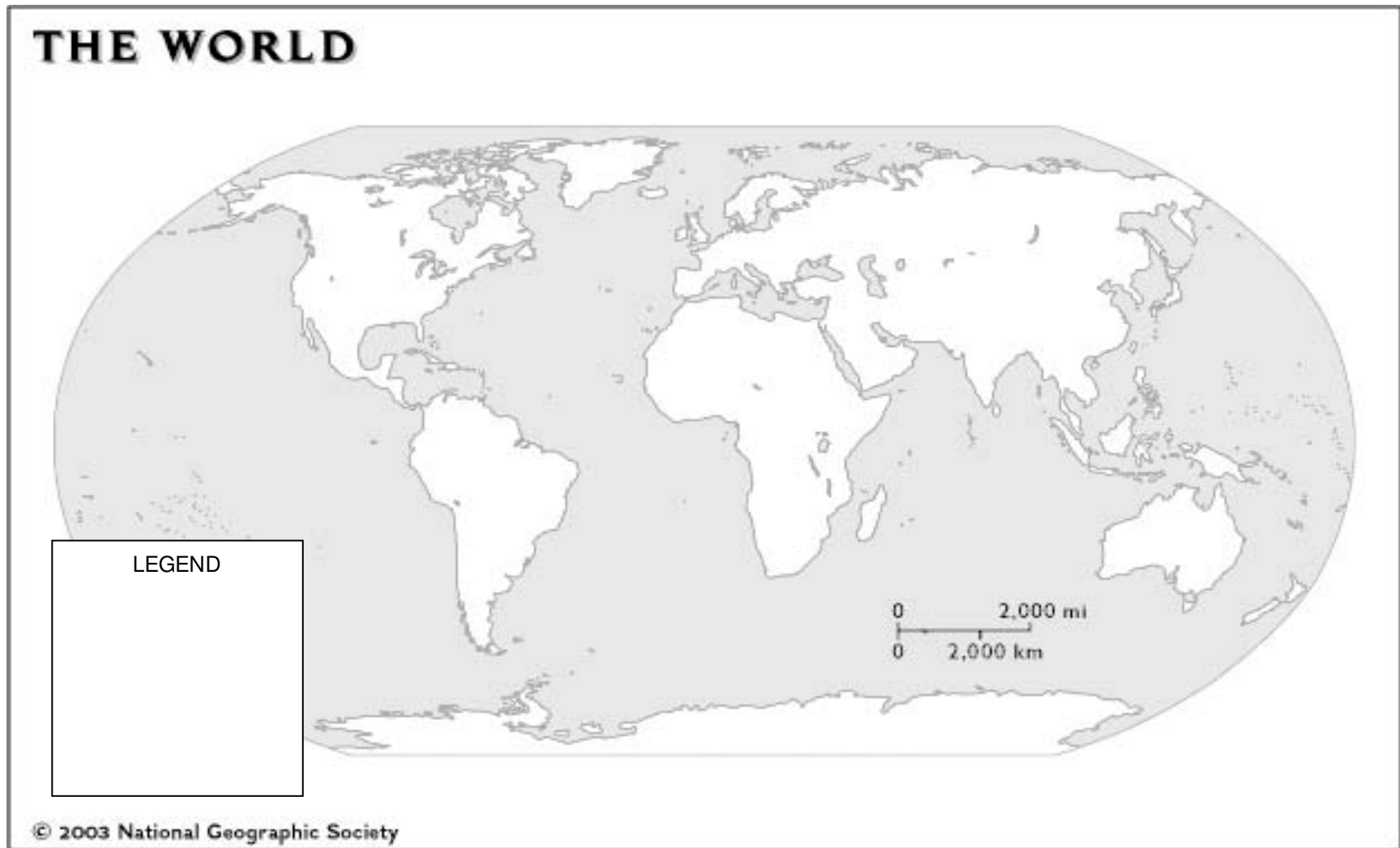
Handout 4-C

3D Map of the World

Use the following materials to create your three-dimensional map of the world:

First, create an outline map of the continents of the world. This will become your base map for this project.

Place a check by each item when you have added it your map.

_____ **Mountains:** Cut long, narrow strips of brown paper. Fold them like a paper fan. Unfold them and place where the 8 major mountain ranges are located.

_____ **Tropical Rainforest:** Use green paper, cut in rectangles, to represent the tropical rainforest regions. Fold the paper like a paper fan. Along the folded edges, make slash cuts. Unfold the paper and lift up the slash cuts so they are standing up to represent trees. Major tropical rainforests are located in South America, central Africa, and Southeast Asia.

_____ **Rivers:** Cut blue yarn and place it at the source of the 16 major rivers and have them end at the mouth of the rivers.

_____ **Deserts:** Spread glue on the desert areas and sprinkle with sand. Major deserts include: Great Basin/Sonora, Atacama, Sahara, Kalahari, Arabian, Gobi, and Great Victoria.

_____ **Grassland:** Cut green paper into circles or ovals and draw crisscrosses on it to represent the grasslands of the world. Large grassland areas include: Great Plains, Canadian Prairie, Mato Grosso, Pampas, African Savannah, Eurasian Steppe, and Australian Grassland.

_____ **Lakes**: Cut circles of blue paper and glue it to the map to represent these lakes: Caspian Sea, Great Lakes, Lake Victoria, Aral Sea, Great Bear Lake, Great Slave Lake, and Lake Tanganyika.

_____ **Major Cities:** Although cities are not physical features, their location is often related to physical features. Use brown beans to represent the 10 largest cities (est. 2005): Tokyo, Japan; Mexico City, Mexico; Seoul, South Korea; New York City, US; Sao Paulo, Brazil; Mumbai, India; Dehli, India; Los Angeles, CA US; Shanghai, China; and Jakarta, Indonesia.

_____ **Oceans:** Label the 5 oceans of the world.

_____ **Map elements:** add the following items to your map: title, orientation, date, author(s), and legend.

Map Author(s): _____

Map Evaluator(s): _____

Handout 4-D

Physical Map Rubric

Award up to the maximum number of points for each characteristic or feature:

Characteristic/Feature	POINTS	
	Maximum Possible	Points Earned
Continents – All continents shown on the map with good relative location.	7	
Mountains – All 8 major mountain ranges shown.	8	
Tropical Rainforests – 3 rainforests of South America, Africa and southeast Asia are shown	3	
Rivers – All 16 rivers are shown on the map.	16	
Deserts – All 7 deserts are shown on the map.	7	
Grasslands – All 7 large grassland areas are shown on the map.	7	
Lakes – All 7 large lakes are shown on the map.	7	
Major Cities – All 10 large cities are shown on the map.	10	
Oceans – All 5 oceans are labeled properly.	5	
Map Elements – All 5 map elements are on the map. Award one extra point if the map states that it is "Not to Scale."	5	
Total points out of 75 possible points		
Comments: On the back write comments and give suggestions to the authors of the map. What did you like about this map? What is one suggestion you would make that would improve this map?		

Mapping Data

What data or facts are available for mapping?

Big Mac Index

Big Mac index
Local currency under (-)/ over (+) valuation against the dollar, %

Big Mac price*, $		50	25	–	0	+	25	50	75	100
6.87	Norway									
6.16	Switzerland									
4.62†	Euro area									
4.06	Canada									
3.98	Australia									
3.75	Hungary									
3.71	Turkey									
3.58‡	United States									
3.54	Japan									
3.48	Britain									
3.00	South Korea									
2.99	United Arab Emirates									
2.86	Poland									
2.67	Saudi Arabia									
2.56	Mexico									
2.44	South Africa									
2.39	Russia									
2.37	Egypt									
2.36	Taiwan									
2.28	Indonesia									
2.16	Thailand									
2.12	Malaysia									
1.83	China									

*At market exchange rate on March 16th   †Weighted average of member countries
‡Average of four cities

Sources: McDonald's; *The Economist*

How fast can you say "twoallbeefpattiesspecialsaucelettuce cheesepicklesonionsonasesameseedbun?"

This question was asked of millions of TV viewers in the now famous 1970s McDonald's television commercial promoting the Big Mac. The Big Mac, perhaps the world's most popular sandwich, was created in 1968 by a McDonald's franchisee in Pittsburgh, Pennsylvania. While most people see the Big Mac as "twoallbeefpattiesspecialsaucelettucecheesepicklesonionsonasesameseedbun," economists also see the sandwich as a consumer good that is sold at over 25,000 McDonald's restaurants in 116 countries around the world. Because of its popularity, the Big Mac allows economists to make (admittedly unscientific) comparisons of exchange rates and relative prices in countries around the globe.

The Economist, March 16, 2010
http://www.economist.com/daily/chartgallery/displaystory.cfm?story_id=15715184

Big Mac Index, March 16, 2010

COUNTRY	Price of a Big Mac in US Dollars
Norway	$6.87
Switzerland	$6.16
Euro area	$4.62
Canada	$4.06
Australia	$3.98
Hungry	$3.75
Turkey	$3.71
United States	$3.58
Japan	$3.54
Britain	$3.48
South Korea	$3.00
United Arab Emirates	$2.99
Poland	$2.86
Saudi Arabia	$2.67
Mexico	$2.56
South Africa	$2.44
Russia	$2.39
Egypt	$2.37
Taiwan	$2.36
Indonesia	$2.28
Thailand	$2.16
Malaysia	$2.12
China	$1.83

For this mapping activity, you will use different colors to represent different dollar amounts. The colors representing the data should go from dark colors to light colors. Be sure to show what your colors represent in your map legend.
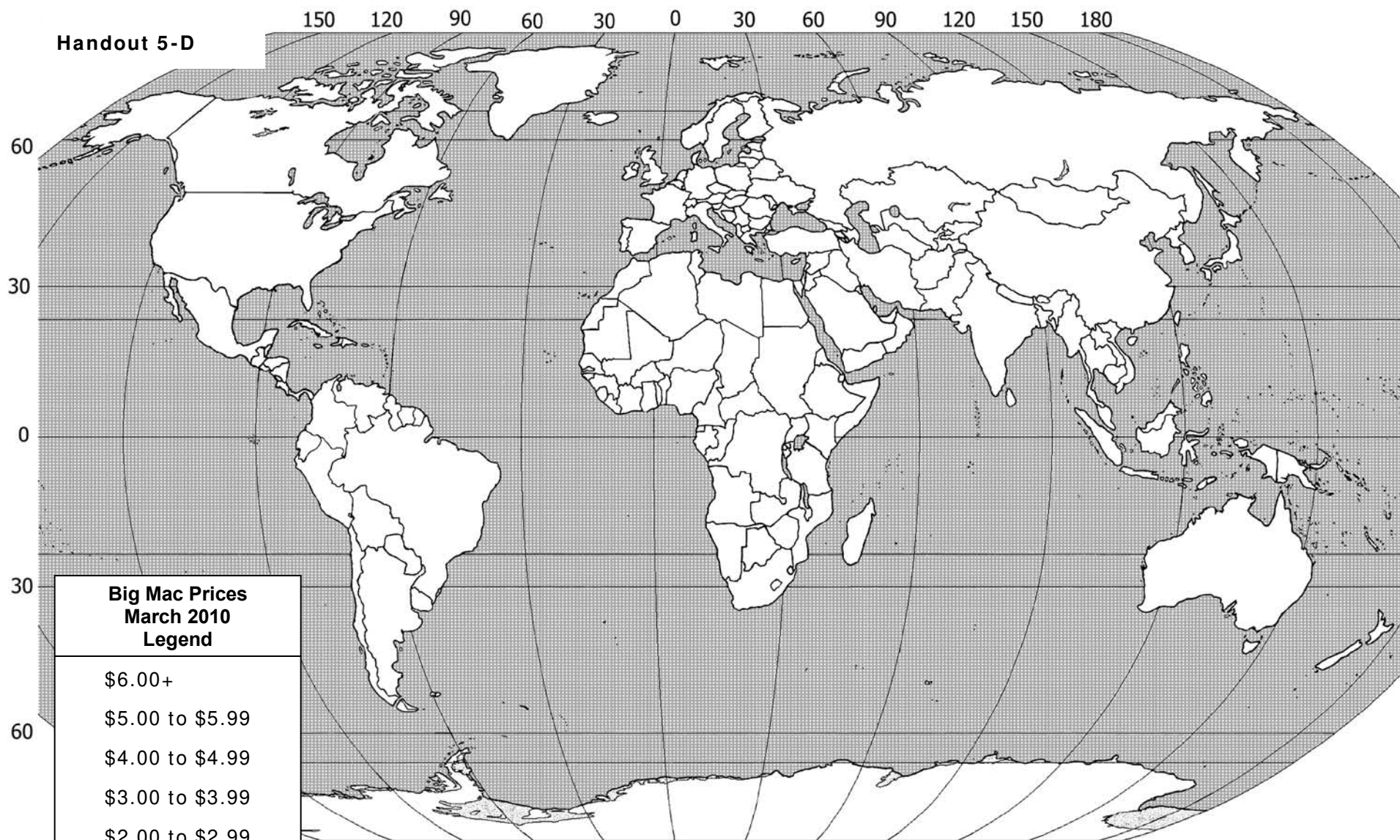
Answer these questions when you are done:

1. Are there areas of the world where Big Macs are most expensive or least expensive?

2. How might you explain the fact that there are areas for which there is no data?

Choropleth map created by Rebecca Reed, June 2010, using Microsoft Paint.

150 120 90 60 30 0 30 60 90 120 150 180

60

30

0

30

60

**Big Mac Prices
March 2010
Legend**

$6.00+

$5.00 to $5.99

$4.00 to $4.99

$3.00 to $3.99

$2.00 to $2.99

$1.00 to $1.99

The World - Political
studentsfriend.com
© 2004 Michael G. Maxwell

3000 kilometers
2000 miles
Robinson Projection

Big Mac Prices
March 2010
Legend

- $6.00 +
- $5.00 to $5.99
- $4.00 to $4.99
- $3.00 to $3.99
- $2.00 to $2.99
- $1.00 to $1.99

The World - Political
studentsfriend.com
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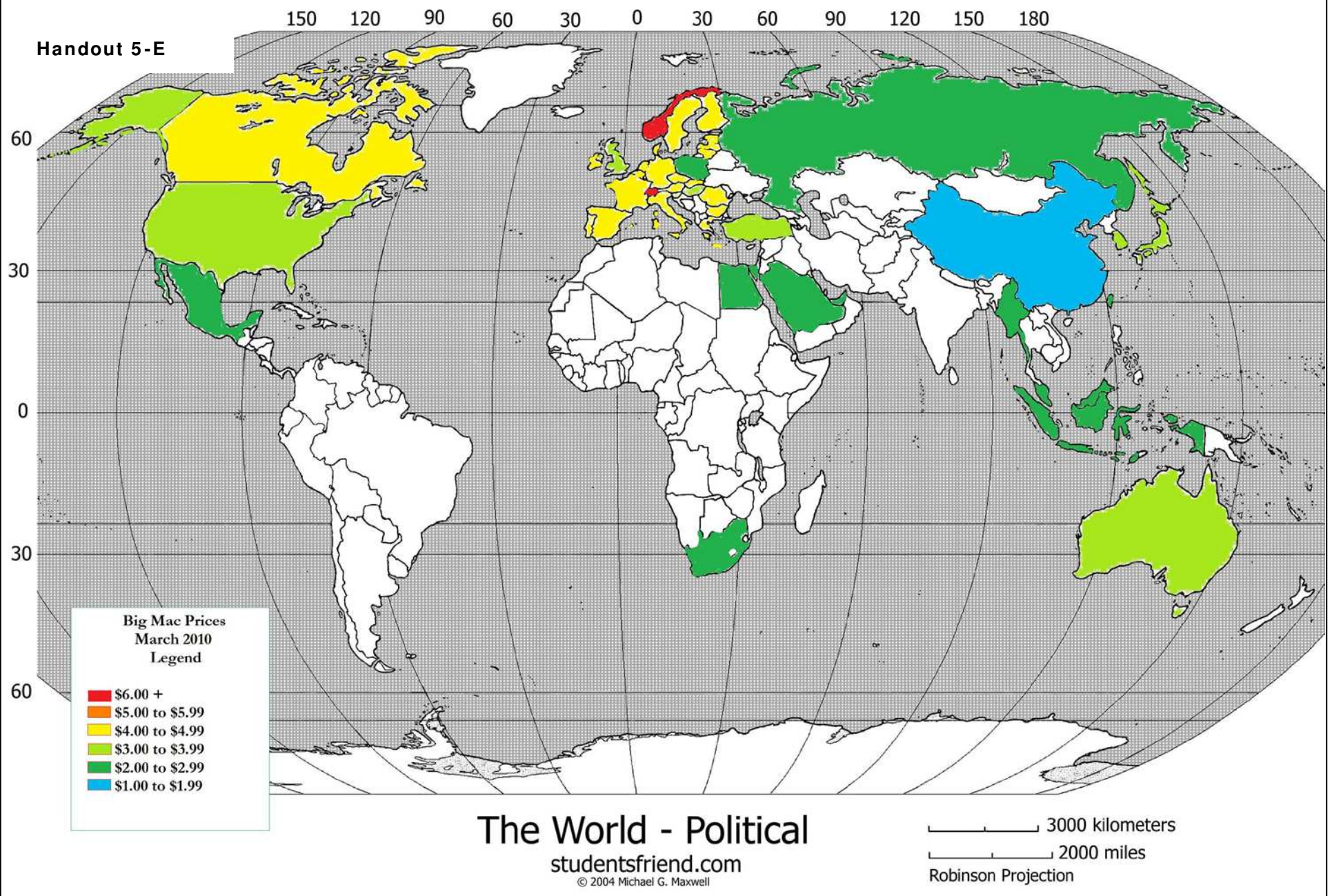3000 kilometers
2000 miles
Robinson Projection

How to Make a Cartogram

Adapted from: Making a Cartogram by Chuck Dwelley, An Educator's Reference Desk Lesson Plan, #:AELP-GGR0021

Cartograms are chart maps that present statistical information. On a cartogram, sizes of geographic areas are changed to show the statistical information. For example, on a cartogram about rainfall, an area that gets more rain would be bigger than one that gets less rain.

Steps:

1. Obtain a listing of the data to be displayed. For example, World Population in 2010 (estimated).

CONTINENT	Population	Population by 10 million (Scale)
Africa	1,033,043,000	103
Asia	4,166,741,000	416
Europe	732,759,000	73
South America	588,649,000	58
Northern America	351,659,000	35
Oceania	35,838,000	4
World	6,908,688,000	
Source: UN Statistics Division, Department of Economic and Social Affairs. "World Population Prospects: The 2008 Revision."		

2. Determine a scale. In the example above we will use one square unit of area per 10 million population. For example, Africa will cover 103 units or squares in the graph paper, and Oceania will cover 4 units in the graph paper.

3. Keep regions, in this case continents, in their approximate locations, making a map showing the data graphically. The distortions will demonstrate the data.

4. Label the cartogram. Be sure to identify the scale used on your map.

World Population
Created by Rebecca Reed
June 2010

1 unit = 10 million people
Data Source: UN Statistics
Division

NORTH AMERICA

EUROPE

ASIA

SOUTH AMERICA

AFRICA

OCEANIA