Numerics, Demographics, and a Billion Homework Questions

There is a potentially calamitous characteristic of the times in which we live, which is this: We have just added one BILLION additional people to our planet in a span of only twelve years, and as this is written, we are well on our way toward adding another billion and another, and another.

If we somehow manage to keep from wrecking our civilizations and our planet by adding our next billion, the decades ahead promise us still more billions, one after another, until all sorts of things break. Despite these facts and their implications, our traditional schooling typically leaves us with little appreciation of how unimaginably large a billion really is. The truly enormous size of a billion therefore consitutes our principle topic in this pdf.

For most of us, a million and a billion are simply two very large numbers. If we could earn a million dollars, that would be great, and a billion dollars would be even better. And while it is true that both values are large, the reality is that the two numbers are enormously different. And, since data involving human population growth typically involves additional millions and additional billions, we must be able to distinguish between the two.

Today we add an extra one MILLION people to our planet every five days, but we add an extra one **BILLION** people to our planet every twelve to fifteen years. Between 1975 and 1987, for example, world population grew from four billion to five billion, and between 1987 and late 1999 it grew from five billion to six billion (UNDESA, 2004).

Thus, to appreciate the implications of repeatedly adding additional billions of persons to our population, over and over and over again, we must be comfortable with how enormously immense a billion really is.

To help us picture a "billion" we need an example. If we are dealing with a college audience, we might imagine an assignment involving endless library shelves of Principia Mathematica, Tolstoy, or college physics. On the other hand, knowing the undergraduate proclivity for pizza, we might imagine something involving billions of slices of pizza.

Since, however, all of us have endured homework questions in our schooling, we will consider as our example the situation of a student who has been assigned one billion homework questions.

First: A " **Million** "

Suppose that school systems in your state adopt a more rigorous graduation standard that requires each student to complete one MILLION homework questions in order to receive a diploma. Now further suppose that a conscientious student decides to work toward this requirement by completing one hundred questions each night, five nights per week, fifty-two weeks a year until all one million questions are finished. A staggering thought, is it not? Working at this rate, how long will the student need to finish his or her homework?

(The answer is 38.5 years.)

Next: A " **Billion** "

Suppose that one of the school districts decides to adopt a more stringent policy and requires its students to complete one **BILLION** homework questions in order to graduate. If our young scholar decides to tackle this assignment at the same rate (one hundred questions per night, five nights each week, fifty-two weeks each year), how long will be needed before their homework assignment is complete?

Answer: To complete a billion homework questions at
500 per week, 52 weeks per year, would require **38,461** years

Thus, we see that a billion is not just a large number,
but that it is a truly enormous number.

Wooly Mammoths

Since a billion is of such demographic importance, let us add further clarity to our example: Assume that a cave-student began to work on this assignment twenty thousand years ago, when ice was one-mile thick over Wisconsin and Ohio, when wooly-mammoths and saber-toothed tigers roamed the Earth, and people still lived in caves.

Assume further that this student conscientiously completes five hundred questions each and every week, fifty-two weeks per year, beginning twenty thousand years ago and works from then until now. Despite the most staggering homework achievement in the history of humanity, our young scholar would have to continue to work for another 18,461 years into the future in order to finish such an assignment. This riddle thus helps us appreciate that a billion is an exceptionally large number.

Every Twelve to Fifteen Years

Now we can use our thought experiment to better understand the times in which we live. First, suppose that we take all of those homework questions, five hundred questions a week from each and every week from all 38,461 years, and change each and every one of those questions into a human being.

Now suppose that we add all of those persons as extra individuals to the surface of our planet every twelve to fifteen years. Next, let us arm them with bulldozers, AK-47s, sport utility vehicles, chain saws, hydroelectric dams, nuclear wastes, greenhouse gases, heavy metals, double-bacon cheeseburgers, investment portfolios, and pesticides. Given each new multitude, so armed and so numerous, and therefore so dangerous, it is little wonder that our combined impacts might quickly amount to an ecological holocaust.

Myers (1995), writing in the journal *Science*, raises the possibility of unexpected environmental consequences. "First, ecosystems can absorb a certain amount of stress without noticeable effect, but once a critical level is reached the disruption may be cataclysmic" (see also Gallagher, et al., 1995). Secondly, it is also possible for two or more environmental processes "...to interact in unforeseen ways so that the outcome is not additive, but multiplicative" (ibid). Other papers conclude that current environmental changes are "profoundly altering the functioning of the biosphere" (Chapin et al., 1997). By helping to quantify the immensity of a billion, our example *encourages us to better appraise the potential severity of our impacts* on earth's ecological, climatic, and waste-cleansing machinery.

Madison Square Garden

To help picture the impacts of our present avalanche, we might also imagine a boxing match in Madison Square Garden. In one corner stands the heavyweight boxing champion of the world. In the opposite corner stands a fragile old lady, "Mother Nature." Each fist of the champion is fitted with a boxing glove labeled "one billion additional people."

With the bell, round one begins – it will last for twelve years. As Mother Nature moves to the center of the ring, the huge right fist of the champion smashes her with a crushing blow. Down she goes, bruised, bloodied and dazed. Struggling, however, she staggers to her feet as the first round ends.

Round two also lasts twelve to fifteen years, and the same scenario unfolds: A powerful left fist, featuring the staggering impacts of a billion additional people blasts the old lady. The champion taunts her to get up. The crowd falls silent. How severe must be her injuries? Will she ever get up again? She is hemorrhaging and barely functioning. Is the match over? Why don't the officials stop the fight?

Round three begins. As its twelve to fifteen years proceed, the champion shows no signs of mercy, no signs of tiring, and no signs of weakening. The world's leaders show no inclination to stop the assault when the profits are so enormous. It is obvious to everyone watching that the repeated blows – a staggering one billion followed by another and another and another are too much for the old lady. The only question is this: Which blow is going to be the last?

After one of these billions, the old lady will fall and will not get up. Today's young people are living their lives at a time when humanity is crushing earth's natural, biotic, and climatic systems with the impacts of one billion additional people every twelve to fifteen years. With each such blow, these systems are injured, bloodied, and staggered. The possibility exists, however, that one of these billions will be the final blow.

Food May Not Be Our First Worry

Dozens of population analyses have been published that focus on food, nutrition, and agriculture such as "Can the growing human population feed itself?" (Bongaarts, 1994). Because producing enough food is both important and intuitively obvious, such papers are clearly appropriate and worthwhile. (For others of this genre, see Revelle, 1974 and 1976; Farrell, et al., 1984; Hudson, 1989, and Waggoner, 1994.)

In 1995 Joel Cohen nicely surveyed a host of these studies. With the exception of Cohen's, however, these papers are flawed because most of them are based on an assumption (that is almost always unstated) that supplies of food are the most critical or most immediate factor affecting or limiting our population.

This assumption, which is routinely unstated, unquestioned, and unchallenged, diminishes what are otherwise useful papers submitted by economists, demographers, and statisticians with limited expertise in biology.

The most immediate danger to our planet, its natural systems, and our civilizations may not be food, and we may be distracting ourselves if we imagine that it is.

It may be, for example, that our ultimate, more immediate, and most serious dangers lie in the **damage** that we have inflicted, are inflicting, and will inflict on earth's biotic machinery,

as well as the impacts of our
industrial and societal **wastes**.

Biologists Campbell, Reece, and Mitchell (1999) observe that it is "possible that our population will eventually be limited by the [environment's limited capacity] to absorb the wastes and other insults imposed by humans." Vitousek, et al. (1997) make a similar point: "Often it is the waste products and byproducts of human activity that drive global environmental change." Similarly, "today's rapid relative and absolute increase in population stretches the...absorptive and recuperative capacities of the Earth...." (Cohen, 2002).

As a result, we devote several other
PDFs to these alternate likelihoods.

Demographic and Numeric Literacy

The central contention of this PDF is this: There are certain numeric and demographic "basics" that must be a part of every school curriculum and our universally-shared societal knowledge if we are to be functionally literate citizens in today's world.

First, we must be demographically literate. Each of us must understand, on an ongoing basis, the number of births and deaths that take place on an average day, as well as the approximate number of additional persons that we add to our population as a result. Secondly, we must each recognize the truly enormous numbers represented by each of our additional billions.

These enormous numbers, and the breathtaking rapidity with which they are arriving, raise challenges to our civilizations and our planet that may be insurmountable. Soule (1985) observes that

"many, if not all ecological processes have thresholds" (another way of commenting on limits). In the same paper he observes that "genetic and demographic processes [also] have thresholds...."

Elsewhere (in Wecskaop and other PDF excerpts in this collection) we examine thresholds, tipping points, and other limits and consider what happens when populations exceed them. If we are to address our impacts over the decades just ahead, society at large, as well as our policymakers, journalists, and leaders, must be cognizant of the major concepts, data, and principles sets that constitute "What Every Citizen Should Know About Our Planet."

Mathematics texts of the last century targeted student mastery of polynomial expansions, multiplication tables, Euclidean geometry, and quadratic equations. Similarly, in our science curricula, most of us have probably been taught too much about the muscles of a frog, the sclerenchyma cells of a plant, and the revolving nosepiece of a microscope.

Our math and science texts of this century must ensure that chapter one and its opening pages introduce all students to the numerics, demographics, and mathematics that will shape their lives and the future of our planet.

Births, deaths, net daily increase, and the enormous contrast
between a million and a billion constitute an appropriate place to start.

A continuation of today's demographic tidal wave *may constitute*
the greatest single risk that our species has ever undertaken.

Excerpted from
What Every Citizen Should Know About Our Planet
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Expanded implications of this excerpt are also
addressed in additional PDFs in this collection:

Razor-thin Films - Earth's atmosphere and seas (pdf)

Numerics, demographics, and a Billion homework questions

Conservation planning - Why Brazil's 10% is not enough

Eight Assumptions that Invite Calamity

Climate - No other animals do this

Critique of Beyond Six Billion

Delayed feedbacks, limits, and overshoot

Sources and Cited References

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