**Agriculture in the 21st Century**

**Lesson Time:** 15-20 minutes with optional extension assignment

**Supplies**: PowerPoint with videos

**Background:**

Food production in the US accounts for 50% of land use, 80% of water use, and 10% of energy use. While farming in recent history has been focused on meeting increasing demand to match population growth, future considerations will need to be taken for long-term sustainability and environmental impact of practices, particularly in the use of chemical pesticides and fertilizers.

Chemical pesticides and fertilizers are used to maximize land usage in order to yield the highest harvest of uniform crop growth with minimal loss. According to the United Nations’ Food and Agriculture Organization, every year about 40% of crops are lost to insects, weeds, and diseases. Pesticides aim to kill the unwanted threats to crops, while not harming other forms of life, including humans. They were not widely used until the invention of DDT in the 1940s.

Despite the fact that 40% of US soil is prairie soil and forest soil, the 2 most productive in the world, nitrogen-based fertilizers are heavily used to supply crops with essential nutrients and replenish the soil. Manure was the predominant fertilization method until about the 1940s, when chemical fertilizers gained popularity. Chemicals in modern pesticides and fertilizers may contribute to soil erosion and attach to soil particles as they flow into waterways, leading to excess nutrients in the water that, in turn, lead to algal blooms and anoxic conditions that create inhabitable aquatic environments.

**Sources:**

<https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf>

<https://livinghistoryfarm.org/farminginthe20s/machines_01.htm>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2984095/>

<https://gro-intelligence.com/insights/articles/a-look-at-fertilizer-and-pesticide-use-in-the-us>

**Goal**: Students will see land and soil as finite resources and understand recent modernizations in agriculture to meet increasing population food demand. They will understand the benefits and consequences of these changes on food production, the environment, and overall quality of life.

**PowerPoint Talking Points**

* Introduction
  + Before we get started, please answer these poll questions:

*Poll questions:*

* + - *Do you think we have sufficient adequate land to grow and produce enough food for the population? A) Yes B) No*
    - *What percentage of the Earth’s land would you guess is available for farming? A) 0-25% b) 26-50% C) 51-75% D) 76-100%*
* Apple Earth
  + Let’s watch this video to learn more about the land available to us on Earth.
  + *Play video- 2 min*
  + As we can see, we have a lot of critical uses for limited resources- space and fertile land. Currently, about half of the land in the US is used for food production. We’re pretty fortunate in that prarie soil and forest soil are the most nutrient-rich in the world, and the US is 40% prarie and forest!
  + However, the amount of land on Earth stays about the same, though we as a human species continue to grow in population. It becomes more and more important to use our land and resources wisely. Do you think we are becoming better or worse at using our environment wisely over time, specifially when it comes to food? *Thumbs up or down.*
  + Let’s look at these photos to compare how our procedures have changed with time.
* 1920s vs. Today
  + It’s probably no surprise that as our population has increased drastically in the last century, how we grow and produce food has had to change as well. The population of the US was about 105 million people in the 1920s, whereas today we have 330 million people, meaning the nation’s population has tripled in 100 years!
  + What do you think we currently do to increase food production (ex. processing in factories, genetically modified fruits and veggies, specialized farms, agricultural machinery, chemical pesticides and fertilizers)? How do you think that differs to how agriculture used to be? *Students may type answers in the chat or be unmuted.*
  + Let’s see one example of how it’s changed.
* Pesticide & Fertilizer
  + Can anyone tell me what pesticides and fertilizers are used for? We brielfy discussed this during I Love A Clean San Diego’s presentation. *Students may type answers in the chat or be unmuted.*
  + In the 1920s, using pesticides was not very common. Insect infestations were isolated events and pesticides at the time were pretty ineffective. It wasn’t until DDT came along in the 1940s that we started using pesticides regularly.
  + However, adding nutrients to the soil through fertilizer has been a common practice in farming to increase crop productivity for quite some time.
  + Left: A manure spreader applies fertilizer onto a plowed field. For most of agricultural history, manure (nutrient-rich animal waste) was the primary way to enrich soil.
  + Right: An agricultural aircraft sprays chemically-based pesticide (crop dusting) or fertilizer (aerial topdressing) to a huge field.
  + What are the benefits (ex. higher production, less time and labor needed) and consequences (ex. pollution, health risks to farmers, chemicals on food) of these changes? How would things be different if we still relied on older methods? *Students may type answers in the chat or be unmuted.*
* Environmental Consequences:
  + This picture is an aerial shot of one of the regions of our planet most heavily affected by pesticides and fertilizers in agriculture, the Gulf of Mexico.
  + What do you think is causing that brown cloud in the water? *Students may type answers in the chat or be unmuted.*
  + One of the biggest consequences of heavy use of chemical pesticides and fertilizers is soil erosion. Currently, 1/3 of Earth’s arable land has been lost to soil erosion.
  + This video will explain what is going on here.
  + *Play video- 2 mins*
* What can we do:
  + After watching that video, this may seem like an overwhelming problem that is out of your control, but it’s never too late to improve practices and do what you can.
  + What ideas do you have to improve agriculture, while still feeding our population (ex. buffer crops between fields and waterways, only applying pesticides and fertilizers when/where needed, incentives to go organic, compost instead of chemical fertilizer, cover crops and mulch)? S*tudents may type answers in the chat or be unmuted.*
  + Also, remember that you’re the consumer of these products, so you actually direct the market and have a lot of power and say here. Is there anything we can do on an individual level (ex. grow your own food, shop locally, research where your food comes from)? S*tudents may type answers in the chat or be unmuted.*

**Optional Post-Extension: Article Analysis and Discussion**

Assign students to read this National Geographic article at home and be ready to discuss the following questions in class. Link to article: <https://www.nationalgeographic.com/news/2017/08/gulf-mexico-hypoxia-water-quality-dead-zone/#close>

* Why was the dead zone so large in 2017?
* How does this pollution affect other areas of life? (fisheries, drinking water)
* What are the goals for the future? What are some ideas for potential paths to take to meet those goals?
* How does this affect us in San Diego County?