



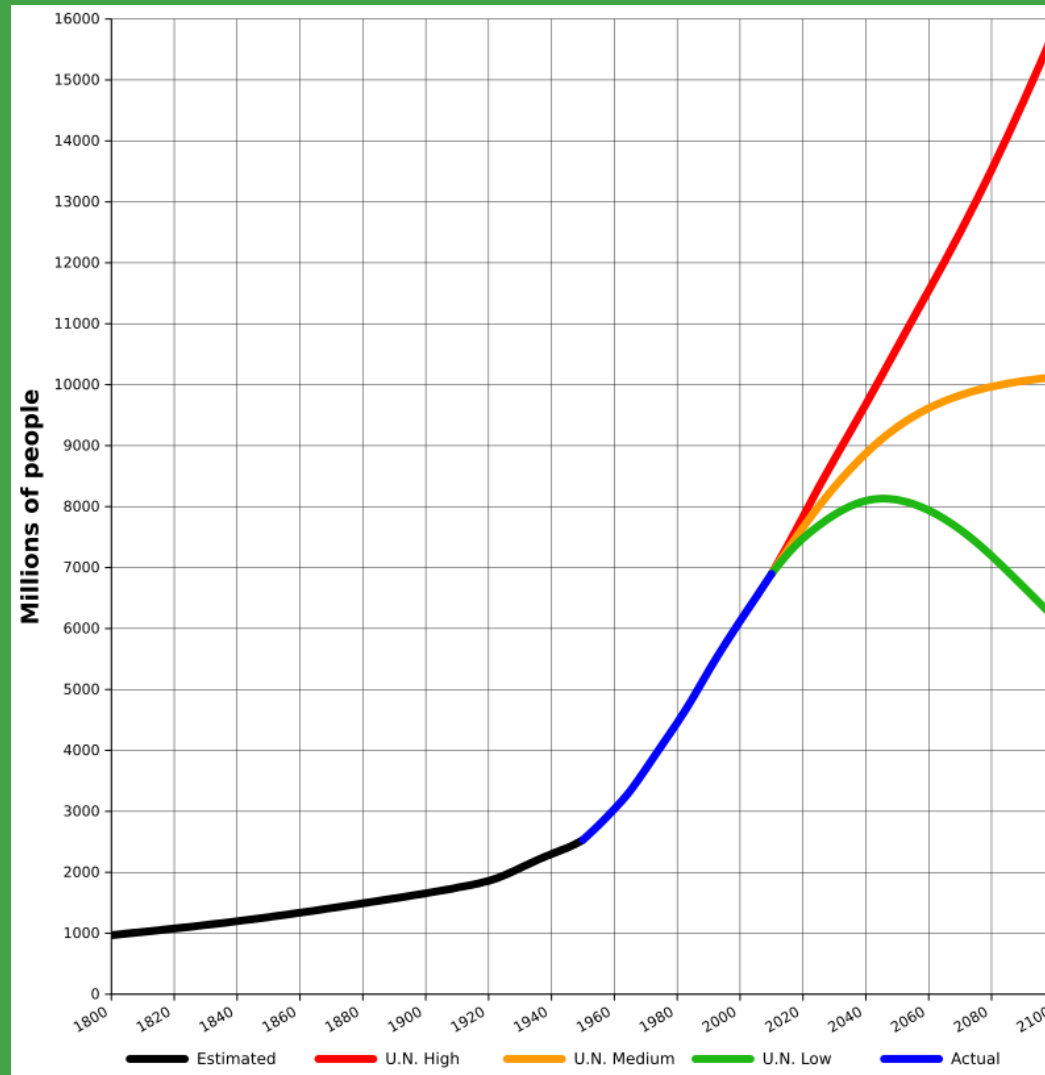
Feeding the World:

Connecting Your Students to International Agriculture

National Agriculture in the Classroom Conference

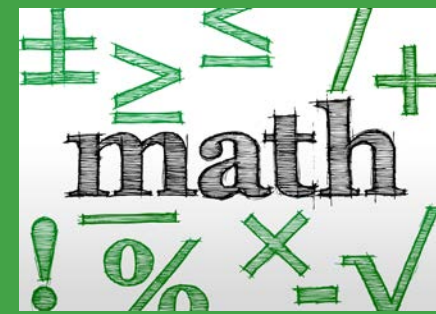
June 2016

In the year 1800 there was 1 billion people on Earth...



It took 125 years to hit **2 billion** people. In 1998 we hit **6 billion**. Now in 2016 we are at **7.4 billion**. By 2050 we will hit **9 billion**.

By the numbers...



- What year, exactly, will we hit 9 billion?

- $y=ab^x$

- By calculator: TI-84

- $y = 4.4489 \times 10^{-8} (1.0094)^x$

- We will hit 9 billion in year 2050

- $y=ab^x$

- By hand

- Using 1800 = 1 billion and 2016 = 7.4 billion

- **Solve for "b" first**

- $7.4/1 = 1b^{216}/1$

- $(7.4)^{1/216} = (b^{216})^{1/216}$

- $b=1.0093$

- **$y=1(1.0093)^x$**

- **$y=9$**

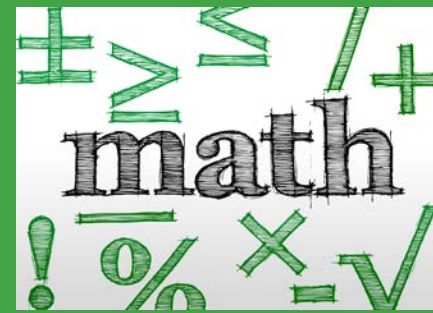
- $9/1=1(1.0093)^x/1$

- $\ln(9)=(x)\ln(1.0093)$

- $x=237$

- **237 years after 1800 or 2037**

By the numbers...



- Average calories needed by a man = 2,500
- Average calories needed by a woman = 2,100
- Assuming the world is 50/50 gender.
- Assuming we currently produce enough calories to feed every person on earth at that level every day.
- **How many more calories do we need to produce every day?**

Current calories consumed: $(3,700,000,000 \times 2,500) + (3,700,000,000 \times 2,100) = 9.25 \times 10^{12} + 7.77 \times 10^{12} = 1.702 \times 10^{13}$

Future calories needed: $(4,500,000,000 \times 2,500) + (4,500,000,000 \times 2,100) = 1.125 \times 10^{13} + 9.45 \times 10^{12} = 2.07 \times 10^{13}$

Difference: 3,680,000,000,000 or **3.68 trillion more calories per day**

3.68 trillion more calories need to be produced



- One cup rice = 216 calories. How many more cups of rice would we need to produce every day?

$$3.68 \text{ trillion} / 216 = \mathbf{17,037,037,037 \text{ cups of rice}}$$



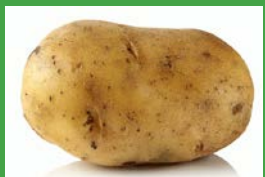
- One banana = 105 calories. How many more bananas would we need to produce every day?

$$3.68 \text{ trillion} / 105 = \mathbf{35,047,619,047 \text{ bananas}}$$



- One 4oz. Or quarter pound cheeseburger = 303 calories. How many more cattle would we need to raise? (Assume 750 quarter pounders per cow)

$$3.68 \text{ trillion} / 303 = 12,145,214,521 / 750 = \mathbf{16,193,619 \text{ cows}}$$



- One potato = 163 calories. How many potatoes will we need to grow to fulfill those calorie needs?

$$3.68 \text{ trillion} / 163 = \mathbf{22,576,687,116 \text{ potatoes}}$$

Resources are limited. How do we produce more with less?

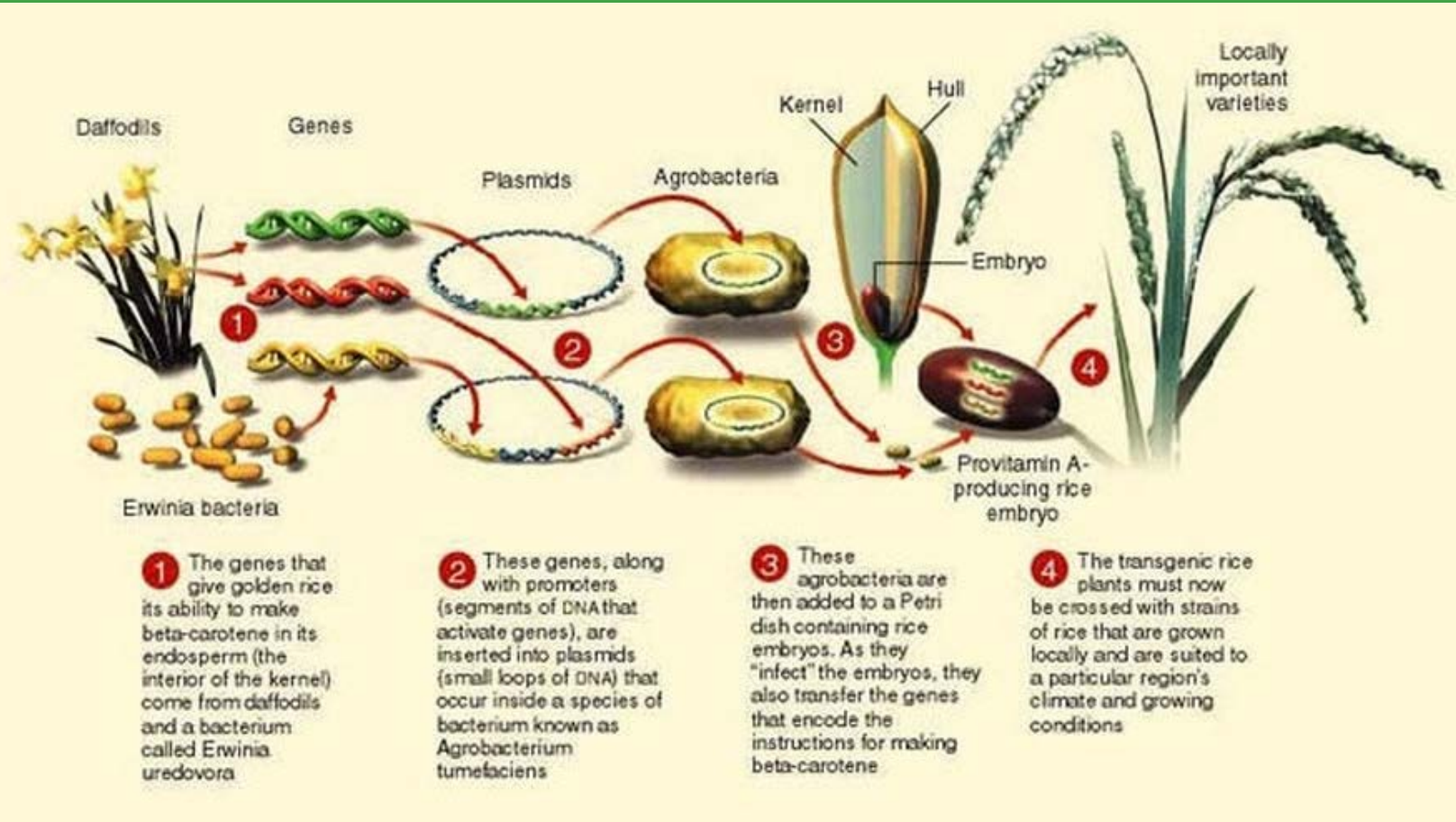
- Advances in biotechnology increase the capability of each plant or animal to produce more
 - Drought tolerant
 - Flood tolerant
 - Disease resistant
 - Insect resistant
 - Increased feed efficiency
 - More nutritious for humans



Golden Rice



In developing countries 500,000 children per year go blind and 6,000 per day die from vitamin A malnutrition.

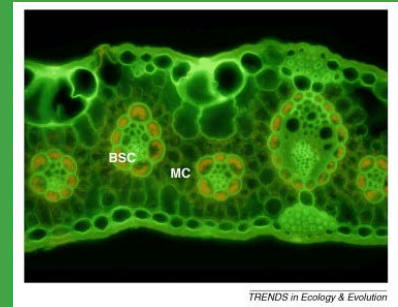
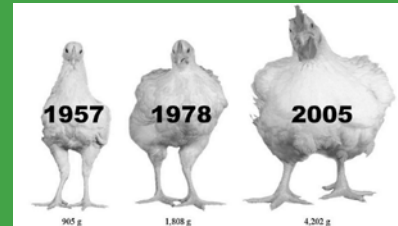


Stack it!

Smallest on the bottom, largest on the top

Humans can manage all levels

- Humans manage plants and animals through herd management, pesticides.
- Humans manage organs with fertilizer (plants) and antibiotics and vaccines (animals) to keep them healthy.
- Humans can directly manage cells (think cancer and chemotherapy).
- Humans manage chromosomes (think selective breeding).
- Humans manage DNA (think genetic engineering).
- Humans manage amino acids (think type of feed-plant based protein versus animal based protein).
- Humans manage atoms and molecules (think C3 -carbon from corn and 97% of plants, and C4-Carbon from grasses (can mean the difference between animals producing omega 3s and omega 6s)). C4 Rice Project may turn rice from a C3 to a C4 plant to be more efficient at converting sunlight into grain



Technology in Agriculture



<https://youtu.be/vpJHgXaPzFA>

Technology in Agriculture

- In order to be most efficient at producing pineapple farmers wanted to have their entire field produce fruit at the same time. How would they accomplish this?
 - Most plants respond to environmental indicators.
 - An increase or decrease in temperature (think cherry trees blooming in the spring).
 - An increase or decrease in daylight (think poinsettias).
 - An increase or decrease in water (think cacti blooming in the desert after a rain storm).



Technology in Agriculture



<https://youtu.be/wFYeFpvik8>

Technology in Agriculture

- How do we protect fruit and other agriculture goods from being damaged in transportation?



Plant it!

Grow your own pineapple

Forget Mechanical Engineering... **Civil Engineering Builds the Systems We Need**

Let's talk about Food Waste

- There are enough calories currently produced to feed all 7.4 billion people on Earth.
- Why are there a billion people that are food insecure?
- Developed countries have a huge problem with food waste. We throw tons of food away every day.
 - Grocery stores, restaurants and consumers are the biggest offenders of this
 - Food is thrown away because it doesn't meet visual standards (uglyfruit.com)
 - Sell by dates versus good by dates
 - Some food is lost in the transportation process
 - meat not refrigerated
 - bruised fruits
 - Lost retail value of \$166B
 - Disposal costs of \$1B in local taxes every year



FOOD WASTE

is a major worldwide problem



**1.3
billion
tons**

of all edible food produced worldwide is wasted or lost each year. That is 1/3 of the food produced annually.

Food is the largest category of waste

reaching US landfills. In 2010, 34+ million tons of food waste were generated in the US. Only 3% was recycled, resulting in 33 million tons going to landfills & incinerators.



or
254 lbs
per person, per
year



Forget Mechanical Engineering... **Civil Engineering Builds the Systems We Need**

Let's talk about Food Transportation

- Hard to get food to the people that need it (droughts in east Africa)
- Developing countries lack infrastructure to order more when they run out.
- Developing countries don't have networks of paved roads to bring food in.
- The lack of good roads means they can't sell the things they grow to outside markets.
- Trade is severely limited.

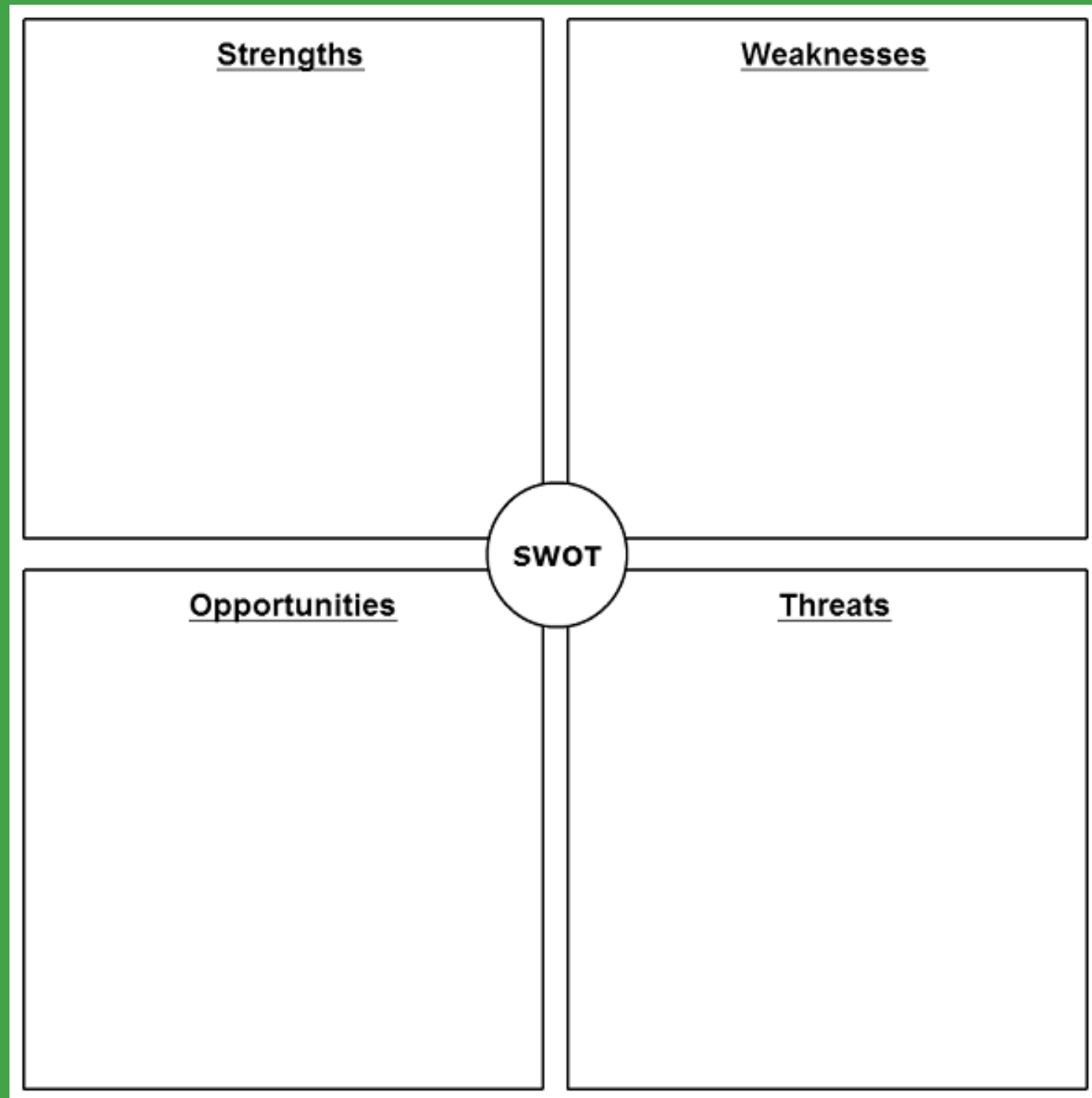


50 km traffic jam in Kenya from Nairobi to port city of Mombasa because of poorly maintained roads and only having one main artery to the port city.

Trucks wait up to 2 weeks to cross the border from Zambia into Zimbabwe. This severely restricts products getting to South African markets.

Solve it!

Become the civil engineer and solve the **food waste** and **food transportation** issues



What solutions did you come up with?

Possible Food Waste Solutions

- Add food waste to methane digesters to create energy.
- Reduce portion size to throw away less 'leftovers'.
- Ignore sell by dates.
- Grocery stores provide food to food banks
- Get food to people who need it.
- Use left overs to feed animals.
- Explore industrial uses.
- Compost food wastes.
- Plan food needs
- Keep cooler in car to transport perishables
- Freeze perishables to extend shelf life.
- Store leftovers promptly.

Possible Food Transportation Solutions

- Build roads
- Build shipping ports
- Develop local and regional economies
- Introduce new technologies
- Ensure electricity is available
- Build a cold chain from production to end user



**Agriculture and STEM can
feed the world**

