



Demographic Data Dive

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Target Grade: 6th-12th Grade Environmental Science

Time Required: 2 days, 90 minute classes

Standards

Next Generation Science Standards (NGSS):

- MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
- MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Lesson Objectives

Students will:

- Create graphs of real data using digital tool to answer a research question.
- Justify a claim using evidence from a graph.
- Draw conclusions about how women's rights and access to healthcare have changed over time and ultimately how these factors influence population growth.

Central Focus

For this lesson, students will use their prior knowledge of identifying correlations on a graph to predict and design scatterplots to ask and answer important questions. Students will investigate data that primarily focus on women's rights and health issues to examine factors that influence population growth rate across different countries.

Key terms: x and y-axes, conclusions, positive and negative correlation, graphing, investigation



Background Information

Students should be previously introduced to the concept of correlation and should be able to identify positive and negative correlations. Additionally, students should be able to draw conclusions about the strength of correlations by looking at a scatterplot. Students should have experience interpreting graphs, and they should know what the x- and y-axes are.

Materials

- Copies of handouts (*A Matter of Timing* and *Question Handout*)
- Access to computers with internet (1 per student)
- Access to PowerPoint, Google Slides, or similar software
- Ziploc bags with 30 beads (1 per pair of students)

Instruction

Day 1

Introduction:

- Have Students complete the following bell work questions in their journal upon entering the classroom:
 - Do you think there is a correlation between the average amount of sugar consumed per person and number of bad teeth per child? If so, what type of correlation (positive or negative; weak or strong)? Explain.
 - Do you think there is a correlation between the number of cell phones per 100 people in a country and the average income in that country? If so, what type of correlation? Explain.
 - What country do you think has the greatest number of cell phones per person?
 - How many cell phones do you think are in the U.S. per 100 people?
- The teacher will then explain to the students about using a website to analyze data.
- Show the students the following video on how the website works.
 - The video discusses the relationship between income and life expectancy. If time allows, ask the students what kind of relationship they predict they will see.

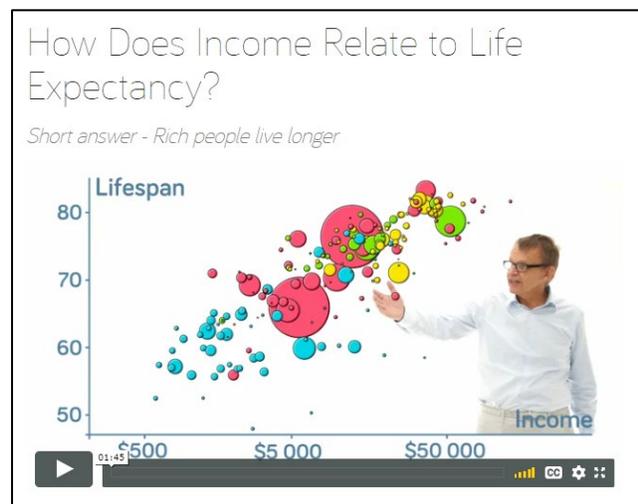


Figure 1: Website Tutorial



- <https://www.gapminder.org/answers/how-does-income-relate-to-life-expectancy/>

Exploration

- Using the following link, model setting up the graph and working through the bell work question:
 - https://www.gapminder.org/tools/#_chart-type=bubbles&locale_id=en
 - Show the students how to change the x- and y-axes including using the search bar feature.
 - Explain to the students how they can only select certain countries in the right hand margin.
 - Explain how the size of the dot corresponds to the population size of that country and the color of the dot represents the region of the world where that country is located.
 - Finally, show students how they can hit the play button at the bottom and see how these factors have changed through time.



Figure 2: Teacher model

- Explain to the students that they will be investigating how multiple factors affect population growth.
- Have students open their devices, go to the gapminder website, and set the x-axis to age at first marriage and the y-axis to population growth rate.
- Students should then select India, United States, and Germany from the “search” icon on the side bar on the right (Figure 3).

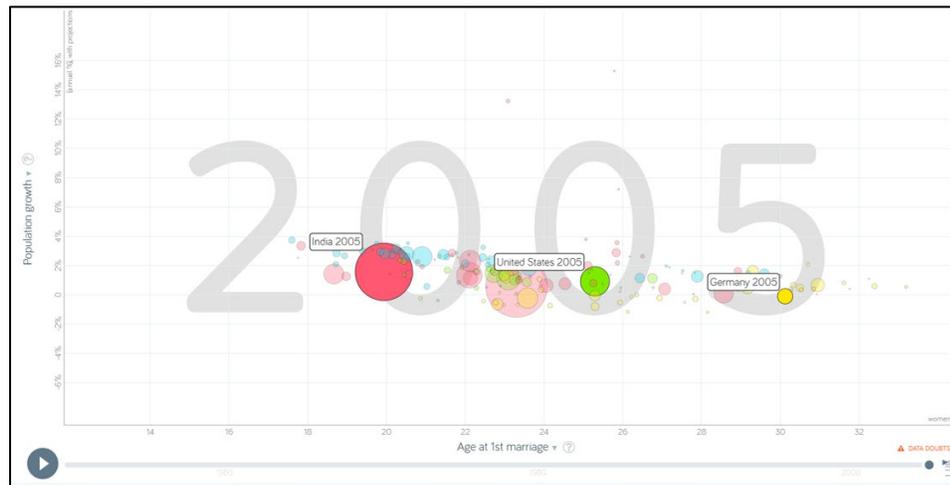


Figure 3: Student model



- Explain to students that correlation does not equal causation.
- Explain that if they are first predicting age, marriage might be a cause of population growth. Then you can set up a model to independently test this hypothesis.
- Give each pair of students a bag of beads and the *A Matter of Timing* handout (modified from Population Education) and have them complete the simulation of family growth using the beads.
- Finally, have students draw conclusions about whether there is evidence for causation in this particular case of correlation and provide evidence to support that conclusion on the analysis question of the *A Matter of Timing* handout that accompanies the manipulative.

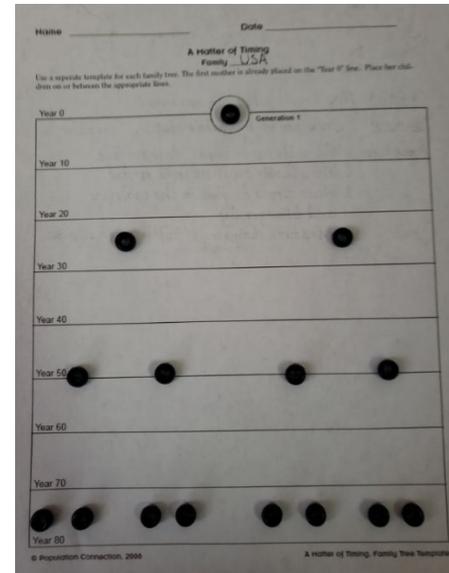


Figure 4: Example student work

Closure:

- Discuss results of the model.
- Have students write on a note card the three questions from the list below that they are most interested researching.
 - Question 1: How has the ratio of girls/boys in school changed over time and across different countries?
 - Question 2: How has ratio of girls/boys that can read changed over time and across different countries?
 - Question 3: How has women's access to healthcare changed over time and across different countries?
 - Question 4: How has the average number of babies per woman changed over time and across different countries?
 - Question 5: Does number of years a woman spends in school affect the number of babies she has?
 - Question 6: Does age at first marriage affect the number of babies a woman has?
 - Question 7: Is there a relationship between the average number of years women spend in school and the average income for the country they live in?
- From student survey results, create teams of 3 to 4 students for each question taking into account student preferences.





Day 2

- Provide students with a data collection sheet (see attached) that matches the question that they are assigned to investigate.
- Have students complete data collection sheet independently.
 - Once they complete their data sheet independently and the teacher initials that it looks good, students will meet with other classmates who researched the same question and compare their findings.
- As a team, students will create a brief PowerPoint that restates their question, their claim (answer to the question), three pieces of evidence to back up their claim, and a picture of the graph that shows this data.

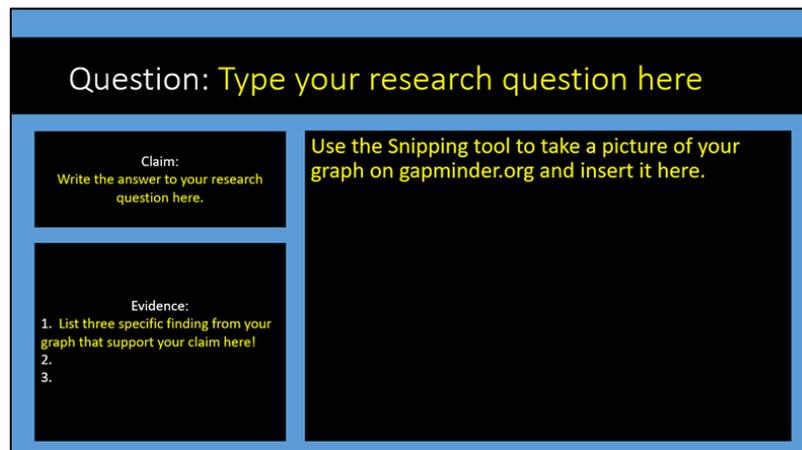


Figure 5: Possible PowerPoint Template

- Once all teams have finished building their presentations, have them present them to the class.
 - They will need to share what their question was, what their conclusion/claim is, and what evidence they have to support that claim.
 - Alternatively, this could be done as a gallery walk or jigsaw style lesson so long as all the students get to see the other students' presentations.

Closure:

- Restate each of the objectives and have students give you a self-assessment of each of the objectives as you remind them of what they were.
 - For each objective, students should give you a thumbs up if they feel like they have mastered the objective, a thumbs sideways if they need more practice but are starting to grasp it, and a thumbs down if they are in need of significantly more support.
- Have the students complete the following exit ticket that is available as a Microsoft Word Template titled, "Exit Ticket."



The graphic contains two main sections. On the left, three circular icons are arranged vertically: a green thumbs-up with the text "I can do this!", an orange thumbs-up with the text "I'm getting there.", and a red thumbs-down with the text "I need help!". A small logo for "Teachers on the Edge" is at the bottom left. On the right is a reflection form with a header for "Name:", "Date:", and "Period/Subject:". Below this are three numbered circles (3, 2, 1) and three corresponding text boxes: "3 things you learned today...", "2 questions you still have...", and "1 thing that made you say, 'WOW!'".

Figure 6: Closure resources

Differentiation

- Students are likely to finish at different times for the individual assignment on Day 2, the group time, after group time, and before presentations.
 - To extend the learning, encourage students who finish quickly to explore the data more.
 - Try out different x- and y-axes and try to find interesting and unexpected correlations.
- Have students come up with the questions on their own that pertain to factors influencing population growth or you could develop the questions for them, but make them determine which data points are important to record instead of giving them the data sheet to fill in.
- Students may be given extended time to finish the day 1 lesson, directions can be provided in small distinct steps, and/or you could modify the assignment to have fewer questions.
- Students could be provided the graph that answers their question instead of building it on their own if necessary.
- ELL students can be provided with a glossary of key terms (correlation, positive, negative, x-axis, y-axis) with pictures relevant to the lesson which they can refer back to as needed.
- Teacher should continually monitor and stop to explain points of confusion to whole class when relevant.

Assessment

Formative assessment:

- Student pairs will be assessed on their ability to accurately model population growth with beads when the teacher walks through the focus on what they are doing with their manipulatives and the conversations student pairs are having.
 - This model will be assessed through their submitted *A Matter of Timing data* collection handout that requires them to support a claim using data.



- Teacher will spot check and sign these to ensure students are on the right track before allowing them to move on to the team work part of the lesson. This will guide teacher questioning to ensure all students are working with the right data that they have pulled from the graph they created.
- Teacher will use closing (thumbs up, thumbs sideways, and thumbs down) and student's turned in exit ticket to assess both students understanding and metacognition.

Summative assessment:

- The completed PowerPoint template will serve as the summative assessment for this lesson. It will be graded using the rubric below.

	Below Expectations (0 pts)	Approaching Standard (1 pt)	Proficient (2 pts)
Question	Question not included.	Question included but with errors.	Question written correctly.
Claim	Claim does not answer question or is not included.	Claim is provided and pertains to the question, but is unclear or too general/broad.	Claim provides a clear and thorough answer to the research question.
Evidence 1	Evidence not related to claim or is not included.	Evidence relates to claim but is unclear or too broad.	Evidence is specific and clearly supports the claim.
Evidence 2	Evidence not related to claim or is not included.	Evidence relates to claim but is unclear or too broad.	Evidence is specific and clearly supports the claim.
Evidence 3	Evidence not related to claim or is not included.	Evidence relates to claim but is unclear or too broad.	Evidence is specific and clearly supports the claim.
Graph	Graph does not have the correct x and/or y-axis or is not included.	Graph included with correct x and y-axis but is missing a key component such as axis labels are not included, countries are not labelled, or tracking function not utilized to show change over time (when appropriate).	Graph is correct and includes all necessary component including axis labels, country labels, and tracking function to show change over time (when appropriate)



Examples of Student Work:

Question: How has the average number of babies per woman changed over time and across different countries.

Claim: The average number of babies per woman has decreased over the years.

- Evidence:
1. Through out the history the average women gave birth to more than five babies but suddenly started dropping around 1960.
 2. In 1820 the average number of babies per woman was 6.4 and in 2015 it was 1.93, in the United States.
 3. In Philippines it was 6.45 but later dropped to 2.96.

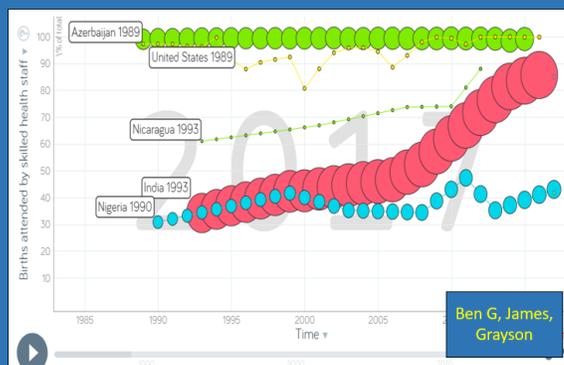


Lucia, Tristan, Halie

Question: How has women's access to healthcare changed over time and across different countries?

Claim: Women's access to healthcare got better in most countries (other than Azerbaijan).

- Evidence:
1. United States: 99 (1989), 99.4 (2010)
 2. Nicaragua: 61 (1993), 88 (2012)
 3. Nigeria: 30.8 (1990), 47.3 (2011)

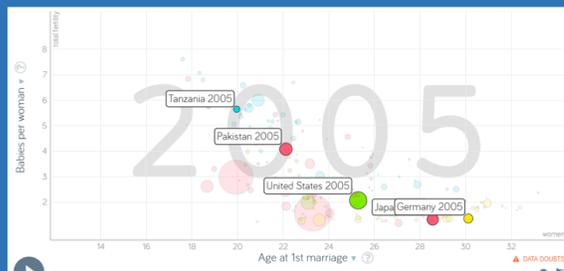


Ben G, James, Grayson

Question: Does age a first marriage affect the number of babies the woman has?

Claim: The younger women are in their marriage, the more babies they will tend to have.

- Evidence:
1. In Germany, women get married at 30.1 and have 1.35 babies
 2. In Tanzania, women get married at 20 and have 5.64 babies
 3. In Japan, women get married at 28.6 and have 1.31



Liana, Brianna, Audrey, and Edward