

For the next class, the only homework/quiz assigned is to complete Lesson 11, Activities 1 and 2, pages 329-331, as described below, and numbered 1-8. (Use those numbers as you work these.) Turn this in as your quiz for next time. It is likely that you will complete most of it in class today.

#### Lesson 11 Overview of Activities 1 and 2.

1. What is “arable land” and why do we care?
2. How much arable land is there on the earth?
3. How much arable land do we need per person? (Actually, how much do we need per 1000 people? )  
This depends on the level of consumption we are used to. So, for various countries, how much arable land is needed per 1000 people?
4. What is the maximum population the earth can support?  
This depends on whether the population will live at the lifestyle of the US or the lifestyle of some other country. Give three different answers.
5. What is a reasonable model for the world population growth, based on the data from Lesson 7 for 1950-1999?
6. Make a graph of the world population growth from 1950 to the end of the 21<sup>st</sup> century, based on the model from question 5.
7. Draw a horizontal line on your graph number 6 to represent the maximum population that the earth can support (from your answer to number 4.)  
Then say when the population will cross that line.  
Do this for two of your three answers in number 4.
8. Choose one of the values from number 4. Say which one it is.  
Then discuss whether you believe this is a realistic estimate of the maximum population the earth can support and why. Discuss what changes might raise that maximum and what changes might lower that maximum.

#### How to work through Activities 1 and 2.

1. What is “arable land” and why do we care?  
Arable land is land that can be used for farming. Almost all of the food supply depends on arable land. (Growing crops or growing food for animals that produce meat.)
2. How much arable land is there on the earth?  
This is Activity 1.
  - a. Calculate the surface area of the earth in square kilometers.
  - b. Calculate the number of square kilometers that are land.
  - c. Calculate the number of square kilometers that are arable land.
  - d. The answer is approximately 14,889,195 square kilometers.
3. How much arable land do we need per person? (Actually, how much do we need per 1000 people?)  
This depends on the level of consumption we are used to. So, for various countries, how much arable land is needed per 1000 people? This is Activity 2, problem 1.

Each row in the table represents a country.

Three values must be computed from the others given.

Use the Bangladesh values to practice.

Then compute the values in the table for Germany and the US. So you'll have three completed rows.

- a. For the Arable Land column, find the percentage of the total land.
  - b. For the Total land per 1000 people, use the first column, which is Total Land, divided by the Population (1000's).
  - c. For the Arable land per 1000 people, divide the Arable land value by the Population (1000's.)
4. What is the maximum population the earth can support? This depends on whether the population will live at the lifestyle of the US or the lifestyle of some other country. **Give three different answers.**
- This is Activity 2, problems 2 and 3.
- a. You'll need the answer from our question 1 about the total amount of arable land, and then you'll need to decide which country you want to use.
  - b. So divide the total amount of arable land (from Activity 1) by the arable land needed for 1000 people (last column of the table in Activity 2.) One answer is: At the Bangladesh level, we would have  $14,889,195/0.73 = 20,396,158$  thousand people, which is, of course, 20,396,158,000 people.
5. What is a reasonable model for the world population growth, based on the data from Lesson 7 for 1950-1999?
- Activity 2, problem 4.
- You do not have to do any work here. Simply use the result from Lesson 7:
- $P = 2.55(1.0182)^x$ , where  $x$  is the number of years since 1950 and  $P$  is the world population. (You can look back at the data in Lesson 7 to see that this is a reasonable summary of the data there.)
6. Make a graph of the world population growth from 1950 to the end of the 21<sup>st</sup> century, based on the model from question 5.
  7. Draw a horizontal line on your graph number 6 to represent the maximum population that the earth can support (from your answer to number 4.) Then say when the population will cross that line. **Do this for two of your three answers in number 4.**
  8. **Choose one of the values from number 4. Say which one it is.** Then discuss whether you believe this is a realistic estimate of the maximum population the earth can support and why. Discuss what changes might raise that maximum and what changes might lower that maximum.

To further analyze the effect on the world, read and discuss the questions on the next page. No written work from these further questions is required on the homework/quiz.

9. Consider the model from question 5. Look at Lesson 7, Table .. of the world population. Is there evidence that the growth rate is declining toward the end of the 20<sup>th</sup> century from what it was during most of the time from 1950-1999?

Lesson 7, Activity 1. Using the information from the Day 13 handout about how to do the problems in Lesson 7, Activity 1, and the additional information about the world population since 1999, confirm the values for these annual growth rates during the years 1950-2008.

year	world pop'n	difference	ratio	average annual growth rate
1950	2.52			
1960	3.02	0.5	1.198413	1.018265
1970	3.7	0.68	1.225166	1.020515
1980	4.45	0.75	1.202703	1.018629
1990	5.3	0.85	1.191011	1.017634
1994	5.63	0.33	1.062264	1.015215
1999	6	0.37	1.065719	1.012811
2000	6.07	0.07	1.011667	1.011667
2005	6.45	0.38	1.062603	1.012218
2008	6.71	0.26	1.04031	1.01326

10. If the growth rate is lower than our model in question 5 above indicates, what effect will that have on the time it will take for the earth to reach the maximum population the earth can support?

11. The decline in the growth rate of world population since 1980 could result from different scenarios. What data would you need to examine to see which of these is occurring?

[Alternative A] The rate of population growth in most countries has declined by an amount similar to the decline in the overall average.

[Alternative B] Prosperous countries have growth rates that are much lower than the overall average, and an increasing portion of the world's countries have become prosperous.

12. In fact, Alternative B is what is happening. Discuss why that does, in fact, lower the overall growth rate.

13. Discuss whether the data cited supports the following conclusion.

“For long-term sustainability, we need for the growth rates of all the major countries in the world to follow the typical growth rate for prosperous countries, so we need to make all the countries reasonably prosperous.

Also, for long-term sustainability, we need for the needed use of arable land in all the countries of the world to not look like that of the US, but to look more like the use in Germany and other similar countries.”