MEAT OF THE MATTER

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

Meat production is an incredibly resource-intensive process that threatens the health of our environment. Much of meat's **environmental footprint** comes from the energy it takes to feed and raise livestock. Consider this: 33 percent of all cropland is used to farm grains, fruits, and vegetables for livestock and 25 percent of the planet's ice-free land is used for livestock grazing.[1] Meanwhile, global meat consumption has nearly doubled since 1961 and demand is not expected to slow anytime soon.[2]

Rising per-capita meat consumption, particularly in the developing world, compounds future risks for global food security. The Food and Agriculture Organization of the United Nations (FAO) estimates that rising incomes in the developing world will require meat production to double by 2050. Making smarter choices about the type and quantity of meat we eat and understanding the environmental risks of industrial agriculture are critical to **sustainable** resource management.

MATERIALS

- Student Worksheet

For each group:

- Environmental Impact Grids 1 – 4 (provided)
- Set of assorted bingo chips

PART 1: GLOBAL MEAT CONSUMPTION TRENDS PROCEDURE

1. To get students thinking about historical trends in meat consumption, ask the following: Do you think people today eat more or less meat on a global per-capita basis than they did 50 years ago? Why or why not?

CONCEPT

Animal proteins have large, often hidden, environmental footprints. Rising global demand for meat products will have a profound impact on the health and wellbeing of our planet.

OBJECTIVES

Students will be able to:

- Graph and interpret global meat production data.
- Compare and contrast the environmental footprints of four different sources of protein (three livestock-based and one plant-based).
- Evaluate the social and environmental implications of a shifting global diet.

SUBJECTS

Science (Earth and environmental), social studies (geography), family and consumer sciences

SKILLS

Graphing and analyzing data, interpreting line graphs, comparing and evaluating, critical thinking

METHOD

Students graph global meat consumption, use manipulatives to explore the environmental impact of four different types of protein, and discuss the pros and cons of a shifting global diet.

2. Divide students into pairs and distribute the Student Worksheet to each pair. Have each pair graph the data provided on the Worksheet.

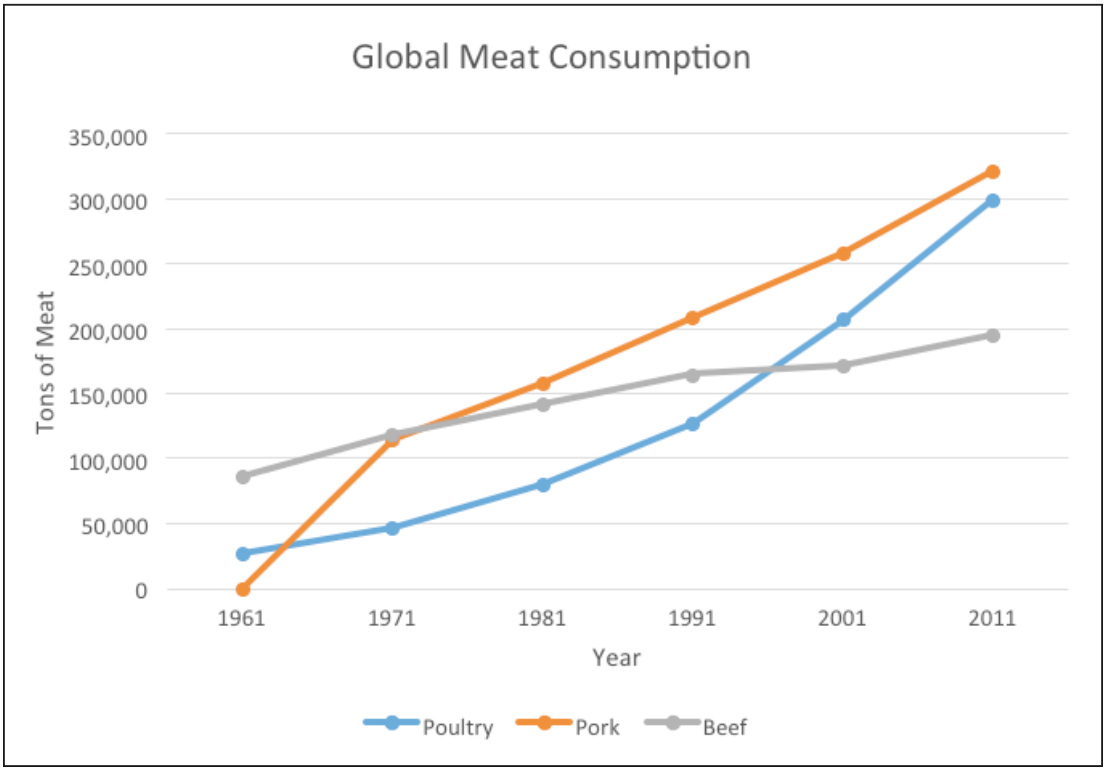
3. Once students have graphed their data, each pair should briefly discuss their initial observations with another pair.

4. As a class, briefly discuss trends observed and then ask students to hypothesize why global meat consumption has been on the rise for the past 50 years.
Answer: We have made many changes to the way we produce our meat in the last 50 years. Industrial-style agricultural practices (factory farming) and the use of pesticides and fertilizers have allowed us to mass produce more food, including meat. Faster production in mass quantities has caused the price of meat to drop substantially, making it more accessible to a greater proportion of the population. Historically, much meat consumption occurred in the developed world. However, as incomes rise in developing nations, like China and India, it has become more affordable for individuals to add meat to their daily diet, resulting in a greater demand for meat.

5. Ask students if they think there are any social or environmental consequences of the rising demand and consumption of meat around the world.
Answers may include: health complications from overconsumption of meat (particularly red meat), increased demand for meat may increase demand for factory farms, increased CO2 emissions, and environmental degradation.

6. Explain that there are very large, often hidden, environmental footprints associated with meat consumption due to all of the **resources** it takes to raise livestock for meat production and the animal wastes produced.

Answer to Student Worksheet



PART 2: THE ENVIRONMENTAL IMPACTS OF AN ANIMAL PROTEIN-RICH DIET

PROCEDURE

1. Divide students into groups of four. You may want to have them work with the pairs they grouped into at the end of Part 1.

2. Distribute the following to each group:

   a. One of each environmental impact grid (beef, pork, poultry, soy).
   b. One pre-assembled set of bingo chips for each group of four, which contains:
      - 67 blue bingo chips
      - 47 red bingo chips
      - 14 green bingo chips

   Note: Numbers do not have to be exact, as long as students have more than what they need to complete the activity.

3. Explain to students that they are going to compare the environmental impacts of four different sources of protein (beef, pork, poultry, and soy) by examining their water, carbon, and land footprints using grids and different colored bingo chips. Each group member is responsible for completing one environmental impact grid.

4. From the Teacher Environmental Impact Sheet, read aloud the Water Footprint statistics for each protein type. Students must listen for their protein and add the appropriate number of blue "water" chips to their grid.

5. Repeat the process for the Carbon Footprint and Land Footprint statistics.

6. Allow students a few minutes to discuss their observations with their group.

7. Spend a few minutes as a class comparing and contrasting the environmental impacts of animal protein to plant-based protein (soy).

DISCUSSION QUESTIONS

1. How did soy's environmental footprint compare to the animal-based proteins' environmental footprints (beef, pork, and poultry)?

   Soy has a much smaller environmental footprint than animal protein. For example, poultry's carbon footprint is about 3 times larger than soy's. Pork and beef's carbon footprints are 6 times and 26 times larger, respectively.

2. Soy is not the only plant-based protein. Can you think of other alternatives to soy?

   Answers may include: beans, chickpeas, lentils, peas, nuts, and quinoa.

3. Why do you think meat has such a large environmental footprint?

   Meat has a large environmental footprint because a lot of energy is lost in the food chain. Much of meat's environmental footprint comes from growing crops to feed livestock. The ten percent law – or law of tens – refers to the idea that with each transfer of energy through the trophic structure, only a small fraction of the energy, approximately 10 percent, remains available for the organism to use, the other 90 percent of energy is lost in the transfer as waste or heat. In the case of meat, 90 percent of the energy from the sun is lost when plants convert sunlight to carbohydrates (glucose) through photosynthesis and 90 percent of that 10 percent is lost again when animals, such as cattle, ingest grass or feed for energy. In short, meat has a larger environmental impact because so much more energy and water are used to produce each pound of meat, relative to a pound of fruits, vegetables or grains.

4. Look at your global meat consumption graph and environmental impact grids. Which type of protein poses the biggest environmental risk?

   Beef has the largest environmental footprint. We cannot tell which type of protein poses the largest environmental risk because our grids do not tell us the quantities of each type of protein consumed each year. If we refer back to our global meat consumption graph, we will notice that global demand for poultry and pork is much higher than beef.

5. Global meat production is expected to double by 2050. What challenges does this present for the environment? For the global community?

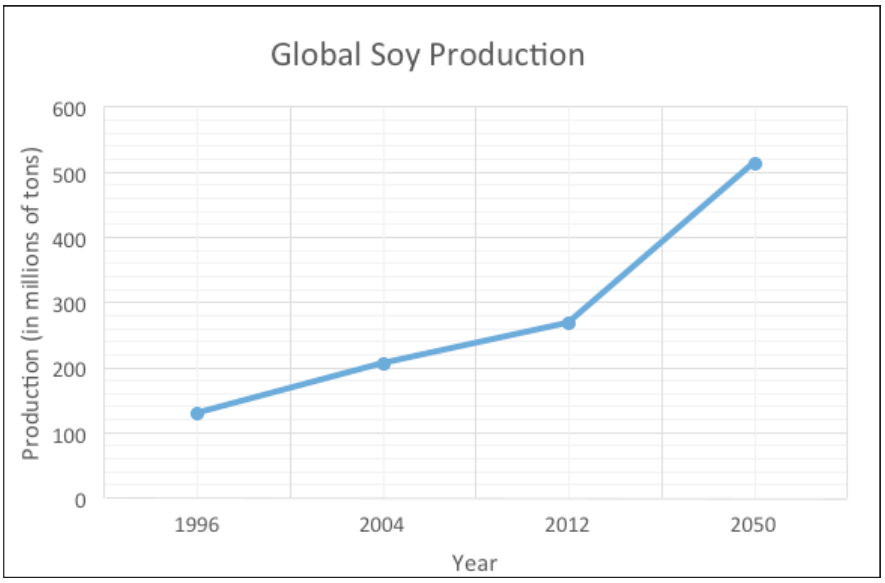
   Rising trends in meat production (and per-capita consumption) present a multitude of problems for the environment and society. Environmental problems include: land degradation caused by industrial-style farming and overgrazing, reliance on pesticides, deforestation, surface and groundwater contamination from chemical runoff and animal wastes, and elevated levels of atmospheric carbon dioxide and methane. Social problems include: health and obesity problems, the threat of antibiotic resistance, and the inhumane treatment of animals in concentrated animal feeding operations (CAFOs).

6. Do you have any ideas for how to curb demand for meat products?

   Answers may include: eating less meat, increasing public awareness about the environmental and social impacts of meat, and changing public health and dietary guidelines through legislation.

7. A rise in global meat consumption means a rise in the demand for animal feed. Currently, 75 percent of all soybeans grown are used to feed livestock.[3] The graph below shows historic and projected global soy production. What does this graph tell you about the need for farmland? Can you think of any negative environmental consequences that stem from this demand?

   The graph tells us that we will need more farmland in the future to keep up with the growing demand for soy products. Negative environmental consequences associated with this rising demand include land conversion and deforestation. A spike in demand for soy has resulted in large-scale ***deforestation*** *in much of South America, where* ***biodiverse*** *rainforests are being converted into fields for soybean cultivation.*



Source: WWF Global

8. While soy production has a lighter environmental footprint than meat production, it still has its drawbacks (converting rainforest and savanna to farmland, industrial farming practices that harm the soil and wildlife, and displacement of small farmers). Can you think of some options for more sustainable ways to grow plant-based proteins?

   Answers may include: organic farming, crop rotation, and sustainable agriculture.

9. Most people in the U.S. (97 percent) include meat in their diet. Given the popularity of meat, is there anything that we can do to lower meat production's impact on the environment? What are the pros and cons of these solutions?

   Purchasing sustainably farmed and locally-raised meat can significantly reduce the adverse environmental and social impacts of meat consumption. Sustainable farms recognize the importance of environmental stewardship and use responsible agricultural practices, like crop and livestock integration, to improve the health of soils and the environment. Additionally, purchasing meat from local farms cuts back on the fossil fuels required to transport goods from farm to table, which shrinks its carbon footprint. Unfortunately, sustainably and locally sourced meats can often be more expensive than their conventional counterparts and many people cannot afford to pay the higher price. There are ways to make sustainably-raised meat more accessible to a wide range of socio-economic groups. Across the United States, cooperative grocery stores and wholesale retailers work to provide low-income communities with high quality, sustainably-sourced meat and produce.

ASSESSMENT

Students create a visual representation, through words or drawing, of three things they learned about global meat consumption and its impact on the environment.

FOLLOW-UP ACTIVITIES

1. Have students explore three interactive maps from Ensia to identify projected changes in beef, pork, and poultry consumption by country and document their observations.

2. Have your students reflect on their experience by creating a poster or brochure to educate the public about the environmental impacts of meat consumption.

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[1]Food and Agriculture Organization of the United Nations. (2012). Livestock and Landscapes.

[2]Food and Agriculture Organization of the United Nations. (2012). World Agriculture Towards 2030/2050: The 2012 Revision.

[3]WWF. Soy: Facts & Data.

[4]National Geographic. The Hidden Water We Use.

[5]Environmental Working Group. (2011). Meat Eater's Guide to Climate Change + Health.

[6]Proceedings of the National Academy of Sciences (PNAS). (2014). Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and diary production in the United States.

[7]United States Department of Agriculture. Economic Research Service. Soybeans & Oil Crops.

TEACHER ENVIRONMENTAL IMPACT SHEET

Water Footprint[4]: 1 blue chip = 50 gallons of water

Soy: It takes approximately **220 gallons** of water to produce 1 pound of soybeans. Place **4 blue chips** on your grid.

Poultry: It takes approximately **470 gallons** of water to produce 1 pound of poultry. Place **9 blue chips** on your grid.

Pork: It takes approximately **580 gallons** of water to produce 1 pound of pork. Place **12 blue chips** on your grid.

Beef: It takes approximately **1800 gallons** of water to produce 1 pound of beef. Place **36 blue chips** on your grid.

Carbon Footprint[5]: 1 red chip = 5 pound of carbon

Soy: Approximately **10 pounds** of CO2 are emitted to produce and transport 1 pound of soybeans. Place **2 red chips** on your grid.

Poultry: Approximately **30 pounds** of CO2 are emitted to produce and transport 1 pound of poultry. Place **6 red chips** on your grid.

Pork: Approximately **60 pounds** of CO2 are emitted to produce and transport 1 pound of pork. Place **12 red chips** on your grid.

Beef: Approximately **130 pounds** of CO2 are emitted to produce and transport 1 pound of beef. Place **26 red chips** on your grid.

Land Footprint[6]: 1 green chip = 20 square feet of land

Soy[7]: Approximately **20 square feet** of land are needed to produce one pound of soybeans. Place **1 green chip** on your grid.

Poultry: Approximately **40 square feet** of land are needed to produce 1 pound of poultry. Place **2 green chips** on your grid.

Pork: Approximately **60 square feet** of land are needed to produce 1 pound of pork. Place **3 green chips** on your grid.

Beef: Approximately **160 square feet** of land are needed to produce 1 pound of beef. Place **8 green chips** on your grid. However, if we take into account the space needed for pasture, it takes **1,560 square feet** of land to produce 1 pound of beef. Place an additional **70 green chips** on your grid*.

*Note: students will realize that there are not enough spaces on their grid or green chips at their workstation. Stop the activity and discuss as a class why meat requires more land than vegetables and other forms of protein.

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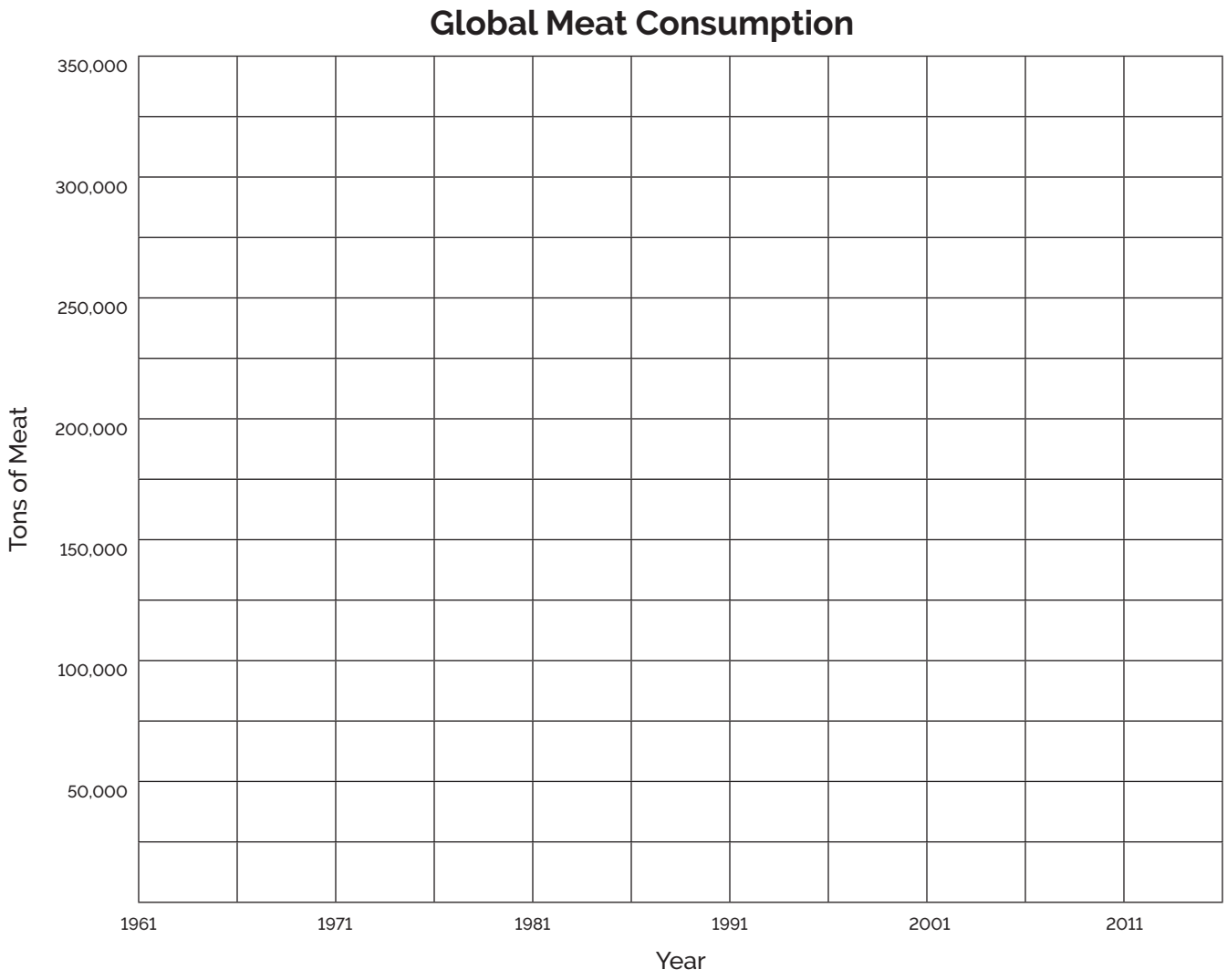
STUDENT WORKSHEET

Name: _____ Date: _____

Directions: Work with your partner to graph and label the data provided below.



Tons of Meat Consumed	1961	1971	1981	1991	2001	2011
Poultry	26,483	46,777	80,916	128,073	207,530	300,131
Pork	73, 779	115,349	158,011	208,663	258,572	321,757
Beef	86,439	118,334	141,975	165,030	171,613	195,166

Source: Food and Agricultural Organization of the United Nations.

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ENVIRONMENTAL IMPACT GRID 1: BEEF

Water Footprint: 1 blue chip = 50 gallons of water

CO_2 CO2 Footprint: 1 red chip = 5 pounds of carbon

Land Footprint: 1 green chip = 20 square feet of land

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ENVIRONMENTAL IMPACT GRID 2: PORK

Water Footprint: 1 blue chip = 50 gallons of water

CO_2 CO2 Footprint: 1 red chip = 5 pounds of carbon

Land Footprint: 1 green chip = 20 square feet of land

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ENVIRONMENTAL IMPACT GRID 3: POULTRY

Water Footprint: 1 blue chip = 50 gallons of water

CO2 Footprint: 1 red chip = 5 pounds of carbon

Land Footprint: 1 green chip = 20 square feet of land

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ENVIRONMENTAL IMPACT GRID 4: SOY

Water Footprint: 1 blue chip = 50 gallons of water

CO_2 CO2 Footprint: 1 red chip = 5 pounds of carbon

Land Footprint: 1 green chip = 20 square feet of land