Big Era Nine
Paradoxes of Global Acceleration
1945 - Present

Landscape Teaching Unit 9.6
Population Explosion and Environmental Change
1945 – Present

Table of Contents

World History for Us All
A project of San Diego State University
In collaboration with the
National Center for History in the Schools (UCLA)
http://worldhistoryforusall.sdsu.edu/

Why this unit?

What were the consequences to the natural environment from exponential population and economic growth that were set in motion in the first half of the century and peaking in the second half?

In this unit, students will investigate the effects on the global natural environment of population increase, shifting land and water priorities, and energy use in the second half of the twentieth century. They will also investigate these same factors and outcomes for their local areas. Students will consider the various ways in which their own lifestyles can be altered to live more sustainably, as they investigate citizens' and governmental groups working in their area on such issues as land and habitat conservation, locally-grown, sustainable food sources, and sustainable energy initiatives.

Unit objectives

Upon completing this unit, students will be able to:

1. Interpret charts and graphs to use as evidence of environmental change.
2. Construct diagrams or models showing the relationship between the historical data and their contemporary communities.
3. Analyze possible relationships between economic growth and environmental sustainability in the second half of the twentieth century.
4. Analyze possible relationships between economic development and environmental costs.
5. Explain examples of effects of human action in the period on the global environment.

Time and materials

This unit should take five to six class periods, with homework.

Materials: Large floor maps of the world and of the students' local area. (See Lesson 1 for additional materials needed for this activity.)

Drawing paper and pencils, colored pencils and markers (or paint and brushes), cardboard, glue, string, metal fasteners, and other model construction supplies teachers may wish to use.

Author

Lori D. Shaller taught world history and English to high school students for eighteen years, the last eight at the Martha's Vineyard Public Charter School. In 2000, she received Northeastern University's World History Center's Award for Excellence in Teaching World History for the lesson "Living Rooms around the World." Lori is an educational consultant working in the areas of world history, Shakespeare, and school assessment. She is also in Rabbinical School.

The historical context

The years 1950-2000 saw a nearly three-fold increase in the world's population, from 2.5 billion to 6.1 billion people. This enormous **demographic** change can be seen as the factor largely responsible for the global environmental history of that half-century. Increased birth rates and age expectancies, improved medicines, and astonishingly-increased farm yields meant that more people were living, and living longer. The period was also one of drastically-increased wealth globally. The increases in both population and wealth—even as millions more people than ever fell into the depths of poverty—resulted in the reality we face today: for so many to live as well as they do, all of humanity can no longer be fully sustained on the earth's resources.

Late twentieth-century environmental history is an intricate web of interconnected factors and conditions. Unraveling the tangle to see the individual constituents that form the web is helpful in understanding the larger structure. Each of the following sections will be connected to the others at various points: demographics, land and water use, energy, international movements and cooperation, and economics and politics.

Population

Thirteen percent of all humans that ever lived have lived between 1950 and 2000.[1] The populations of Asia doubled, Latin America tripled, and Africa almost quadrupled. Taken together, Europe's and North America's populations tripled.[2] Increased food production was made possible by the increased use of chemical fertilizers and pesticides, as well as more irrigation and astronomic amounts of petrol, the latter being used not only in food production but also in its distribution and storage. Increasingly over the period, however, there was not enough farming globally to meet food demands, due to changes in land and water use and loss of farm land to accommodate increased population.[3] By 1998, almost half of the world's population lived in urban areas. In 1990, urban populations accounted for as much as 75 percent of total US and 78 percent of total European populations.[4]

Land and Water Use

Between 1950 and 1990, the amount of land under cultivation grew to be one third of the earth's land cover, and it was able to feed an extra 4 billion people. Since land was limited, the focus was on getting greater yields out of the same amount of land under cultivation. This was done with fertilizers, pesticides, specialization (growing fewer types of crops) and the development of genetically-engineered and virally-resistant grains. Nineteen ninety-eight, however, was the first year in which using more fertilizer to grow more food did not increase crop yields.[5] While there

[1] John R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 8.

[2] Ibid., 271.

[3] Lester R. Brown, *Plan B 3.0: Mobilizing to Save Civilization* (New York: W. W. Norton, 2008), 117.

[4] McNeill, *Something New*, 283.

[5] Ibid., 213; Brown, *Plan B 3.0*, 176.

was less and less land available worldwide for cultivation, the land under cultivation was increasingly reaching its limits, with soil erosion and compaction also eating into yields.[6]

There was an intensification of fossil fuel use for producing food in this period.[7] It was taking one calorie of energy for every calorie of food produced, including the fuel that went into the fertilizer, powered the farm machinery, got the food to market, and kept it fresh. Moreover, the chemicals in the soil and the runoff into fresh water supplies were beginning to make people sick.[8]

Amounts of forest and woodland also dropped in the period, each giving way to urban sprawl, but grassland and desert land covers increased.[9] Because of the enormous growth in the number of grazing animals in the period, increased amounts of land were needed for grazing.[10] And increasingly over the half century, this put people in conflict with one another. For example, in Sudan, where the Sahara creeps inches farther south every year, northern herders have been encroaching on southern farmers' lands, resulting in a horrible war affecting the civilian population.[11]

Similar conflicts over water use have increased over the last fifty years. Increased irrigation, another boon to crop yields, meant the rerouting and damming of rivers and the using-up of aquifers faster than they were being replenished.[12] Water was also being lost to contamination from both agricultural and industrial run-off or dumping and to increased levels of evaporation due to rising global temperatures. Lake Chad has decreased 96 percent in the last forty years, and the Aral Sea, having lost two-thirds of its volume and fifteen meters of its depth, became two seas in the same period. Each of these bodies supplies water to multiple nations and millions of people. Half the lakes in Qinhai Province in China have disappeared in the last twenty years, as did 969 of 1,052 lakes in Hebei Province surrounding Beijing.[13]

The contamination of the world's oceans, rising global temperatures, over-fishing, and the dwindling of new ocean fishing grounds, accounted for the collapse of more than two-thirds of the world's fisheries by the last decade in the period.[14] Species are being lost as water temperatures rise. Those species most adaptable are nosing out local fish as the former expand

[6] McNeill, *Something New*, 35, 47.

[7] Michael Pollan, *The Omnivore's Dilemma* (New York: Penguin Books, 2006), 45.

[8] McNeill, *Something New*, 30.

[9] Ibid., 213.

[10] Ibid., 264.

[11] Brown, *Plan B 3.0*, 118.

[12] McNeil, *Something New*, 154, 180; Brown, *Plan B 3.0*, 74.

[13] Brown, *Plan B 3.0*, 68; McNeill, *Something New*, 164.

[14] McNeill, *Something New*, 250; Brown, *Plan B 3.0*, 97.

their ranges. As poor countries sell their coastal fishing rights to richer countries, these fisheries are also being used up with the added problems of lost lease revenues and fish supplies.[15]

Energy

Demand for energy increased exponentially in the period owing to the enormous population increase, a huge increase in the world **Gross Domestic Product**, and technological innovation. As David Christian has written,

> Total human energy consumption multiplied many more times in the twentieth century than in all of previous human history. At the end of the twentieth century, the total amount of energy consumed by humans may have been 60,000 to 90,000 times that used by humans early in the **Neolithic** Period. As a result of these changes, human societies became, in the twentieth century, a major force acting on the biosphere.[16]

Indeed, "at any given time after 1970, about five gallons of oil were in transit at sea for every man, woman, and child on the face of the earth."[17]

There was a shift in the uses of energy midway through the period as well. Whereas **agriculture** accounted for most energy use earlier in the period, electrical generators accounted for more use later in the period.[18]

Energy demands for transportation also increased, with more people driving greater distances and more vehicles occupying the roads.[19] Between 1948 and 1973 and again after 1984, oil prices dropped and more uses were found for it, for example, in plastics manufacture.[20] Even so, refrigeration accounts for the single greatest consumer use of energy.[21] Global oil prices are tied to global grain prices; if oil is cheap, so is food, and vice versa.[22] One-fifth of the petrol used in the US today is to bring food to market.[23] Both agriculture and energy production are subsidized in rich countries, making for inequalities in ability to enter world markets for poor countries that do not use subsidies.[24]

---

[15] Brown, *Plan B 3.0*, 99, 146. Brown also notes the leasing of waters by poor countries to the richer nations for garbage dumping.

[16] David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2005), 459.

[17] McNeill, *Something New*, 304.

[18] Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 230.

[19] Brown, *Plan B 3.0*, 228; McNeill, *Something New* , 60.

[20] McNeill, *Something New*, 305.

[21] Brown, *Plan B 3.0*, 36.

[22] Ibid., 38.

[23] Pollan, *Omnivore's Dilemma*, 83.

[24] Brown, *Plan B 3.0*, 146.

The results of the use of coal and fossil fuels have been harmful to both the earth's land and water. For example, the coal burned in Britain damages Norway's thin soils; China's air pollution affects Japan's air quality.[25] The release of toxic chemicals into the air, such as sulfur from coal burning and **chlorofluorocarbons (CFCs)** from the burning of fossil fuels, has created unsurpassed climatological change, four times what it was in 1950.[26] This has meant rising seas, which will eventually mean mass migrations of coastal and island-living peoples.[27] Between 1989 and 2000, Mt. Kilimanjaro lost 33 percent of its ice cap, resulting in local rivers becoming seasonal. Warmer seas will also mean the loss of additional fish species.[28]

International agreements and cooperation

Rachel Carson's *Silent Spring*, a watershed book on pesticides published in 1962, changed forever humans' attitudes toward the environment and their relationship to it. In 1970, 20 million Americans came out to celebrate Earth Day, and in 1990, 200 million people in 140 countries celebrated the earth.[29] In 1971, the UN started the Man and the Biosphere research program, "and by 1990 most rich countries had global-change science programs. Taken together, by 1998 these amounted to the largest research program in world history."[30]

The western nations, led by the US, were the major signers of the Montreal Protocol on Chlorofluorocarbons in 1987, whose amounts in the atmosphere have dropped 60 percent since their peak in 1988.[31] And then there was the Earth Summit in Rio in 1992, which demonstrated the intractability of some nations on some issues, making international agreements difficult to organize. Yet citizens' environmental groups grew, as evidenced by the burgeoning Green Parties in Europe and actions such as those in Japan where, in the 1960s, citizens succeeded in winning damages and legislative changes to guarantee an end to industrial pollution. Lester Brown suggests that this was unprecedented before there had been experiences of international cooperation.[32]

Economics and politics

The strength of the global economy—unprecedented growth to the tune of a twenty-fold increase between the beginning and end of the century—created demand for goods ever further away. For example, wealthy Americans' taste for beef has meant the loss of increasing amounts of forest to grazing land, notably in the Amazon basin.[33] World Gross Domestic Product per capita was $100 in 1500 CE, $2,238 in 1950, and $11,664 in 1992.[34] Economic growth helped take people out of

[25] McNeill, *Something New*, 99, 103.

[26] Brown, *Plan B 3.0*, 50.

[27] Ibid., 48.

[28] Ibid., 55.

[29] McNeill, *Something New*, 339.

[30] Ibid., 340.

[31] Ibid., 354.

[32] Brown, *Plan B 3.0*, 352.

[33] Ibid., 320.

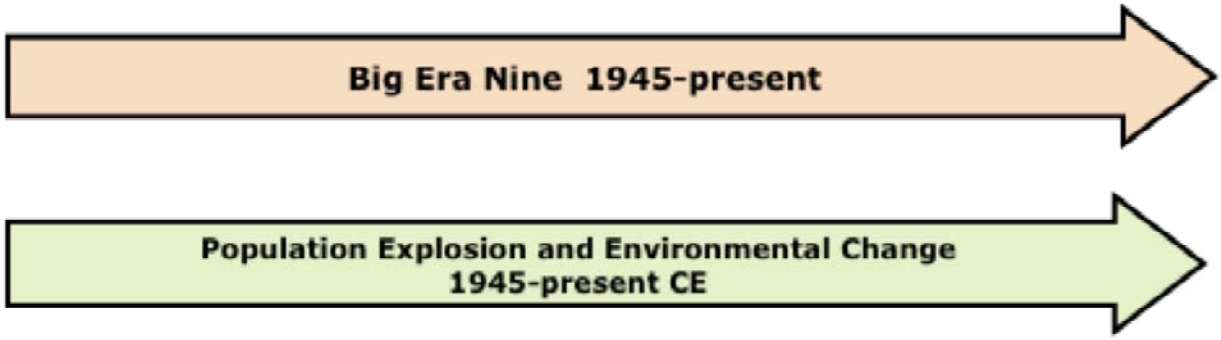
[34] McNeill, *Something New*, 6.

poverty in places such as China.[35] But economic growth also caused serious global environmental problems. "While the economy is growing exponentially, the earth's natural capacities, such as its ability to supply fresh water, forest products, and seafood, have not increased. … Today, global demands on natural systems exceed their sustainable yield capacity by an estimated 25 percent."[36] Some suggest that our future as a species, and the earth's future as well, depend on a new way of understanding economics and politics with respect to the environment. Lester Brown suggests that taxing the costs of pollution, resource depletion, and energy consumption involved in producing goods would help to pay for the clean-up that is needed immediately.[37] Similarly, David Christian suggests the following:

> If environmental constraints do not bring the capitalist world system crashing down—if, instead, it manages to find new markets by selling to the poor as well as to the rich, by seeking profits in ecologically-sustainable production, and by trading more in services and information than in materials—then we can envisage further transformations generated by technologies we can only glimpse at present.[38]

Politically, conflict zones exist in pockets throughout the world, and some of the battles have become more severe as natural resources are more heavily taxed. The aforementioned issues of the loss of fresh water sources and changing demands on the land account for many of the violent conflicts in play today.[39]

This unit in the Big Era Timeline



[35] Brown, *Plan B 3.0*, 131.

[36] Ibid., 11.

[37] Ibid., 7.

[38] Christian, *Maps of Time*, 483.

[39] Ibid., *Plan B 3.0*, 118.

Lesson 1
Think Globally
Mapping Environmental Change in the Last Half Century

Introduction

This lesson is intended to have students "create" and "witness" the impact of an additional four billion people inhabiting the planet, with global wealth increasing exponentially. Students will interpret and analyze graphs, charts, and quotations to understand the effects of human action on the environment in the second half of the twentieth century. This lesson can be used alone or as the first one in the unit.

Preparation

Teachers should use the largest laminated map of the world they can get and be able to lay it out on the floor or over desks in the classroom. This activity will also require dry-erase markers and the following materials:

Several boxes of Cheerios = people
Pine needles, acorns, leaves = forest and woodland cover
Small twigs = range land
Grass = grassland
Sand = desert

Prepare copies of Student Handout 1.1, figures 1-15, which includes data the students will need to do the activities in Lesson 1.

Activities

1. Give students time to read the data presented in Student Handout 1.1. This may be done as homework the night before. You may also choose to have students read the "Historical Context" essay for this unit, as well as for Landscape Teaching Unit 8.7.

2. Have students arrange themselves around the map with the Cheerios, pine needles, sand, and other materials. Have them use a dry-erase marker to draw circles around large urban areas. Then, have them place the Cheerios on the map in populated areas, more in city areas, as per the year 1950. Have the students arrange the greenery and sand for the approximate year 1950.

3. Do this again and again for each of the ten-year increments through the year 2000. After each decade, ask students what they notice and what kinds of implications there may be for what they notice. For example, if more people are taking up more cropland, what does that mean for food cultivation? If cities are expanding into cropland, what kinds of effects could be expected in

terms of pollution and the distances it travels? Have students refer to the tables and charts in Student Handout 1.1 to inform their suppositions. Write these down.

Have students complete Student Handout 1.2 (Question Sheet) and discuss as a class.

Have students complete the activities in Student Handout 1.3 (Performance Task and Assessment Rubric).

Lesson 1
Student Handout 1.1
Figure 1

World Gross Domestic Product
1950 - 1992

Year	World GDP
1950	2,238
1973	6,693
1992	11,664

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 6. These are index numbers relative to 1500, index number 100.

Lesson 1
Student Handout 1.1
Figure 2

World per Capita Gross Domestic Product 1950-1992

Year	Per Capita World GDP (1990 dollars)	Index Numbers (1500 CE = 100 World GDP)
1950	2,138	378
1992	5,145	942

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 7.

Lesson 1
Student Handout 1.1
Figure 3

World Energy Use
1900-1990

"Technological changes are what made it possible to support such huge populations."

David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2005), 442.

Year	Total (millions of metric tons of oil equivalent)	Index Numbers (1900 = 100)
1900	800	100
1990	10,000	1,250

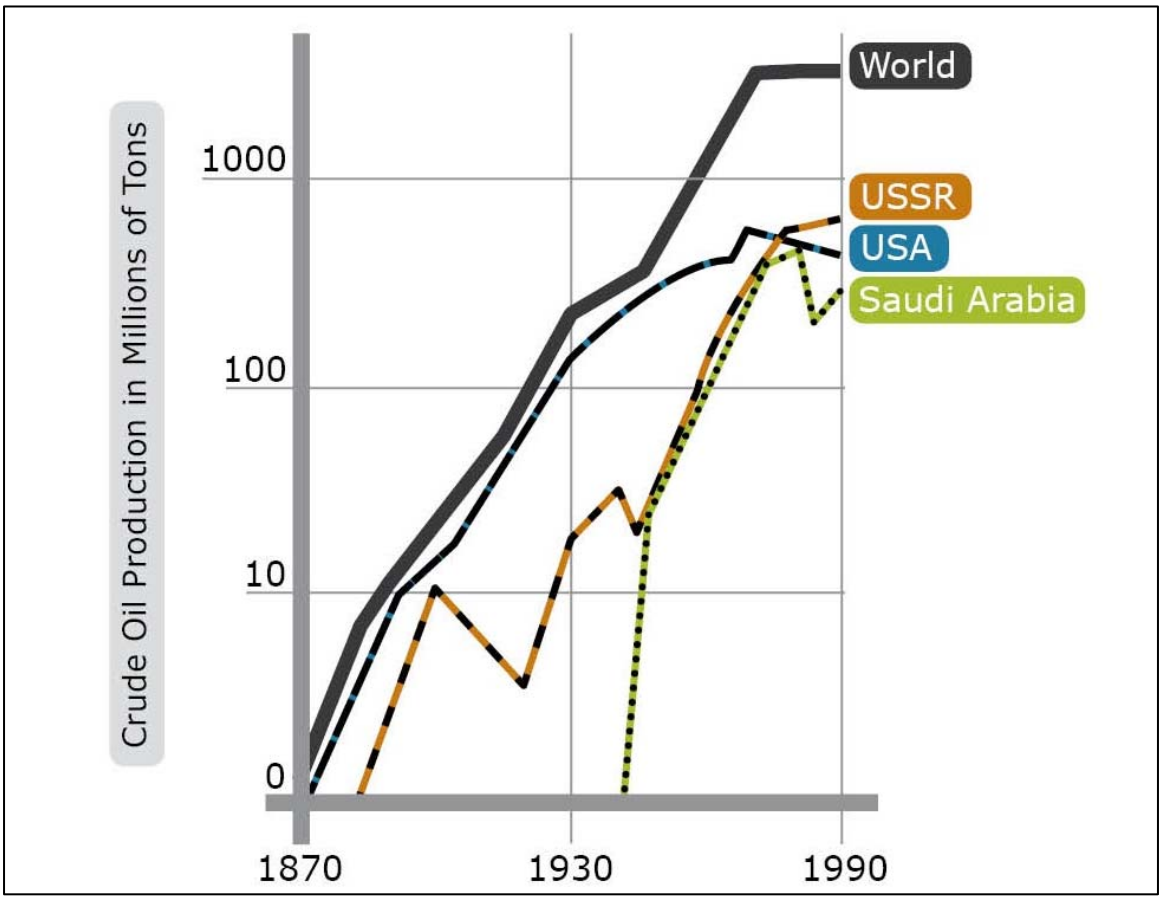
Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 15.

Lesson 1
Student Handout 1.1
Figure 4

Crude Oil Production
1900-1950

"Technological changes are what made it possible to support such huge populations."

David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2005), 442.



Source: Adapted from Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 186.

Lesson 1

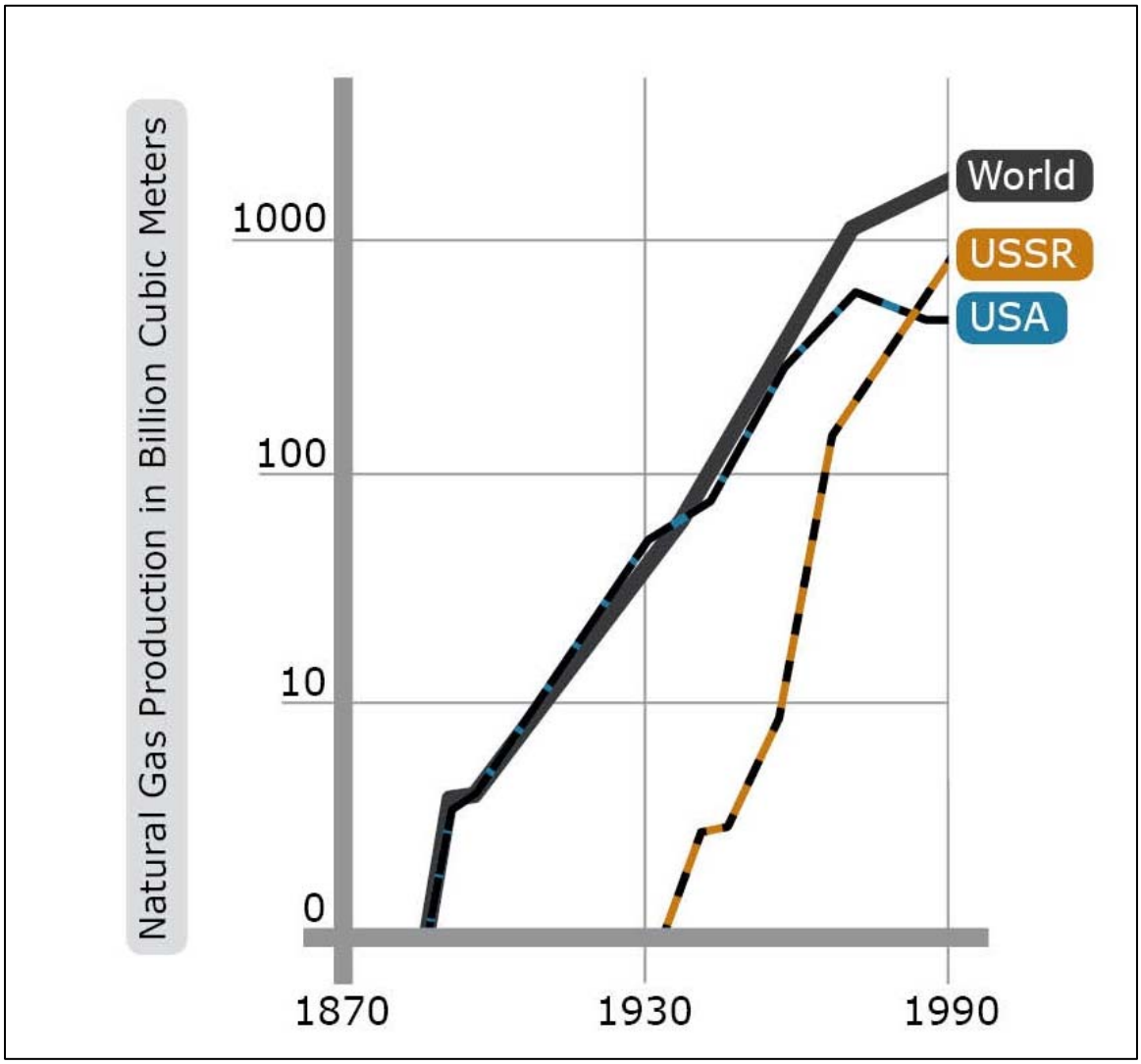
Student Handout 1.1

Figure 5

Natural Gas Production
1900-1950

"Technological changes are what made it possible to support such huge populations."

David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2005), 442.



Source: Adapted from Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 186.

Lesson 1

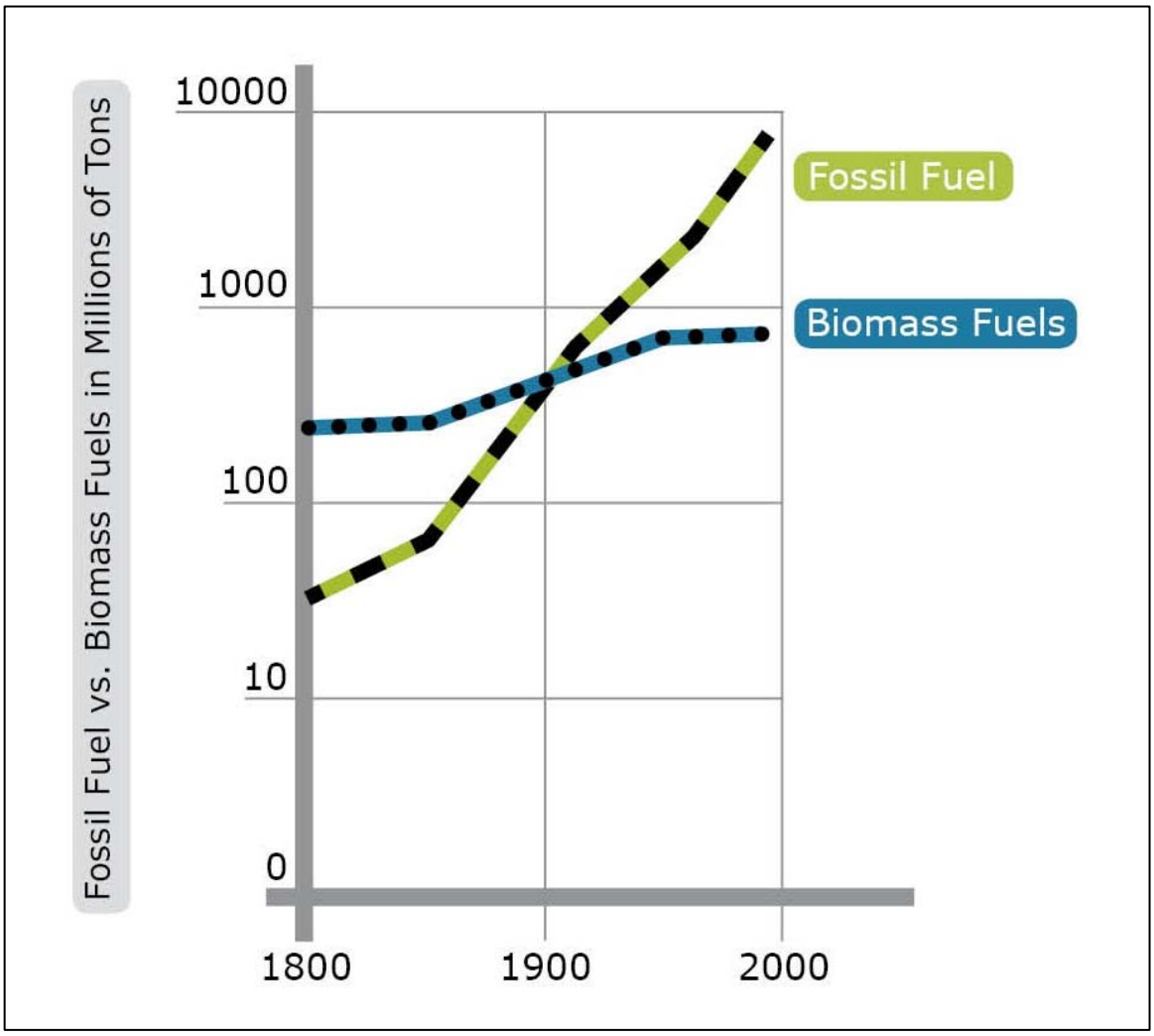
Student Handout 1.1

Figure 6

Fossil Fuel vs. Biomass
1800-2000

"Technological changes are what made it possible to support such huge populations."

David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2005), 442.



Source: Adapted from Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 187.

Lesson 1
Student Handout 1.1
Figure 7

Estimated Fresh Water Uses 1950-2000

Year	Withdrawals (km^3)	Withdrawals (per capita)	Irrigation %	Industry %	Municipal %
1950	1,360	0.54	83	13	4
1970	2,590	0.70	72	22	5
1990	4,130	0.78	66	24	8
2000*	5,190	0.87	64	25	9

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 121.

* Numbers were projected at the time of the publication of the above source.

Lesson 1
Student Handout 1.1
Figure 8

Approximate Global Vegetation Cover 1950-1990

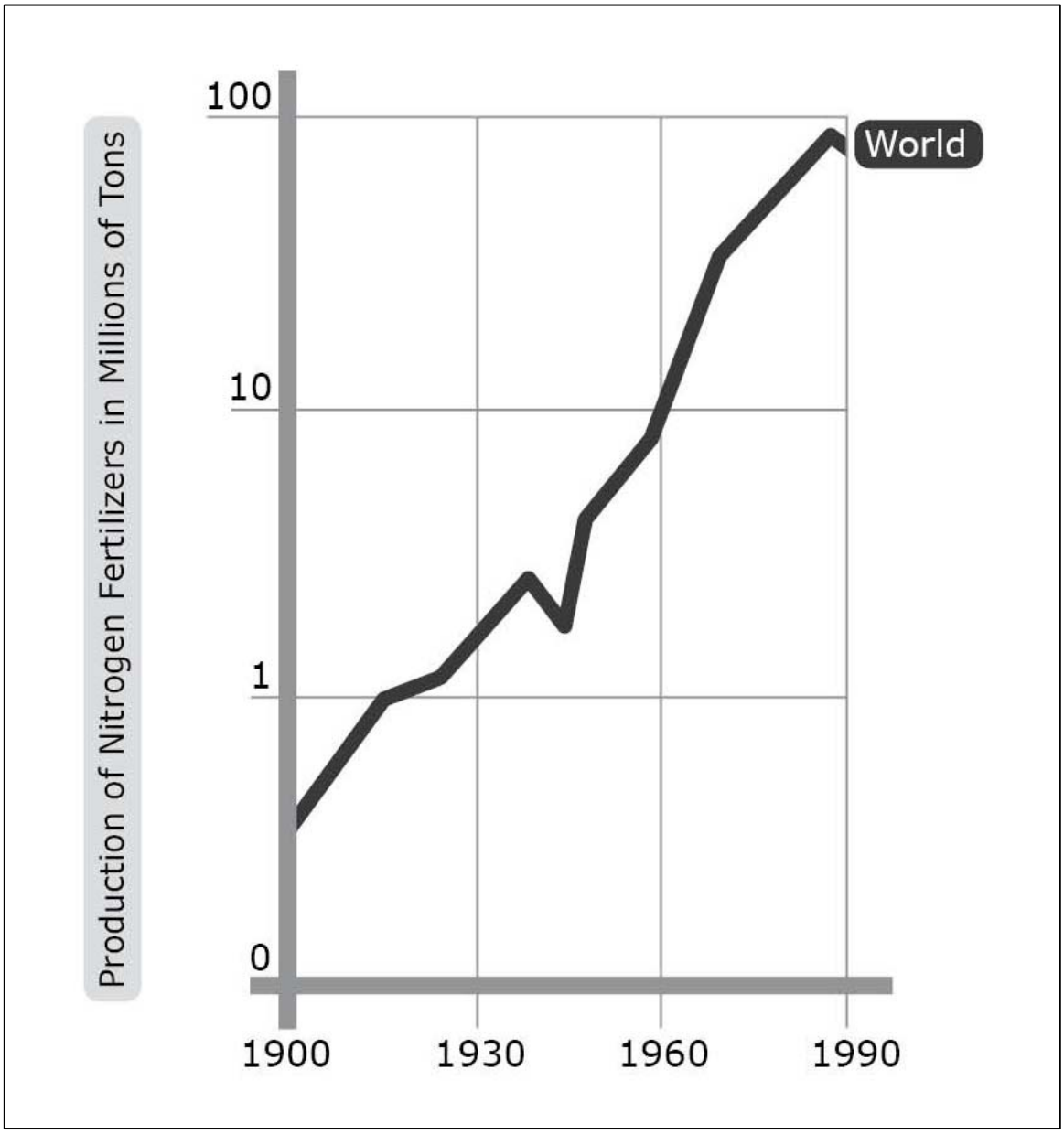
(Types of land cover in million km^2)

Year	Forest and Woodland	Grassland	Pasture	Cropland
1950	54	45	23	11.7
1960	53	41	27	12.8
1970	51	38	30	13.9
1980	51	35	33	15.0
1990	48	36	34	15.2

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 213.

Lesson 1
Student Handout 1.1
Figure 9

Production of Nitrogen Fertilizers 1900-1990



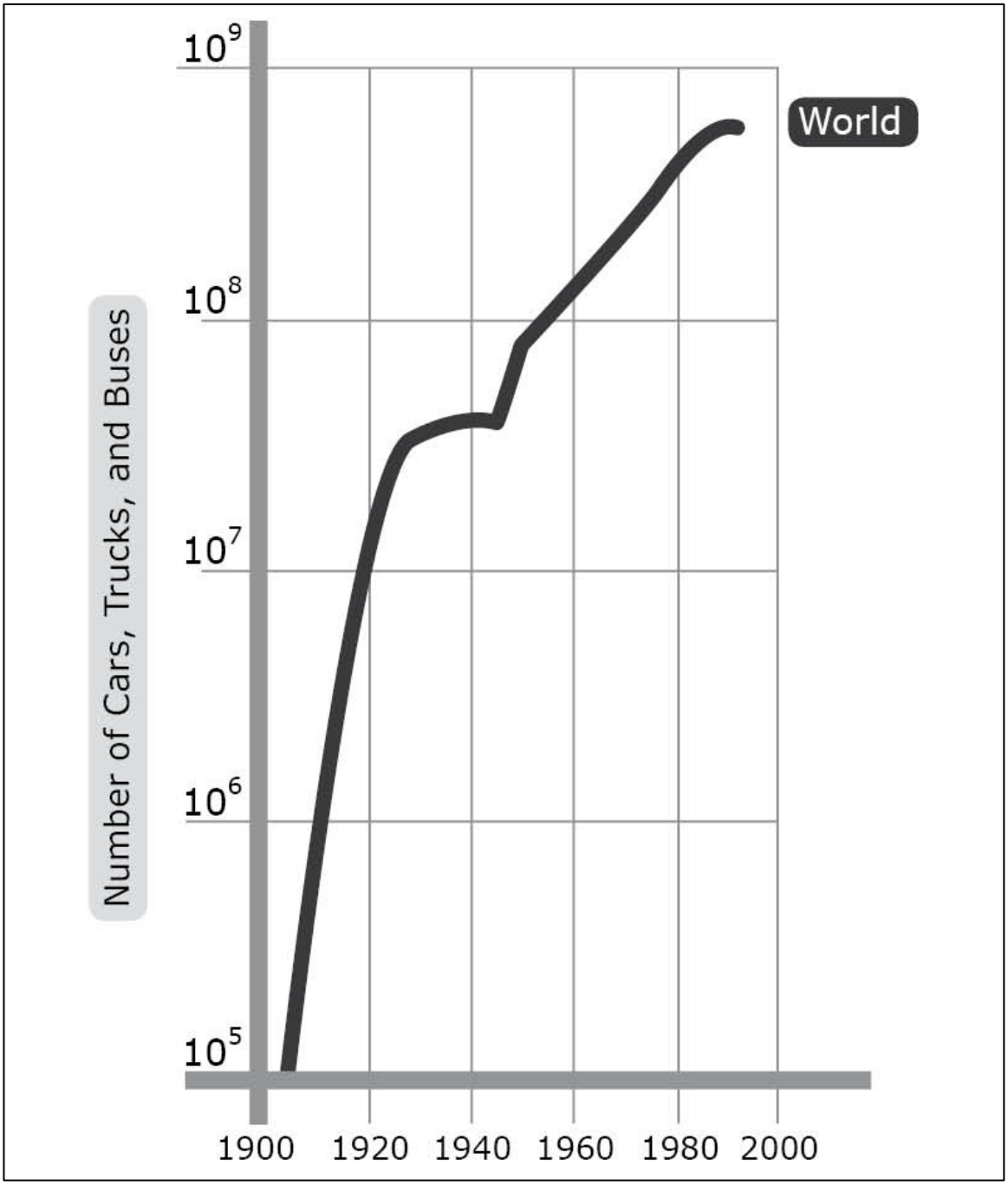
Source: Adapted from Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 183.

Lesson 1

Student Handout 1.1

Figure 10

Number of Cars, Trucks, and Buses 1900-200



Source: Adapted from Vaclav Smil, *Energy in World History* (Boulder: Westview Press, 1994), 199.

Lesson 1
Student Handout 1.1
Figure 11

Global Fish Catch
1900-1958
(in million metric tons)

Year	Marine Catch	Inland Catch	Aquaculture	Total
1950	15			
1958	29			
1961-1963	33			
1970-1972	51			
1985-1987	68	6	9	83
1988-1990	71	6	12	89
1991-1993	68	6	15	89
1994-1996	74	7	21	101

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 247.

Lesson 1
Student Handout 1.1
Figure 12

Global Livestock Population
1950-1990
(in millions of heads)

Year	Cattle	Sheep	Goats	Pigs	Horses	Poultry
1950	644	631	187	300	69	1,372
1970	1,016	1,001	325	634	81	2,734
1990	1,294	1,216	587	856	61	10,770
% Increase 1890-1990	406	342	1,129	951	119	1,525

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton), 20.

Lesson 1
Student Handout 1.1
Figure 13

Population by Region
1950-1996
(in millions)

"In the period 1850 to 1950, the populations of Africa, Asia, and Europe roughly doubled. Meanwhile numbers in the Americas, Australia, and Oceania grew much faster, five- or six-fold in 100 years."

J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000), 271-2.

	1950	1996
Asia	1,386	3,501
Europe	576	728
Africa	206	732
North America	167	295
Central and South America	162	486
Australia and Oceania	13	29

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 271.

Lesson 1
Student Handout 1.1
Figure 14

Urban Population Proportions by Region 1950-1990

(in percent of total population)

"In the period 1850 to 1950, the populations of Africa, Asia, and Europe roughly doubled. Meanwhile numbers in the Americas, Australia, and Oceania grew much faster, five- or six-fold in 100 years."

J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000), 271-2.

	1950	1970	1990
United States	64	70	75
Japan	56	71	77
Western Europe	63	72	78
Latin America	41	57	71
USSR	39	57	66
Africa	15	23	34
China	11	17	33
South Asia	16	21	28
World	29	37	43

Source: Adapted from J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 283.

Lesson 1
Student Handout 1.1
Figure 15

World Population 1950-2000

(in billions)

"In the period 1850 to 1950, the populations of Africa, Asia, and Europe roughly doubled. Meanwhile numbers in the Americas, Australia, and Oceania grew much faster, five- or sixfold in 100 years."

J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000), 271-2.

Year	
1950	2,515
1960	3,019
1970	3,698
1980	4,450
1990	5,292
2000	6,100

Source: David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2004), 443; Robert W. Kates, Billie L. Turner, II, and William C. Clark, "The Great Transformation," in Billie L. Turner II, *et al.*, eds., *The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years* (Cambridge: Cambridge UP, 1990), 1.

Lesson 1

Student Handout 1.2—Question Sheet

What do you notice as each billion humans is added to the earth's surface?

What kinds of direct human actions contributed negatively to the natural environment?

How do you think more wealth contributed to both the choices and the effects on the environment, in terms of use of natural resources and abuse of the natural environment?

What periods specifically would you call "tipping points" or points from which permanent change took place?

Attempt to calculate the amount of energy used and the cost to the environment of your favorite meal.

Lesson 1

Student Handout 1.3—Performance Task and Assessment Rubric

Choose one area of global environmental impact, such as population increase, increased urbanization, reduced cropland, pollution at sea, or other. Construct an argument for an international cooperation action plan for either remedying the problem or preventing it from getting worse.

Find out what international agreements are already in place regarding the issue you choose and cite these in your argument.

Cite data from a variety of sources to support your argument.

Suggest leaders who would implement and oversee the plan and identify non-governmental organizations (NGOs) and citizens' groups with whom they would work.

Create a public service announcement and accompanying visual materials to explain your plan to the public.

Assessment Rubric

Awesome! The argument is based on a wide variety of data and is logically constructed. The action plan is creative. The public service announcement clearly and effectively explains the plan. It is artfully crafted.

Pretty darn good! The action plan is a good synopsis of the problem and a reasonable, if unoriginal solution based on a variety of data. The public service announcement clearly and effectively explains the plan. It is neatly crafted.

Good enough. The action plan is based on limited data and presents a simple solution to the problem. The public service announcement is adequate and neatly crafted.

Not yet. Evidence is very limited. The proposal lacks clarity and depth. The public service announcement is incomplete or hard to understand.

Lesson 2
Act Locally: Planning for Sustainability

Introduction

Students will learn about their local natural environment. They will then investigate areas in which they can have an impact on sustainability and construct a personal plan for living more sustainably. A critical connection for students to make in this lesson is the effect of consumption on the environment.

Preparation

Teachers will need as large a laminated map of your local area as they can get, showing about fifty square miles. It does not matter if it is all farmland or mountain, all city blocks or suburbs. On it, draw roads and settled areas with buildings. Mark power plants and other utilities, as well as hospitals, schools, and other infrastructure.

Teachers will also need some statistical data of the local area that is comparable to the data given in Lesson 1 of this unit on the global scale. This can be retrieved from town and state public records, as well as from the records of local conservation groups. If students have done the first lesson in this unit, they will have a sense of how global population increase has affected land, water, and energy use in the last fifty years. However, their local area may not have been similarly affected. For example, they may be in an area that has been depopulated due to job loss.

Repeat the activity in Lesson 1 with the local area map, adding or removing Cheerios (people) and pine needles, leaves, and other materials to match the data.

After this activity, students will research an area critical to reducing or stabilizing population, reducing energy use, or increasing or stabilizing "green" space and clean water accessibility. Therefore, they will need to understand the environmental "big picture" in their area. Inviting a speaker to talk about conservation or alternative energy use would be a good addition to this unit.

Materials

In addition to the big map, Cheerios, and plant matter (see Lesson 1 materials), students will need to create data charts for land use, population, energy use, etc., for their local area.

Procedure

Prepare students for the lesson by looking at the data gathered for them, either as homework or as the first activity in the lesson. Proceed as in Lesson 1, adding or taking away "people," "cropland," etc., for each decade for which data is available. Distribute Student Handout 2.1 (Assessment), with the Assessment Task and Scoring Rubric on it, and Student Handout 2.2 (Organizations and Groups that Work on Environmental Issues). Give students one or two class periods to do their research and a period for presenting their findings.

Lesson 2

Student Handout 2.1—Assessment

Performance Task

Based on the research on the global environment in the last fifty years and research on the natural environment where you live, construct a model plan to reduce energy and non-renewable resource use and to increase sustainable living. What is already being done? Investigate the organizations and citizens' groups in your area. What regulatory and legislative changes need to be made to implement your plan? How can you personally act to help your community?

It may be easiest to choose one area of focus, such as food production and distribution, energy sources and consumption, water pollution, etc. Or you may try to create an integrated plan that considers all of the environmental issues in your area.

Scoring Rubric

Awesome! The research is exhaustive and a wide variety of evidence is employed. The plan answers all of the questions above in detail and logically. The plan is original. The plan is presented to the local news media, the local government, and/or local environmental groups, as well as adopted by the student to whatever degree is feasible.

Pretty darn good! The research is thorough and a variety of evidence is employed. The plan logically answers all of the questions above in some detail. The plan presents some original ideas within the context of plans already in place in the area or elsewhere. The plan is adopted by the student to whatever degree is feasible.

Good enough. The research is limited, with some evidence employed. The plan logically answers the question of what is already being done and suggests a citizens' group or organization that does work in the area of the research. Some aspect of the plan is adopted by the student.

Not yet. Little or no evidence was employed. None of the above questions was answered. There is a recapitulation of a plan already in place. A citizens' group or organization is identified. The student does not know how to implement a piece of the plan in her/his own life.

Lesson 2

Student Handout 2.2— Organizations and Groups That Work on Environmental Issues

Food Production and Distribution

Community-sustained agricultural organizations
Food cooperatives
Slow food movement
Anti-hunger initiatives
Grange or agricultural societies
Organic farming

Land and Water Conservation

Many of the groups listed here are national and have local chapters. All of the organizations listed below deal with land, and in some cases water, conservation issues.

Land banks
The Nature Conservancy
The American Birding Association
Audubon Society
Sierra Club

Alternative Energy

Energy cooperatives
Wind farms
Solar energy
Plant fuel sources

Lesson 3
You Are What You Eat

Introduction

In this lesson, students are asked to calculate, roughly, the "real cost" of their favorite meal or individual food item. They are then asked to think about actions they could take to reduce the meal's real cost. In this lesson, "real cost" is the short-term cost of all of the components of production, distribution, and consumption of the food, as well as the long-term cost of the meal, considering the factors of loss of plant and animal habitat and species, use of non-renewable resources, air and water pollution, soil degradation, and loss of forest, crop, and pasture land.

This lesson could easily be done in groups instead of by individuals. Each student might research natural resource use and biological impact.

Students may not be able to research every component of a meal or even a single food item. The process of researching aims to a large extent to increase student awareness of environmental issues from a very personal perspective.

Materials

The teacher's facilitation of this research requires a good grounding in the resources available, to which students may be directed. Begin with the charts, graphs, and lists in Lesson 1 and then the resources in the list at the end of this unit. Teachers will also need to help students to keep refining their lists, assumptions, and the conclusions toward which the data may be leading them. Creating charts for tracking data, resource lists, deadlines, work completion, and so on will also be important for particular students.

Preparation

Distribute Student Handout 3.1 (The What, the Why, and the How) and go over it carefully with the students. Because the pedagogy of the lesson is informed by the notion of student as either an inductive or a deductive thinker, it will be useful to help students assess this in themselves if they have not already done so.

Assessment

Awesome! You analyzed a meal. You researched using many sources, including the graphs and charts, monographs, government and NGO reports, print and electronic news media, and local experts. You answered all of the questions in depth showing clear analysis. Your assessment of what you would need to do to reduce the real cost of your favorite meal is based on the data and can be put into action.

Pretty Darn Good! You analyzed a meal or a food item. You researched using many sources, including the graphs and charts in Lesson 1, government and NGO reports, print and electronic

news media, and a local expert. You answered most of the questions showing clear analysis. Your assessment of what you would need to do to reduce the real cost of your favorite meal or food is based on the data and can be put into action.

Good enough: You analyzed a food item. Your research included the graphs and charts in Lesson 1 and print and news media. You answered a few of the questions showing minimal analysis. Your assessment of what you would need to do to reduce the real cost of your favorite food is based on the data and can be put into action.

Not yet: You looked at an aspect or two of the real cost of a food item. Your research included the graphs and charts in Lesson 1. You answered an aspect of a few questions. Your assessment of what you would need to do to reduce the real cost of your favorite meal or food is simplistic and/or unrealistic.

Lesson 3

Student Handout 3.1—The What, the Why, and the How

The task: Calculate the total real cost of your favorite meal or food. Then choose a course of action you can take to reduce the real cost of the meal or food.

Real cost: The total cost of production, distribution, and consumption, including short- and long-term consequences.

The why: There is action each of us can take individually and collectively to begin to reverse the damage that has been done to the earth's bio-, aqua-, and stratospheres. We need to start now.

The how: First, determine whether you are an inductive or a deductive thinker. Inductive thinkers go from part to whole; deductive thinkers go from whole to part.

Inductive thinkers: Start with your own energy expenditure—the amount of gas you need to use to go and get the meal. Then calculate the amount of energy used in your home to make the meal—the energy consumed in storing the food in your refrigerator until it is eaten, in making the food in the oven, on the stove, in the microwave, in disposing of the leftovers and trash. Next, find out how much energy the store used to keep the food, then how much the distributor used to get the food to the store. Next, calculate the total energy used to grow and manufacture the food. Finally, calculate the long-term effects on the environment, such as air and water pollution, plant and animal habitat loss, and so on. See Student Handout 3.3 (Resources).

Deductive thinkers: Figure out the energy consumption of growing and manufacturing the food, then of the distribution of the food to the stores in which you buy it, then of getting it home, storing, and making it. Next figure out how much waste disposal there is from the meal: packaging that goes in the trash and ultimately into landfills, and water and air pollution. What are the long-term effects in terms of habitat loss?

Second, review the questions in Student Handout 3.2 (Questions to Guide Your Research). Begin to note resources where you might find some of the information.

Third, review the materials you received for lessons 1 and 2 of this unit. Then visit some of the websites identified in Student Handout 3.3. Use links to other, useful websites you find there, and search in the print materials available on this topic. Be sure also to check with local experts, such as biologists, who work for local land banks or conservation organizations, as well as experts at food co-ops, farms, factories, and supermarkets. Once you have information on such items as the amount of oil and water used to produce the corn syrup or steak ingredient on your menu, you can begin to apply the same procedures to the other items. You may not be able to estimate down to the exact penny, gallon, or gram, but you can find good approximations of the real cost of your meal or food item.

Fourth, look at the list of possible actions on Student Handout 3.4 (Possible Actions). Consider the implications for choosing any of them and think of other possible actions that would achieve the desired goal: to reduce your impact on the environment by making different eating choices.

Lesson 3

Student Handout 3.2— Questions to Guide Your Research

1. List all of the ingredients of your favorite meal or food item. Identify any ingredients that you are unfamiliar with.

2. What amount of energy do you expend to get them? Include: bringing home from the store, storing, cooking, and making and disposing of packaging and scraps.

   a. your energy (gasoline) getting the food home.

   b. the gas it took to get the food to the store (gasoline, oil, coal?).

   c. the energy to get the food to the processor.

   d. the energy to produce the food, from the land/water and in manufacturing.

3. What amount of energy is used in making and packaging the food?

   a. at the factories.

   b. at your home: cooking—stove, oven, microwave, toaster oven, cleaning cooking utensils and dishes.

   c. at the farms.

4. What amount of energy is used in disposing of the meal's detritus?

   a. dishwashing.

   b. trash removal and its destruction (incinerator? landfill? turned into compost?).

   c. keeping leftovers—refrigerating or freezing.

5. How far does the food travel to your table?

   a. calculate miles from origin to home.

   b. multiply by dollars per gallon on the oil commodities exchange.

6. How much oil, water, and other natural resources were used?

7. How long after and in what ways will the effects be felt?

   a. plant and animal habitat loss.

   b. water and air pollution.

   c. effect of carbon dioxide on global climate change.

   d. desertification and deforestation.

8. What would you need to do to reduce the meal's real costs? Brainstorm.

Lesson 3

Student Handout 3.3—Resources

http://www.earth-policy.org/

This is your starting point, where you should be able to find most of what you are looking for and from where you will be able to navigate.

http://www.350.org/

This is a site where you can take action to inform the public about what "350 parts per million" of carbon monoxide means for reversing the effects of climate change.

http://www.un.org/

Find documents such as the Kyoto Protocols and those mentioned in the introductory essay of this unit.

Lesson 3

Student Handout 3.4—Possible Actions

What would you need to do to reduce the total, real cost of your favorite meal or food item?

Eat lower on the food chain—reduce meat and poultry, increase whole grains, legumes.

Grow your own food.

Preserve food—canning, salting, smoking.

Participate in or help start a community garden, community-sustained agricultural group, food co-op.

Only consume food produced in your region or within 250 miles from where you live.

Choose where you can reduce portions of, if not complete, real cost.

This unit and the Three Essential Questions

	Since the middle of the twentieth century, have human exploitation and management of the natural environment been more beneficial than destructive to the planet and its life forms, or the other way around? What criteria would you develop to answer this question?
	List five specific human-generated events since 1940 that you think caused significant change to the natural or physical environment on a large regional or a global scale. What factors did you consider in selecting your events? Why do you think your choices had a significant impact on the natural or physical environment? Was the impact short-term, long-term, or both?
	David Christian has written: "In the course of the twentieth century, human beings have caused changes so decisive, so rapid, and so vast in their scale that they force us to see human history, once again, as an integral part of the history of the biosphere" (*Maps of Time: An Introduction to Big History*, 462). Consider these questions: • Is the history of human relationship to the environment basic to understanding all other history—political, social, cultural, and so on? • Might humans look back a hundred years from now and conclude that environmental change was the single most important development of the twentieth century?

This unit and the Seven Key Themes

This unit emphasizes:

Key Theme 1: Patterns of Population

Key Theme 7: Science, Technology, and the Environment

This unit and the Standards in Historical Thinking

.

Historical Thinking Standard 1: Chronological Thinking

The student is able to (F) reconstruct patterns of historical succession and duration in which historical developments have unfolded, and apply them to explain historical continuity and change.

Historical Thinking Standard 2: Historical Comprehension

The student is able to (H) utilize visual, mathematical, and quantitative data presented in charts, tables, pie and bar graphs, flow charts, Venn diagrams, and other graphic

organizers to clarify, illustrate, or elaborate upon information presented in the historical narrative.

Historical Thinking Standard 3: Historical Analysis and Interpretation

The student is able to (C) analyze cause-and-effect relationships bearing in mind multiple causation including (a) the importance of the individual in history; (b) the influence of ideas, human interests, and beliefs; and (c) the role of chance, the accidental, and the irrational.

Historical Thinking Standard 4: Historical Research Capabilities

The student is able to (B) obtain historical data from a variety of sources, including: library and museum collections, historic sites, historical photos, journals, diaries, eyewitness accounts, newspapers, and the like; documentary films, oral testimony from living witnesses, censuses, tax records, city directories, statistical compilations, and economic indicators.

Historical Thinking Standard 5: Historical Issues-Analysis and Decision-Making

The student is able to (E) formulate a position or course of action on an issue by identifying the nature of the problem, analyzing the underlying factors contributing to the problem, and choosing a plausible solution from a choice of carefully-evaluated options.

Resources

Resources for teachers

Brown, Cynthia Stokes. *Big History: From the Big Bang to the Present*. New York: New Press, 2007. The author sets the history of humankind within the environmental context, not only of the earth but the entire cosmos.

Burke, Edmund III and Kenneth Pomeranz. *The Environment and World History*. Berkeley: University of California Press, 2009. This volume includes eleven essays by eight scholars on issues of environmental change from ancient times to today.

Christian, David. *Maps of Time: An Introduction to Big History.* Berkeley: University of California Press, 2004. Chapter 14, "The Great Acceleration of the Twentieth Century," provides an overview of earth's ecological history in this period.

McNeill, J. R. *Something New under the Sun: An Environmental History of the Twentieth-Century World.* New York: W. W. Norton, 2000. The major comprehensive text on this topic.

Penna, Anthony N. *The Human Footprint: A Global Environmental History*. Hoboken, NJ: Wiley-Blackwell, 2009. "One of the first environmental histories to embrace the entire

world and all of human history. As our relationship with the world's diverse environments deteriorates, such educational resources are becoming increasingly vital" (David Christian).

Smil, Vaclav. *Energy in World History*. Boulder: Westview Press, 1994. Chapter 5 discusses the transition from biomass to fossil fuel use and the results of that transition.

Turner, Billie L. II, William C. Clark, Robert W. Kates, John F. Richards, Jessica T. Mathews, and William B. Meyer, ed. *The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years.* Cambridge: Cambridge UP, 1990. This collection of essays covers topics from population and migration to technology and chemicals, and changes in the atmosphere, hydrosphere, and biosphere of the earth.

Correlations to National and State Standards

National Standards for World History

Era 9: The Twentieth Century since 1945: Promises and Paradoxes. 2A: The student understands how population explosion and environmental change have altered conditions of life around the world.

Michigan High School Content Expectations

World History and Geography. Contemporary Global Issues. CG2. Resources. Explain the changes over the past 50 years in the use, distribution, and importance of natural resources (including land, water, energy, food, renewable, non-renewable, and flow resources) on human life, settlement, and interactions.

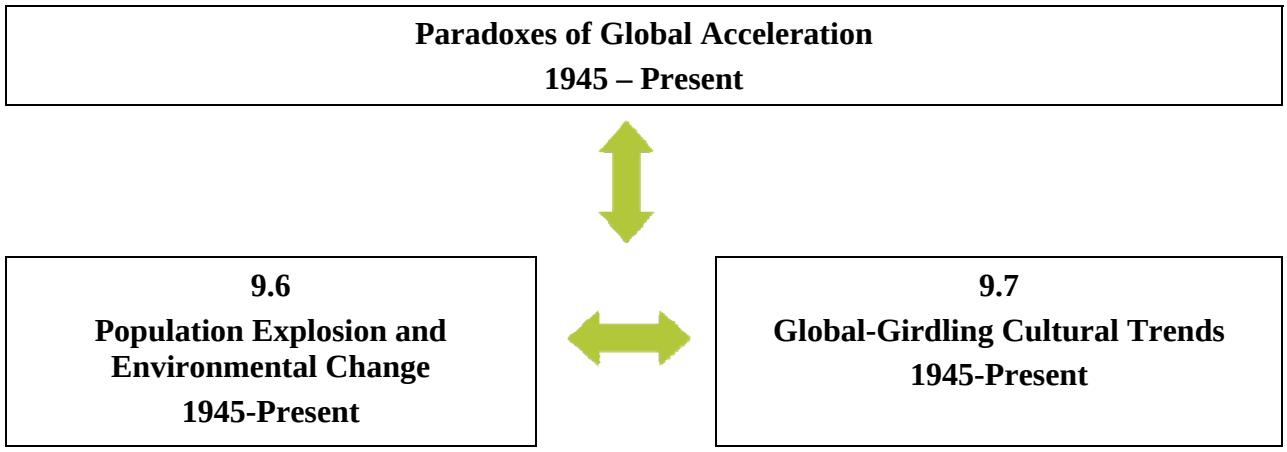
New York: Social Studies Resource Guide with Core Curriculum

Unit Eight: Global Connections and Interactions. C. The environment and sustainability.

Virginia History and Social Science Standards of Learning

WHII.16. The student will demonstrate knowledge of cultural, economic, and social conditions in developed and developing nations of the contemporary world by b) assessing the impact of economic development and global population on the environment and society.

Conceptual links to other teaching units



Environmental and cultural change on a global scale are interrelated. Human action to exploit, manage, and conserve the natural and physical environment means that the ways people think and behave in groups are rapidly changing as well. Conversely, cultural changes inevitably produce environmental changes. Human exploitation of fossil fuel energy in the past several decades has produced a flood of material goods, things like automobiles, movies, electronic devices, fashions, new cuisines, and medical miracles, which change the way we live. Culture in turn shapes the way we use those material things. For example, industrial and consumer waste piles up in great mountains, worsening problems of pollution and productive land use. On the other hand, one element of cultural change is the growth of environmental movements dedicated to reforming our living habits and thereby saving the earth. Landscape Teaching Unit 9.7 considers the continuing development of a "global culture" in the later twentieth century and the accelerating speed of cultural change, a phenomenon tightly bound up with our relationship to the planet.