**World Population and Food Production**

According to the United Nations, the world population reached 1 billion in 1804, reached 2 billion in 1927 (took 123 years), reached 3 billion in 1960 (33 years later), reached 4 billion in 1974 (14 years later), reached 5 billion in 1987 (13 years later), and reached 6 billion in 1999 (12 years later). They predict the world population will reach 7 billion in 2013, 8 billion in 2028 and 9 billion in 2054.

Meanwhile, the Physics Fact book contains the following information. About 70% of the earth’s surface is water, so land makes up the other (approximately) 30%. The 30% of the Earth’s surface that is land can be broken into: 20% covered by snow, 20% mountains, 20% dry land, 10% that does not have topsoil, and 30% land appropriate for farmland. We must also consider that land must be shared with all animals. The total land surface area is about 1.5 x 108 sq. km. ([www.hypertextbook.com/facts/2001/DanielChen.shtml](http://www.hypertextbook.com/facts/2001/DanielChen.shtml))

1. The data we examined suggest that agriculture production is growing linearly and that the world population is growing exponentially. If these trends continue, do you think there will be increased hunger or decreased hunger in the world? Discuss this question in your group. Support your ideas with information that can be researched.
2. The table below contains data from the Activities 7.1.1 and 7.1.4
3. Fill in the Agriculture Production Index for 2005. (See Activity 7.1.4, question 6.)
4. For each row, find the ratio of Agriculture Production to Population and fill in the rest of the last column.

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Population (in billions)** | **Agriculture Production Index** | **Ratio of Agriculture Production Index to Population** |
| 1965 | 3.35 | 111 | 33.1 |
| 1975 | 4.09 | 143 |  |
| 1985 | 4.85 | 180 |  |
| 1995 | 5.7 | 215 |  |
| 2005 | 6.48 |  |  |

1. Describe any trend you see in the last column of the table.
2. Based on information in this table, do you think world hunger is increasing or decreasing? Justify your answer.

**Linear Growth vs. Exponential Growth**

The growth pattern in the World Agriculture Production Index is **linear** since a **constant number is added** to the value of the index to get the value of the index two years later.

The growth pattern in the world population is **exponential** since a **constant number is multiplied** by the population size to get the population size the next year.

1. In Activity 7.1.3 we looked at a model for exponential growth based on a yearly multiplier of 1.0174. If the trend in that model continues, the population in 2055 will be 16.238 billion.
2. What is the predicted agriculture production index for the year 2055? (See Activity 7.14, question 7.)
3. What is the predicted ratio of agriculture production index to population for the year 2055?
4. Would the result in 3(b) cause you to rethink your conclusion in 2(d)? Explain.
5. Reread the first paragraph of this investigation. Do you think the United Nations used the same model for population growth that we found in Activity 7.1.3? Explain.

Unit 7 is titled “An Introduction to Exponential Functions.” Just as we modeled relationships that exhibited an **additive** pattern with **linear** functions, we will model relationships that exhibit a **multiplicative** pattern with **exponential** functions. Enjoy the upcoming unit!