

MAPPING POPULATION

The following reading accompanies the World Population Map, 2023.

What is a Population Cartogram?

To determine the impacts of human population growth, it is important to make sense of demographic data. One way that demographers interpret data is by using population cartograms. A **population cartogram** is a map where country size is based on population rather than land area. It is a valuable tool for determining where people are located around the world.

What is a Population Cartogram Used For?

This population cartogram is probably very different from other maps you're used to. Most maps show the physical dimensions of an area, like the distance between cities or the course of a river. A cartogram instead shows data, in this case the sizes of different populations. Displaying this population data as a map helps us to make connections between population size and the physical realities of that part of the world.

Take Bangladesh, which has a small land mass compared to many other countries. On a regular map, Bangladesh is very small, and you probably wouldn't immediately see it if you weren't looking for it. On this population cartogram, however, Bangladesh is prominently visible. That's because Bangladesh is the eighth biggest country in the world by population and only the 92nd biggest country by land area. Bangladesh has one of the densest populations in the world, meaning that there are many people living in a relatively small space. What does this contrast between land size and population size mean for Bangladesh's future? Displaying this population data in a cartogram makes this comparison immediately visually apparent.

How Do You Read a Population Cartogram?

With any map, it's important to first look at the **key**, which explains how information is represented on a specific map. For the population cartogram on this poster, the key tells us that one square represents a population of one million people. You can look at any country on this map and find its total population by counting up the number of squares. For some countries, that might be a quick task. But for other countries, like China and India, the two most populous countries in the world, counting the grid squares would be quite the undertaking. Both countries have a population of well over one billion people, which means that China and India are each represented by at least a thousand squares on this map.

Determining the key is one of the most important parts of creating a map. Cartographers must weigh accurate representation against the readability of the map. This is important in cases like this map, which shows populations that are both very big and very small. For example, if the cartographer had chosen a key that represented 10,000 people as one square, that would show a country like Tuvalu much more accurately. But countries like China and India would become so large on the map that it would be impossible to see anything else. Maps are tools to understand the world, so cartographers must find a way to depict things as accurately as possible while maintaining the utility of the map.



Because this map's key must represent so many different sized populations, some nuances are lost. Again, take the country of Tuvalu. Its population of 11,400 is represented on the map with a star, the symbol for any country with a population between 10,000 and 500,000. Belize, with its population of 410,000 is represented with the same star. Belize is proportionally many times larger than Tuvalu, and this difference influences the many social, political, and economic differences between these two countries. But because so many other countries are even larger than Belize, the map's scale requires that we represent these two countries in the same way.

Limitations of the Population Cartogram

While this type of map is a great visualization of the relative sizes of populations, there are some things that cartograms can't reveal. For instance, a cartogram doesn't indicate how fast or slow a population is currently growing. It also can't reveal what life is like for the people who live in a particular area or what social or environmental challenges a country might face as a result of their population trends. Combining cartogram data with information from other sources gives meaning to the numbers and allows important questions to be addressed: How does the quality of life on Earth vary for people around the world? What might change in the future when the population is much larger? How do humans impact the natural world they depend on?

Mapping 8 Billion

The relationship between people and our natural world is at the core of so many global challenges, from water pollution to food production to biodiversity loss. As our population continues to grow, many of these challenges will grow even more pressing. A population cartogram is one piece of information among many that can help us plan for a future that takes care of the needs of all 8 billion people on the planet.

POPULATION SQUARED

Introduction

A cartogram is a map in which each area is sized proportionally according to some particular characteristic. Demographers use population cartograms, like the World Population Map, to visually represent population data and show the relative size of different country populations on a world map according to a set scale. This creates a powerful tool for examining population data and exploring trends that affect population size and growth in countries worldwide.

Materials

- World Population Map
- Student Worksheet

Procedure

1. Display the World Population Map and distribute the Student Worksheet to each student.
2. Define cartogram and instruct students to write the definition on their Worksheet.
Cartogram: a map in which the size of an area is determined by a specific variable.
3. Ask students to independently compose ideas to the Pre-Think prompts and then discuss their ideas with a partner.
4. Students work through Sections A and B of the Worksheet independently.
5. Divide students into small groups to work through Sections C and D.
6. Ask some groups to share their answer to Small Group Discussion Question #4.

Concept

Cartograms are maps used to visualize different kinds of data and can be used to map the world's population.

Objectives

Students will be able to:

- Identify, explain, and interpret population data from a cartogram.
- Construct a population cartogram representing six world regions.
- Compare a population cartogram with an equal area land map.
- Evaluate how population cartograms influence perspective of geographic regions.

Skills

Critical thinking, developing questions, reading and interpreting maps, comparing and evaluating data representations, making inferences, communicating reasoning

Method

Using the methods of a demographer, students will analyze, interpret, and evaluate conclusions on population data from the World Population Map, and then construct their own population cartogram.



Student Worksheet Answers

See Student Worksheet Answer Key

Discussion Questions

1. How do each of the groups' cartograms compare?
2. How does your understanding of global population change when looking at country data (like on the World Population Map) versus geo-regional (like on the student-made cartograms)?
3. What are the benefits of a cartogram in understanding population data?
4. What are the limitations of a cartogram in understanding population data?
5. What variables, other than population, could be used to create a cartogram?

Assessment

Have students construct written arguments in support of their claims to the following question: How has the use of a population cartogram influenced your understanding of world population? Provide at least three examples from the World Population Map.

Student Worksheet

In November of 2022, world population reached 8 billion people. But where are these people located? What countries do they call home and what does that mean for their daily lives? Through the questioning and analysis of population data, we as global citizens can better understand how we live and interact with our world.

A cartogram is (write the definition): _____

PRE-THINK:

Your task is to play the role of a demographer and use the World Population Map to make sense of the data.

- What do you see when you look at the World Population Map?
- What questions do you have about the World Population Map?

A. Gathering the Facts

1. Is the map's scale of analysis local, national, regional, or global?
2. What variable is represented on the map?
3. Look at the map's key. What is the World Population Map's scale?
4. How large must a country's population total be for the number to be written on the World Population Map?
5. How are countries labeled if their population is less than 1 million people?
6. From what sources were the country population totals gathered?
7. What are the scales of the small historic maps (found at the bottom of the poster, or on page 4 of the desktop map)? Are they the same as the scale of the large map? Do all of the small population maps use the same scale?



B. Using and Analyzing the Map

1. What is the population of Costa Rica?
2. What is the population of Egypt?
3. India has the most grid squares on the map. What does that tell us about India's population?
4. France has fewer grid squares than Nigeria. What does that tell us about the sizes of these two countries' populations?
5. The global population is projected to reach over 10 billion people by 2100. How might the scale of the large map need to change when 10 billion people are represented?
6. Compare the population cartogram to the equal area map.
 - a. Identify two countries that are larger on the World Population Map than the equal area map.
 - b. Identify two countries that are smaller on the World Population Map than the equal area map.



C. World View

1. How does this map compare to an equal land area map? (The Hobo-Dyer Projection is at the bottom right corner of the map poster or back of the folded map.)

What looks the same?	What looks different?
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2. What do you find most interesting when you compare the World Population Map to the equal land area map?



3. If you had to select one map to represent the world, which map would you choose: The World Population Map or the equal land area map? Explain your choice.

4. Give an example of when the equal land area map would be most useful and explain your answer.

5. Give an example of when the World Population Map would be most useful and explain your answer.

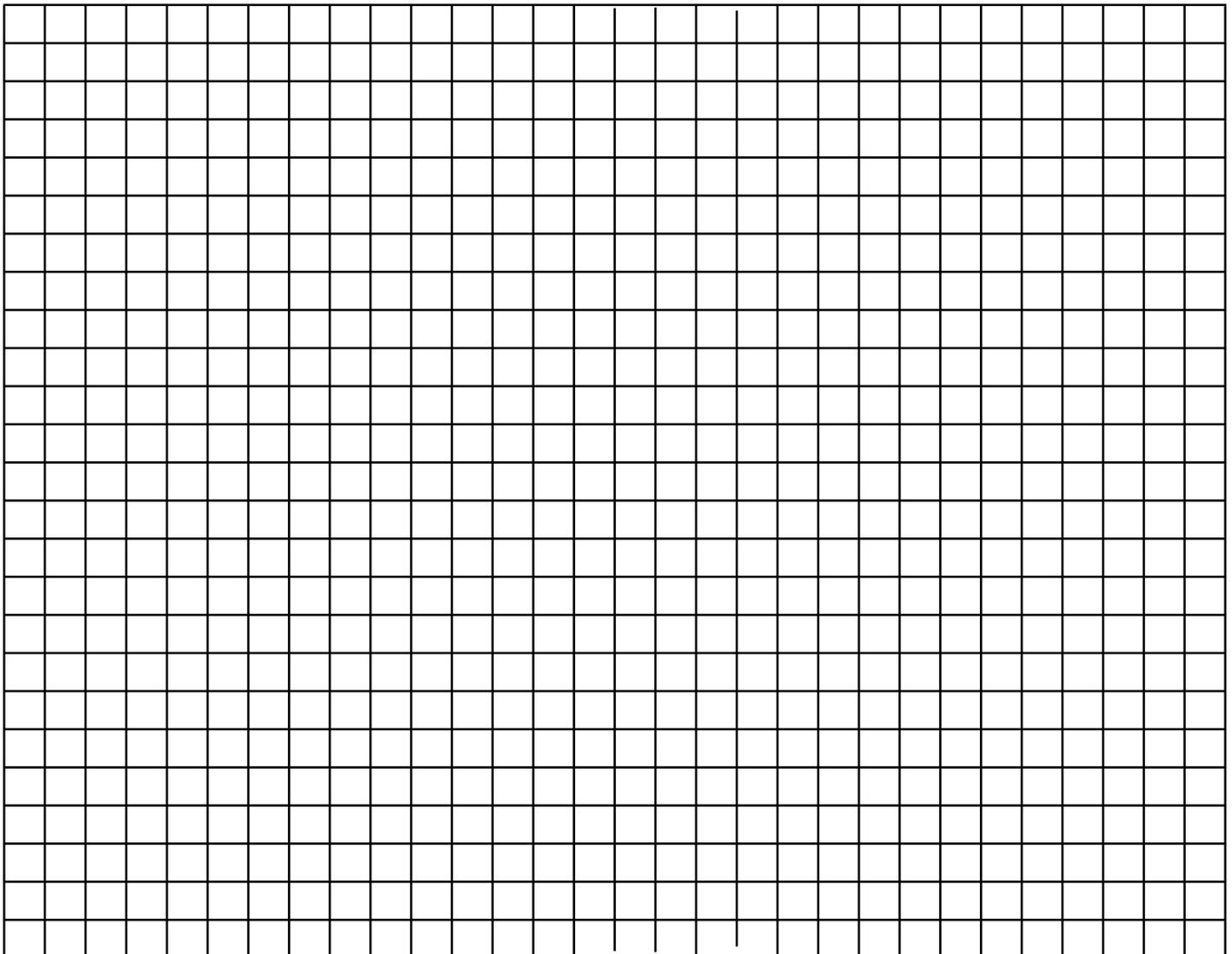
D. Cartography in Action

Construct a cartogram of the world's population by region.

1. Use the scale: 1 grid square = 25 million people. Calculate the number of grid squares for each region (round to the nearest whole number).

Region	Total Population	Number of Grid Squares
Africa	1.4 billion people	
Asia	4.7 billion people	
Europe	745 million people	
Latin America	656 million people	
Northern America	375 million people	
Oceania	44 million people	

2. Plot the regions on the graph below. Try your best to position and shape the regions like they look on a land map. Use a different color or pattern to identify each group. Remember to give your graph a title, list the scale, and label the regions.
3. Answer the Small Group Discussion Questions (on back).





Small Group Discussion

1. Describe the process of your cartogram construction. What factors did you have to keep in mind while you built the map?
2. How does your understanding of Northern America's population differ based on your cartogram versus the World Population Map?
3. How does your understanding of Asia's population differ based on your cartogram versus the World Population Map?
4. Is your cartogram useful for understanding world population? Why or why not?

Student Worksheet Answer Key

Section A: Gathering the Facts

1. *Global scale of analysis*
2. *Population*
3. *1 grid square = 1 million people*
4. *At least 10 million people*
5. *Star*
6. *UN Population Division, 2022 Data*
7. *1 grid square = 1 million people. The small maps' scales are the same as the large map's scale. All of the small maps' scales are the same.*

Section B: Using and Analyzing the Map

1. *5 million*
2. *112 million*
3. *Having the most grid squares means it has the most people. India is the most populous country in the world.*
4. *France's population is smaller than Nigeria's population.*
5. *Each grid square might need to represent more people.*
6. *Examples of countries larger on the Population Map: United Kingdom, Nigeria, Indonesia, South Korea, Vietnam*
Examples of countries smaller on the Population Map: Canada, Mongolia, Saudi Arabia, Australia

Section C: World View

1. *Similarities: the general location of country in relation to other countries; the location of the oceans; roughly how far north/south a country is located*
Differences: sizes of the countries; the shapes of some countries; some countries are neighboring countries they don't actual touch
2. *Answers will vary.*
3. *Answers will vary.*
4. *Answers would be scenarios where distance or geographic location are in question. For example: Is Nigeria closer to Egypt or India? Which countries are located on the equator? What countries border France?*
5. *Answers would be scenarios where population numbers are in question. For example: What is the ratio of people living in Australia to Canada? Which countries are the most populated?*

Section D: Cartography in Action

Grid Square totals: Africa (56); Asia (188); Europe (30); Latin America (26); Northern America (15); Oceania (2)

LAND USE SQUARED

Introduction

The World Population Map, a population cartogram, provides a snapshot of human population numbers for the year 2022 while a conventional land area map shows the relative size of the Earth's land masses. These two pieces of information, population and land area, can be useful to explore alone. But when the population cartogram and land area map are explored together, they tell us much more.

Consider that not all land is created equal. Some land is arable and will grow crops while other land will not. Some land is tree-covered, some is developed with houses, stores and malls, and some is used for a country's infrastructure. As the population continues to grow, how people use and interact with the land changes. Where people live changes as well; urbanization is on the rise, resulting in more people living in cities and megacities.

Materials

- World Population Map
- Equal area map
- Student Worksheet
- Cross section graph paper (10 x 10 squares per inch)

Procedure

1. Display the Population World Map alongside a conventional land area map and give students time to study each. Then discuss the following:
 - a. Which countries are prominently featured on one map but not the other?
 - b. What is the significance of this?

A country's size does not determine its population. A country with a large land area can have a small number of people and a country with a small land area can have a large number of people.

Concept

Population and land area maps provide information and insights on the relationships between population, land availability, and land use.

Objectives

Students will be able to:

- Read and interpret quantitative data represented on a population cartogram.
- Create visual representations of land and population data.
- Calculate and interpret a country's ratio between land, arable land, and population.
- Interpret urbanization and land use data charts.

Skills

Reading and interpreting maps and data charts, calculating and reducing ratios, making inferences, communicating reasoning

Method

Students compare the World Population Map with an equal area map to calculate statistics related to urbanization and arable land.

2. Distribute graph paper and the Student Worksheet to each student. Divide the class into groups of 2-3 students and assign each group a country from the following list:

Australia	Canada	India	Nigeria	U.S.
Botswana	China	Indonesia	Russia	
Brazil	Germany	Japan	Singapore	

3. Ask each group to find their country on both the World Population Map and the land map.
4. Instruct students to find their country on the GDP Per Capita chart at the top of their Worksheet and circle the row for their country.
5. Groups complete section **A. Population** on their Worksheet by writing down their country's name, its population, and the total number of population grid squares.
6. Groups continue working through the Worksheet section by section, with class discussion following each section.

B. Urbanization

Groups complete the Urbanization section on their Worksheet. This asks them to draw a population diagram of their country on graph paper. You may want to encourage students to try and shape their diagram to match the shape of their country like a cartographer would and as they see on the World Population Map. However, it's also possible to create the diagram as a block shape.



Urbanization Questions

1. What are the benefits of having a highly urban population? What are the drawbacks?

Benefits: access to services like healthcare and education; more job opportunities; improved infrastructure and public transportation; higher economic output

Drawbacks: population is exposed to higher levels of air and water pollution; easier for some diseases to spread; higher cost of urban living might fuel economic inequality

2. Singapore has an urbanization rate of 100%. How is that possible? Are other countries likely to ever reach that level of urbanization?

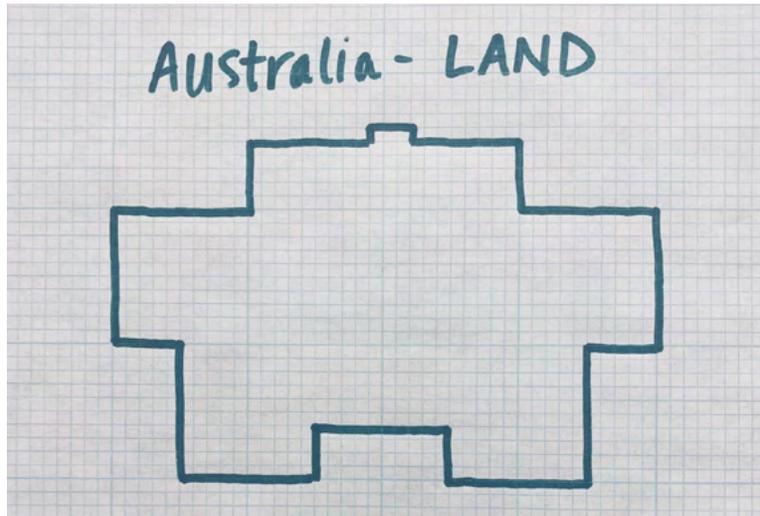
Singapore is a city-state, which means that any resident of Singapore is inherently a resident of a city. It is unlikely other countries become 100% urban unless they are also city-states, like Monaco or San Marino. Even in other countries with high urbanization rates, there are always some people who choose to live in rural areas, whether for economic reasons like agricultural work or simple preference.

3. Do you see a pattern between countries' wealth and their urbanization rates? Why might this be the case?

As countries grow wealthier, their urbanization rates increase. It's easier to provide services like sanitation, healthcare, and schooling in cities where people are located close to each other. Rural-to-urban migration occurs for many reasons, but one of the biggest drivers is better economic opportunity for residents of cities.

C. Total Land by Area

Groups complete the Total Land by Area section on their Worksheet. This asks them to draw a land diagram of their country on graph paper. Encourage students to try and shape their diagram to match the shape of their country. However, it's also possible to create the diagram as a block shape.



Total Land Area Questions

1. Are there benefits to having a large land area? Benefits of having a small land area?

Countries with a large land area have more space to develop things like housing and industry. It's easier to leave land undeveloped when there is more land available in the first place. Countries with a small land area have an easier time centralizing goods and services to make them more accessible for the total population. Land may be used more efficiently out of necessity.

2. Not all land is created equal and people depend on their country's land for many things. List the various ways that land might be used in a country.

Answers may include: farm land, industrial areas, forests, prairie, cities/urban areas, oil fields, mountains, landfills, parks

3. What are some reasons a country might not use certain areas of land and leave areas of land undeveloped?

It might not be possible to use all land, like areas that are mountains, deserts or tundra. A country may want to keep areas undeveloped for preservation or conservation, or to promote eco-tourism.

D. Ratio of Population to Land Ratio

Groups complete the Population:Land Ratio section on their Worksheet.

Project the chart that shows all of the countries' Population to Land ratios in order.

Country	1 Pop : Land
Australia	1: 33.4
Botswana	1: 28.5
Canada	1: 26
Russia	1: 12
Brazil	1: 4
US	1: 2.8
Indonesia	1: 0.7

Country	1 Pop : Land
China	1: 0.68
Nigeria	1: 0.5
Germany	1: 0.43
Japan	1: 0.28
India	1: 0.24
Singapore	1: 0.01

Total Land Area Questions

1. What does it mean when a country has a large population to land ratio?

It means there is a lot of land per person.

2. Based on your country's population to land ratio, have your feelings about the amount of land in your country changed?

3. Does the Population:Land ratio relate to wealth? What patterns do you notice?

There is no strong correlation between wealth and the Population:Land ratio. Both the richest and the poorest countries on the list have low Population:Land ratios, with Singapore and Germany among the richest and India and Nigeria among the poorest. Similarly, there are both rich and poor countries with high Population:Land ratios.

4. Which three countries have the most land per person?

Australia, Botswana, and Canada

Are these three countries similar in other ways?

They all have a small total population.

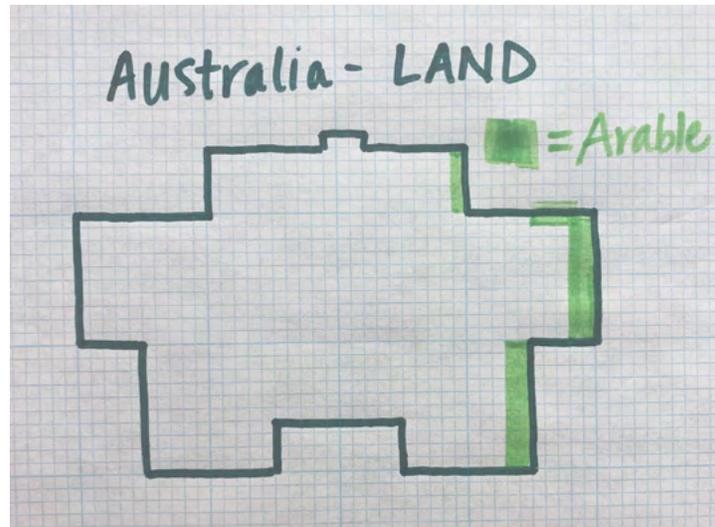
How are these countries dissimilar?

The countries are located in different geographic regions, have different climates, different land composition, etc.

E. Percentage of Arable Land

Provide students with the definition of **arable land**: land that can be cultivated for the production of crops.

Groups complete the Percentage of Arable Land section on their Worksheet. Students will need to shade their land diagram to show the percentage of arable land.



Arable Land Questions

1. What are the benefits of having a large percentage of arable land?

Many places to grow food.

2. Do countries use all of their arable land to grow food?

No. Some arable land is left undeveloped for recreation or conservation, and some arable land is used for infrastructure, industry, and residential use.

3. What could change the amount of arable land available in a country?

Desertification, development, or change in a country's land borders

F. Ratio of Population to Arable Land

Groups complete the Population:Arable Land Ratio section on their Worksheet.

Population:Arable Land Questions

1. How would a high or low population to arable land ratio impact a country?

High ratio: more food grown per person, food security independence, can export food stuffs for profit

Low ratio: import more food stuffs, more fertilizer/pesticide use, more conflict over food, more aid needed, increased hunger/malnutrition

2. What factors could change this ratio?

Changes could result from an increase/decrease in population or an increase/decrease in total arable land.

3. What does this ratio not tell us about the food situation in a country?

The ratio doesn't relay how food is distributed among the people, who has access to food, how much food is wasted, what kinds of crops are grown and for what purpose, etc.

4. If a country doesn't have enough arable land to grow food for its population, what might this mean for the country and its residents?

Answers may include: a need to import food from other countries, greater use of fertilizers and pesticides to increase productivity of the land, conflict over food, hunger and malnutrition

Student Worksheet Answers

See Student Worksheet Answer Key

Discussion Questions

1. What piece of data did you find most compelling and why?

2. How did your feelings about your country's land use change as the activity progressed?

3. Do you notice any trends in the data?

4. Is there additional information on your country that would help you understand the provided data?

5. Based on the data in this activity, which countries are the most similar to each other? The most different?

Measuring Learning

Students partner with a classmate who had a different country, share information, and then each student writes a short paragraph comparing and contrasting the two countries in regards to population, urbanization, and arable land.

Student Worksheet

My country: _____

Circle the row with your country's name and per capita GDP.

Country	GDP Per Capita
Australia	\$62,625
Botswana	\$18,323
Brazil	\$17,821
Canada	\$58,399
China	\$21,476
Germany	\$63,149
India	\$8,379
Indonesia	\$14,652
Japan	\$45,572
Nigeria	\$5,860
Russia	\$36,484
Singapore	\$127,564
United States	\$76,398

Source: World Bank, <https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD>

A. Population

Record your country's population: _____

Record your country's total number of population squares: _____

B. Urbanization

Based on the chart on the next page, which country has the urbanization rate closest to your country? How many percentage points apart are they?

First, draw a population diagram on graph paper to represent your country's population. The diagram should be made up of the number of population squares listed in Section A. You may want to use the World Population Map as a guide.

Then, determine the number of 'urban population squares' for your country. Convert the percentage to a decimal and use this equation:

$$[\text{Total population squares}] \times [\text{Urban percentage}] = \text{Urban Population Squares}$$

Country	Percentage living in urban areas (2023)
Australia	89%
Botswana	57%
Brazil	85%
Canada	82%
China	54%
Germany	75%
India	32%

Country	Percentage living in urban areas (2023)
Indonesia	53%
Japan	93%
Nigeria	47%
Russia	74%
Singapore	100%
United States	75%

Source: World Bank, <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=D>

2023: Urban Population Squares: _____

Finally, represent the urban population by shading the appropriate number of urban population squares on the diagram.

C. Total Land by Area

Which countries have the most land area? _____

Which countries have the least? _____

Notice how the size of your country's land area compares to other country's land area. Do you think the amount of land you have is good, bad, or neutral? Why?

Country	Land (hectares)
Australia	768,230,000
Botswana	56,673,000
Brazil	845,942,000
Canada	909,351,000
China	932,749,000
Germany	34,857,000
India	297,317,000

Country	Land (hectares)
Indonesia	181,157,000
Japan	36,450,000
Nigeria	91,077,000
Russia	1,637,687,000
Singapore	70,000
United States	914,742,000

Scale: 1,000,000 hectares = 1 land square

First, calculate your country's total number of land squares. To do this, divide the country's total hectares by 1,000,000.

Total Land Squares: _____

Then, draw a land diagram on graph paper to represent the land area of your country, using the appropriate number of squares.

D. Ratio of Population:Land

What is the ratio of people to land in your country?

First, find the ratio of people to land for your country: _____ population squares: _____ land squares

Then, reduce the ratio to one population square and calculate the number of land squares:

1 population square: _____ land squares

E. Arable Land

Why is it important for a country to have arable land?

Notice the percentage of your land that is arable. Do you think your country's amount of arable land is good, bad, or neutral? Why?

First, determine the number of 'arable land squares' for your country. First, convert the percentage to a decimal and use this equation:

$$[\text{Total land squares}] \times [\text{Arable land percentage}] = \text{Arable Land Squares}$$

Country	% Arable Land (2020)
Australia	4.0%
Botswana	0.5%
Brazil	6.7%
Canada	4.3%
China	12.7%
Germany	33.4%
India	52.3%

Country	% Arable Land (2020)
Indonesia	14.0%
Japan	11.3%
Nigeria	38.4%
Russia	7.4%
Singapore	0.8%
United States	17.2%

Source: World Bank, <https://data.worldbank.org/indicator/AG.LND.ARBL.ZS?locations=1W>

Number of Arable Land Squares for your country: _____

Then, shade the appropriate number of arable land squares on the land diagram. This will display a comparison of your country's total land to the amount of arable land.

Finally, based on this new information, have your feelings on the amount of total land in your country changed? Explain.

F. Ratio of Population:Arable Land

What is the ratio of people to arable land for your country?

Find the ratio of people to arable land for your country: _____ population squares: _____ arable land squares

Then, reduce the ratio to one population square and calculate the number of land squares:

1 population square: _____ land squares

Student Worksheet Answer Key

	Australia	Botswana	Brazil	Canada	China	Germany	India
A	Your country's population	26,000,000	3,000,000	216,000,000	39,000,000	1,426,000,000	1,418,000,000
	Total population squares	26	3	216	39	1426	1418
B	Urban population squares	23	1.7	184	32	770	454
C	Total land squares	768	57	846	909	933	297
D	Ratio of pop:land squares	26:768	3:57	216:846	39:909	1426:933	1418:297
	Reduced pop:land squares	1:30	1:19	1:4	1:23	1:0.7	1:0.2
E	Arable land squares	31	0.3	57	39	118	155
F	Ratio of pop:arable land squares	26:31	3:0.3	216:57	39:39	1426:118	1418:155
	Reduced pop:arable land squares	1:1.2	1:0.1	1:0.3	1:1	1:0.08	1:0.1

	Indonesia	Japan	Nigeria	Russia	Singapore	U.S.
A	Your country's population	276,000,000	124,000,000	219,000,000	145,000,000	339,000,000
	Total population squares	276	124	219	145	339
B	Urban population squares	146	115	103	107	254
C	Total land squares	181	36	91	1638	915
D	Ratio of pop:land squares	276:181	124:36	219:91	145:1638	339:915
	Reduced pop:land squares	1:0.7	1:0.3	1:0.4	1:1.1	1:3
E	Arable land squares	25	4	35	121	157
F	Ratio of pop:arable land squares	276:25	124:4	219:35	145:121	339:157
	Reduced pop:arable land squares	1:0.1	1:0.03	1:0.3	1:0.2	1:0.5