**Nitrogen Cycle and Food Homework**

1. The following article discusses nitrogen, and why although it is an essential component to life on Earth, too much can do more harm than good.

Since it is such a common element in nature, until recently, nitrogen was ignored as being a pollutant. Nitrogen is a natural part of the ecosystem and helps to increase the rate of plant growth. Because of this benefit, nitrogen has been used frequently, during the last decades, as an agriculture fertilizer. However, there are negative effects brought on by nitrogen that many people aren’t aware of.

Agricultural fertilizers and burning fuels are sources of nitrogen pollution. These occurances involve the predominance of nitrogen in the atmosphere which lead to the greenhouse effect, pollution of waters and soil, and to breathing and heart problems for living creatures. Calculating the impact on health, by respiratory problems, asthma and cancer; the nitrogen pollution reduces life expectancy of any European by six months.

Accordingly to a recent study on European Nitrogen Assessment, in Europe each person pays between £130 and £650 per year for the cost of nitrogen pollution, while on average, the total amount rises to $70-120 billion: costs of pollution on air, soil, water, increased greenhouse gases and damage to wildlife.

[BBC News](http://www.bbc.co.uk/news/science-environment-13025304) announced that 80 percent of the nitrogen in crops feeds livestock, not people. Meat consume is heavily increasing the nitrogen pollution, especially in Europe. Dr. Mark Sutton, from UK’s Centre for Ecology and Hydrology, one of the leaders of the study, according to the [Telegraph](http://www.telegraph.co.uk/earth/earthnews/8438737/Cut-out-meat-to-stop-nitrogen-pollution-say-scientists.html): “Amazingly, livestock consume around 85 per cent of the 14 million tones of nitrogen in crops harvested or imported into the EU; only 15 per cent is used to feed humans directly.

European nitrogen use is therefore not primarily an issue of food security, but one of luxury consumption”. The advice is not to become all vegetarians, but at least to try a “[demitarian](http://www.telegraph.co.uk/earth/earthnews/8438737/Cut-out-meat-to-stop-nitrogen-pollution-say-scientists.html)” regime, to try a reduction of meat consumption. Other advice, to lesson the negative impacts seen by nitrogen, are being shared by the [U.S. Department of Agriculture (USDA)](http://www.toonaripost.com/test/21Sept/A%20U.S.%20Department%20of%20Agriculture%20%28USDA%29).

The Department said, in order to improve soil-management practices, using conservation-tillage, crop rotation, and cover crops as wheat, rye and other grasses will be neccessary. Among agricultural strategies through methods as “precision farming” (fertilizers calculated with precision for each surface), manure recycling, genetically modified crops (which absorb nitrogen from air), governments should adhere to a new set of policies, at least in Europe, said professor Bob Watson, Chief scientist at the Department for Environment, Food and Rural Affairs.

Even though [European Union statistics](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Air_pollution_statistics) shows that the emission of nitrogen decreased from 13.84 million tones in 1997 to 10.94 in 2007, improvements are still required. “There have been and still are many attempts to control nitrogen but we believe the big challenge is to link existing policy areas and make them work together.” stated Sutton.

However solutions reside also in the hands of individuals by cutting down meat consumption, and choosing a responsible industrial and agricultural business.

1. The article discusses how a surplus (too much) nitrogen can lead to an increased Greenhouse Effect. What is the Greenhouse Effect, and how does nitrogen contribute to it?
2. What are the three main components of fertilizer (review from your notes), and what do each of them do?
3. Draw a simplified nitrogen cycle, being sure to define what each process is in your diagram.
4. According to the article, what health problems can arise from nitrogen pollution? How does that affect the life expectancy and costs of people in Europe?
5. What is eutrophication? How does this process happen and what can result after eutrophication occurs in a sea/ocean?
6. What has the US Department of Agriculture (USDA) claimed is the best approach to use the soil (and the nitrogen in it) sustainably? How do legumes play a part in this conservation process?
7. The following article is a synopsis of the PBS documentary special entitled “Harvest of Fear,” which exposes the Genetically Modified Organism (GMO) industry for viewers.

In "Harvest of Fear," FRONTLINE and NOVA explore the intensifying debate over genetically-modified (GM) food crops, an industry that was spawned after the Green Revolution in the 1970’s. Interviewing scientists, farmers, biotech and food industry representatives, U.S. regulators, and critics of biotechnology, this two-hour report presents both sides of the debate--exploring the risks and benefits, the hopes and fears, of this new technology.

[Hugh Grant,](http://www.pbs.org/wgbh/harvest/interviews/grant.html) an executive with Monsanto--the leader in agricultural biotechnology--and farmers like [Gerald Tumbleson](http://www.pbs.org/wgbh/harvest/interviews/tumbleson.html) in Minnseota, tout the benefits of GM crops. They say they can help feed the world and preserve the environment by reducing the need for pesticides. One example: by inserting a gene from the organic pesticide Bacillus thuringiensis (BT) into crops such as cotton, corn, and apples, farmers can grow these crops using very little pesticide.

Even more promising is the hope that GM technology can save lives. Scientists like [Charles Arntzen](http://www.pbs.org/wgbh/harvest/interviews/arntzen.html) are working on GM techniques to make edible vaccines--inside bananas and other foods--to combat viruses in developing countries.

But others aren't so sure. Organic farmer [Paul Muller](http://www.pbs.org/wgbh/harvest/interviews/muller.html) argues that GM crops can increase pest resistance and have other bad consequences for sustainable agriculture. And opposition groups such as Greenpeace, Friends of the Earth and the Union of Concerned Scientists are concerned that in redesigning plants using genes from other organisms--even other species--a new, possibly reckless experiment is underway with [unforeseen impacts (video)](http://www.pbs.org/wgbh/harvest/etc/video.html) on nature and the environment.

"Harvest of Fear" chronicles how in Europe, opponents like [Charles Margulis](http://www.pbs.org/wgbh/harvest/interviews/margulis.html) with Greenpeace, campaigned and nearly halted, the development and use of genetically-modified foods. However, in the U.S., genetically modified crops like corn and soybeans have been in the food supply since 1996--in [everything from cereals to sodas.](http://www.pbs.org/wgbh/harvest/coming/) Interviewing scientists like [Martina McGloughlin](http://www.pbs.org/wgbh/harvest/interviews/mcgloughlin.html) and U.S. regulators such as [Jim Maryanski](http://www.pbs.org/wgbh/harvest/interviews/maryanski.html) with the FDA, this report asks the key question: Is GM food safe to eat?

This FRONTLINE/NOVA report also examines the contrasting public perceptions about GM foods and what explains it. In Europe, there is skittishness about this new technology. But in the U.S., focus group research reveals that American consumers' top priority is 'choice'--if GM foods [are labeled,](http://www.pbs.org/wgbh/harvest/viewpoints/regulated.html) it will help reduce fear.

Throughout this FRONTLINE/NOVA report, cameras take viewers inside the laboratories of scientists developing the latest applications of GM technology, and show anti-GM demonstrations in Europe and the U.S., including violent tactics employed by some opponents. Some farmers had genetically-modified crops hacked away during the night by "eco-terrorists." And members of the Earth Liberation Front claimed responsibility for a fire at Michigan State University that destroyed a building being used for work related to agricultural biotechnology.

Such demonstrations and protests, however, haven't deterred the technology's supporters. Pandora's box has been opened, they say. No amount of protests or violent tactics can put the lid back on. "We'll not be able to stop this technology," USDA Secretary [Dan Glickman](http://www.pbs.org/wgbh/harvest/interviews/glickman.html) says. "Science will march forward."

1. What is the Green Revolution, and why was it important in giving rise to the GMO industry?
2. According to your notes, what defines a person to be chronically hungry? Why, remembering the discussion in class, did people think GMOs could solve the world hunger crisis?
3. Explain one form of GMOs that the article talks about, and what it does to the food in question.
4. Why can GMOs be a good thing (give three reasons) – use this article and your notes?
5. What do some skeptics of GMOs take issue with?
6. Where do you stand on this GMO debate and why?
7. According to your notes, meat sources are currently grown in harmful ways. Explain them here:
   1. Aquaculture (fish)
   2. CAFO (cows and chickens)