Objectives, EKs & Skills

Unit 5 - Land Use

LEARNING OBJECTIVE

EIN-2.A

Explain the concept of the tragedy of the commons.

ESSENTIAL KNOWLEDGE

EIN-2.A.1

The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources.

SUGGESTED SKILL

Concept Explanation

1.B

Explain environmental concepts and processes.

5.1

Tragedy of the Commons (TOC)

Tragedy of the Commons:

Individuals will use **shared/public resources*** in their own self interest, **degrading**** them

*Must be a public resource (not privately owned)
**Must be degraded, overused, depleted, used-up in some way

Examples

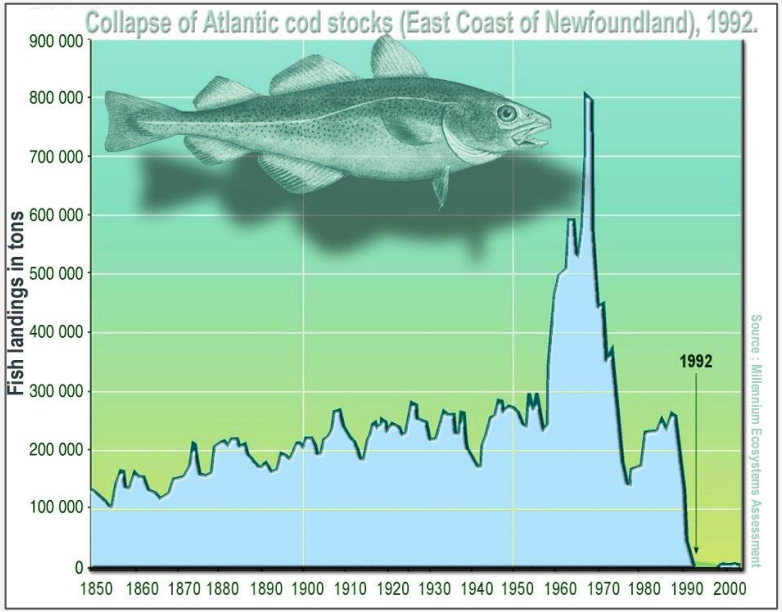
- **Overgrazing**
- **Overfishing**
- **Water & Air pollution**
- **Overuse of groundwater**

Why does it happen?

- When no one owns the resource (land, water, air) no one directly suffers the negative consequences of depleting, degrading, or overusing it
- People assume others will overuse the resource if they don't
- There is no penalty for overusing, degrading, polluting many public resources

What's the problem?

- Overfishing can lead to fishery collapse (population crash) loss of income & starvation
  - Air pollution from coal power plants can lead to bronchitis, asthma, increased healthcare costs
- Pesticide runoff from farms contaminates drinking water



Examples

- **Clean Air Act**
- **Clean Water Act**
- **Safe Drinking Water Act**
- **BLM (Bureau of Land Management)**

How to Solve the TOC

- Private land ownership (individual or gov.)
- Fees or taxes for use
  - Ex: permit system for grazing, logging
- Taxes, fines, criminal charges for pollution or shared air/soil/water resources

Manages rangelands in western US by collecting grazing fees from ranchers, evaluating land, and repairing effects of overgrazing

Practice FRQ 5.1

SUGGESTED SKILL

Concept Explanation

1.B

Explain environmental concepts and processes.

The oceans of the world are often referred to as a commons. **Identify** one other such commons, **explaining** how human activities affect that commons, and **propose a solution** for managing that commons.

5.2 Clearcutting

Objectives, EKs, and Skills

LEARNING OBJECTIVE

EIN-2.B

Describe the effect of clearcutting on forests.

SUGGESTED SKILL

Concept Explanation

1.A

Describe environmental concepts and processes.

ESSENTIAL KNOWLEDGE

EIN-2.B.1

Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.

EIN-2.B.2

Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change.

Direct Effects of Clearcutting

Soil Erosion

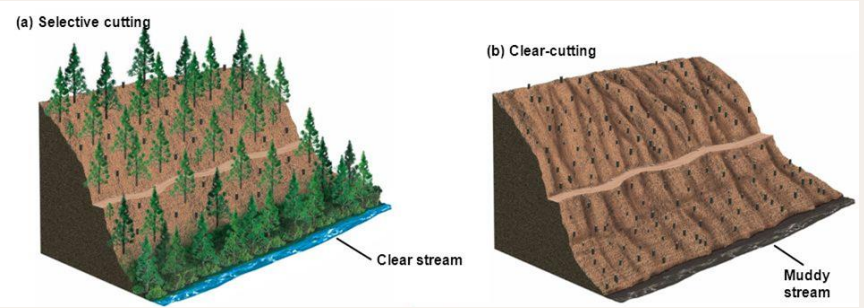
- Caused by loss of stabilizing root structure
- Removes soil organic matter & nutrients from forest
- Deposits sediments in local streams
  - Warms water & makes it more turbid (cloudy)

Increased soil & stream temp.

- Loss of tree shade increases soil temperature
  - Soil has lower albedo than leaves of trees
- Loss of tree shade along rivers & streams warms them
  - Erosion of sediments into rivers also warms them

Flooding & Landslides

- Logging machinery compacts soil
- Increased sunlight dries out soil
- Loss of root structure = erosion of topsoil & O horizon
  - All of these factors decrease H_2O holding capacity of soil causing flooding & landslides



Tree Plantations

Areas where the same tree species are repeatedly planted, grown, and harvested

Lowers Biodiversity

- Biodiverse, mature forests are replaced with single species forests
- Less species diversity = lower resilience
- Less habitat diversity for other org.

All the Same Age

- All trees planted at the same time = all the same age
- Lowers biodiversity further (no dead trees for woodpeckers, insects, decomposers)

Forest Benefits

1 Filtering of Air Pollutants

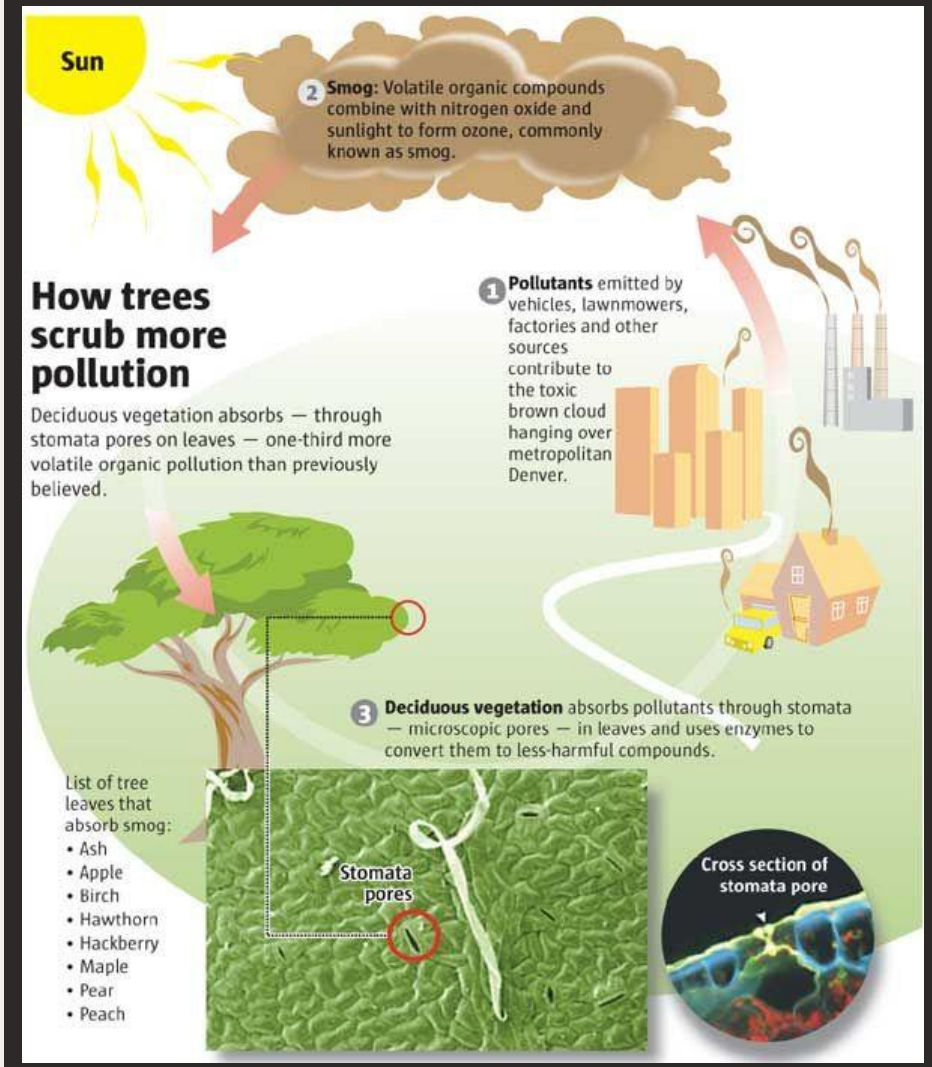
Stomata (leaf pores) remove VOCs, NO_2, PM from air & store in tree

2 Removal & storage of CO_2 from atm.

Trees take in CO_2, store carbon as sugar, wood, other tissue & release O_2

3 Habitat for organisms

Many organisms live in forests (biodiv, ecotourism)



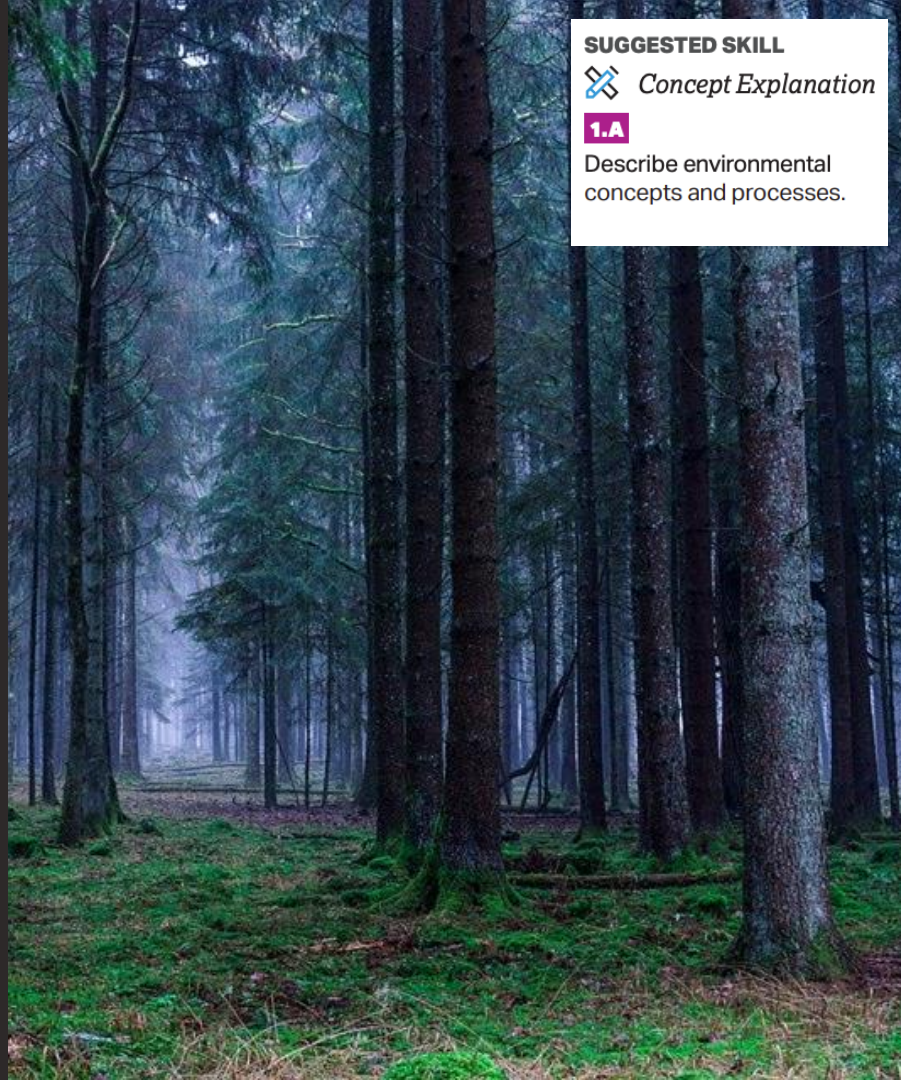
Deforestation

Consequences

- Reduces air filtering and carbon storing services
- Cutting trees down releases CO_2 from decomposition of leftover organic material
- **Slash & burn** method of clearing land for agriculture by cutting trees & burning them releases CO_2, N_2O and water vapor into the atmosphere (all GHGs)

Practice FRQ 5.2

Describe TWO ecosystem services provided for humans by forests.
Explain how clear-cutting would affect each ecosystem service you describe.



SUGGESTED SKILL

Concept Explanation

1.A

Describe environmental concepts and processes.

5.3 The Green Revolution

Objectives, EKs, and Skills

LEARNING OBJECTIVE

EIN-2.C

Describe changes in agricultural practices.

SUGGESTED SKILL

Text Analysis

3.B

Describe the author's perspective and assumptions.

ESSENTIAL KNOWLEDGE

EIN-2.C.1

The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically modified organisms (GMOs), fertilization, irrigation, and the use of pesticides.

EIN-2.C.2

Mechanization of farming can increase profits and efficiency for farms. It can also increase reliance on fossil fuels.

The Green Revolution

Shift in agriculture away from small, family operated farms to large, **industrial-scale agribusiness**

- Increased use of mechanization, GMOs, irrigation, fertilizers, and pesticides

+ Greatly increases efficiency of lands, short-term profitability, and food supply

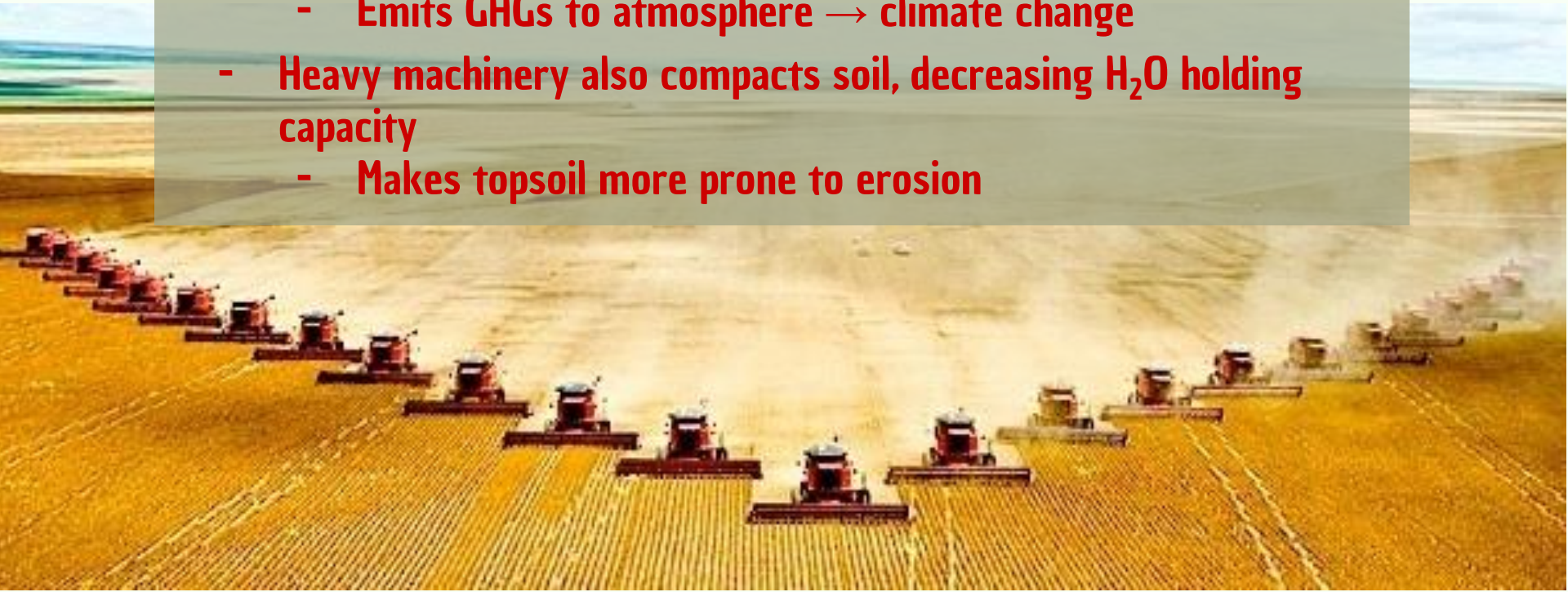
  + Decreased world hunger and increased earth's carrying capacity for humans

- Bring neg. Consequences (soil erosion, biodiversity loss, ground ɛ surface water contamination)

Mechanization

+ Increased use of tractors for plowing and tilling fields, and combines for harvesting = increased yield + profits

- Increases reliance on fossil fuels (gasoline/diesel fuel)
  - Emits GHGs to atmosphere → climate change
- Heavy machinery also compacts soil, decreasing H_2O holding capacity
  - Makes topsoil more prone to erosion

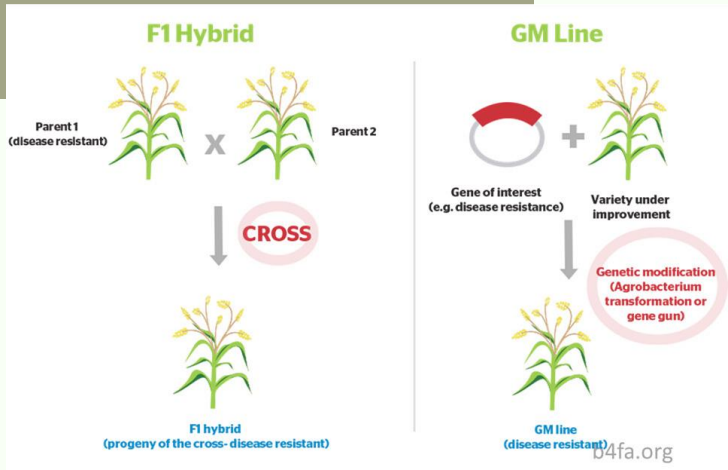


High-Yield Variety (HYV) Crops

- Hybrid, or genetically modified crops that produce a higher yield (amount of crop produced per unit of area)
  - Hybrid = cross-pollinating different species, or parent plants with ideal traits

\+ Increased yield and food stability in regions previously prone to famine (India, Pakistan, Mexico)

- GMOs = crops with new genes "spliced" into their genome



GMOs

- Genetically modified crops have genes for drought tolerance, pest resistance, faster growth, and larger fruit/grain
  - \+ Increases profitability with fewer plants lost to drought, disease, or pests + larger plant size + yield/acre
  - \- GMO crops are all genetically identical so gen. diversity is decreased and susceptibility to diseases or pest is increased

Ex: Bt corn has been modified with a gene from soil bacteria (Bacillus thuringiensis) to produce a protein that kills many different corn pests

Synthetic Fertilizer

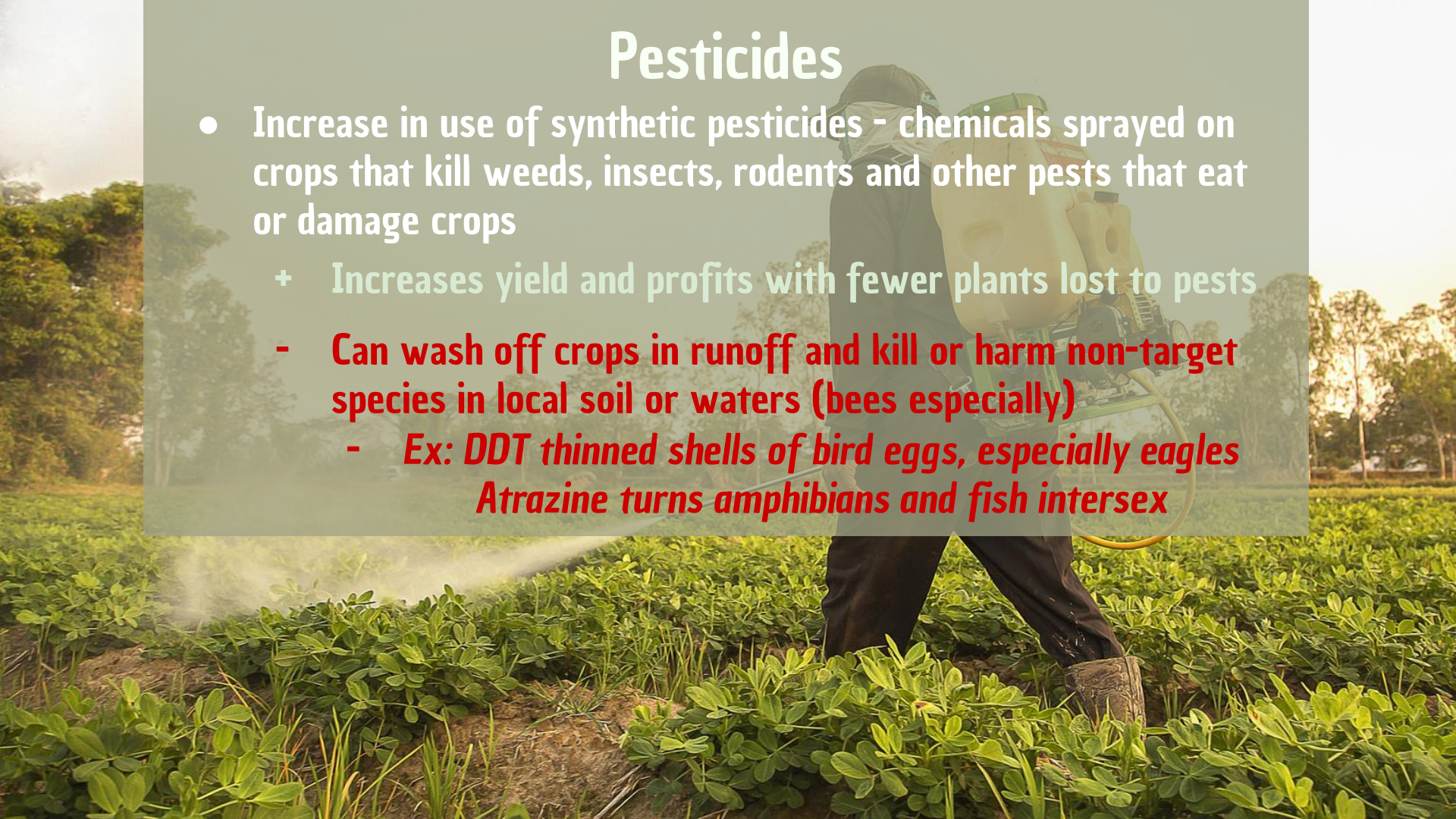
- Shift from organic fertilizers (like manure and compost) to synthetic fertilizers (man made ammonium, nitrate, phosphate)
  - \+ Increases yield and profits with more key nutrients needed for plant growth (N, P, K) added to the soil
  - \- Excess nitrate, phosphate are washed off fields and into nearby waters where they cause eutrophication (algae blooms)
  - \- Require FFs for production, releasing CO_2 (climate change)

Irrigation

- Drawing water from the ground or nearby surface waters and distributing it on fields to increase plant growth
  - \+ Make agriculture possible in many parts of the world that are naturally too dry (don't receive enough rain)
  - \- Can deplete groundwater sources, especially aquifers
  - \- Over watering can drown roots (no O_2 access) and cause soil salinization (increase salt level in soil)

Pesticides

- Increase in use of synthetic pesticides - chemicals sprayed on crops that kill weeds, insects, rodents and other pests that eat or damage crops
  - \+ Increases yield and profits with fewer plants lost to pests
  - \- Can wash off crops in runoff and kill or harm non-target species in local soil or waters (bees especially)
    - *Ex: DDT thinned shells of bird eggs, especially eagles*
      Atrazine turns amphibians and fish intersex



5.3 Practice FRQ

We'll practice text analysis in class, so try this FRQ instead:

Describe one environmental advantage and one environmental disadvantage of using GM crops.

SUGGESTED SKILL

Text Analysis

3.B

Describe the author's perspective and assumptions.

5.4

Impact of Agricultural Practices

Objectives, EKs, and Skills

LEARNING OBJECTIVE

EIN-2.D

Describe agricultural practices that cause environmental damage.

ESSENTIAL KNOWLEDGE

LOR-2.D.1

Agricultural practices that can cause environmental damage include tilling, slash-and-burn farming, and the use of fertilizers.

SUGGESTED SKILL

Concept Explanation

1.A

Describe environmental concepts and processes.

Monocropping

- Growing one single species (corn, wheat, soy) of crop
  - Highly efficient for harvest, pesticide and fertilizer application
- Greatly decreases biodiversity (more prone to pests, fewer nat. predators)
- Increases soil erosion (crops harvested all at once & soil left bare)
- Decreases habitat diversity for species living in the area

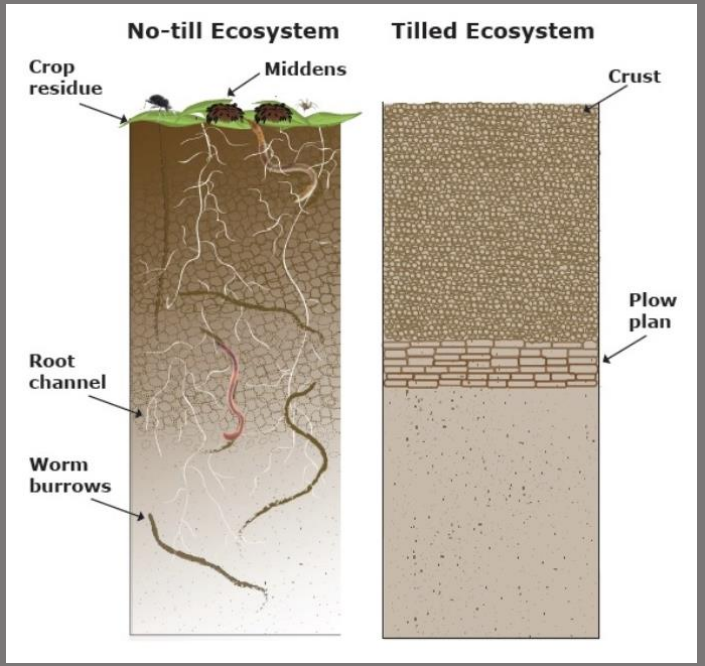
Tilling

- Mixing and breaking up soil to make planting easier
  - Also loosens soil for roots

- Increases erosion by loosening topsoil, breaking up leftover root structure from harvest

- Loss of organic matter & topsoil nutrients over time

- Increased PM in air (rerp. irr) and sediments in nearby water (turbidity)



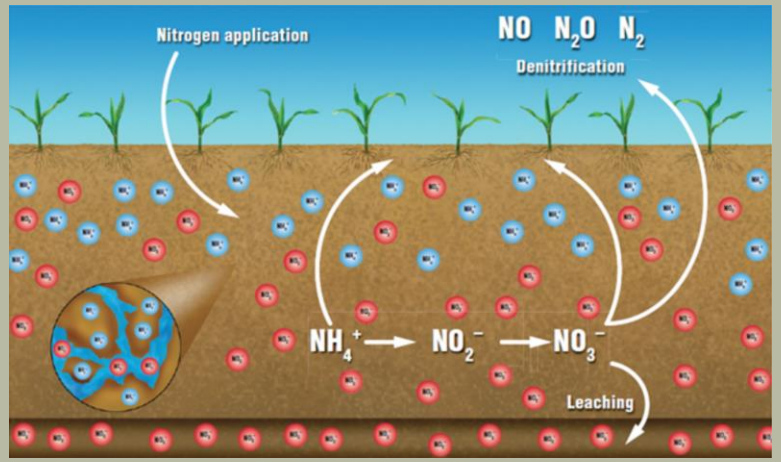
Slash & Burn

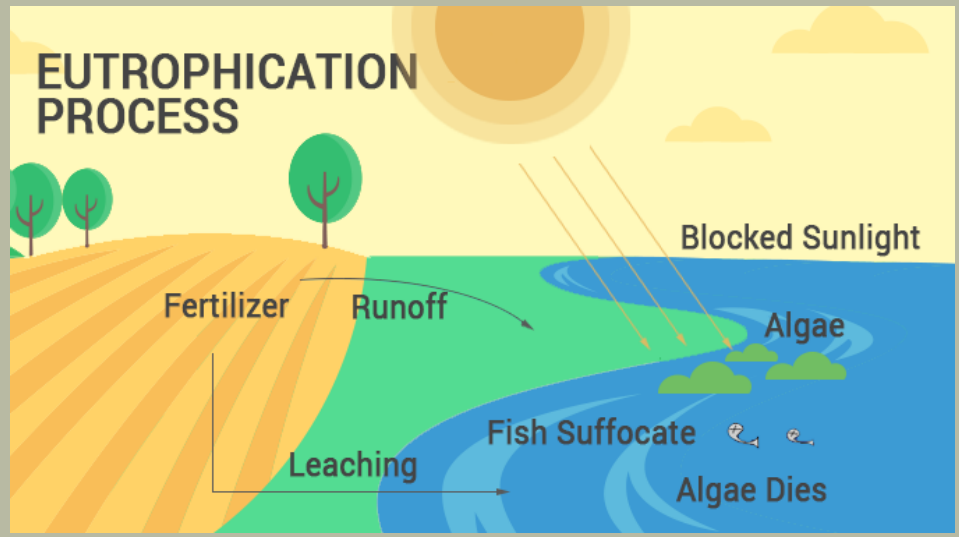
- Cutting down vegetation and burning it to clear land for ag. & return nutrients in plants to soil

- Deforestation
  - Loss of: habitat, biodiv, CO_2 sequestration (storage), loss of air pollution filtration
- Releases CO_2, CO, N_2O - all GHGs that lead to global warming
- Increases PM in air (asthma)
- Lowers albedo, making area warmer

Synthetic (inorganic) Fertilizers

- Don't return organic matter to soil; no increased H_2O holding cap. & no soil decomposers
- **Leaching**: water carries excess nutrients (nitrates & phosphates) into groundwater or into surface waters (as **runoff**)
  - Contaminates groundwater for drinking
  - Causes eutrophication of surface waters





Practice FRQ 5.4

SUGGESTED SKILL

Concept Explanation

1.A

Describe environmental concepts and processes.

Explain one disadvantage of using inorganic, commercial fertilizers

5.5 Irrigation

Objectives, EKs, Skills

LEARNING OBJECTIVE

EIN-2.E
Describe different methods of irrigation.

EIN-2.F
Describe the benefits and drawbacks of different methods of irrigation.

ESSENTIAL KNOWLEDGE

EIN-2.E.1
The largest human use of freshwater is for irrigation (70%).

EIN-2.E.2
Types of irrigation include drip irrigation, flood irrigation, furrow irrigation, drip irrigation, and spray irrigation.

EIN-2.F.1
Waterlogging occurs when too much water is left to sit in the soil, which raises the water table of groundwater and inhibits plants' ability to absorb oxygen through their roots.

EIN-2.F.2
Furrow irrigation involves cutting furrows between crop rows and filling them with water. This system is inexpensive, but about 1/3 of the water is lost to evaporation and runoff.

EIN-2.F.3
Flood irrigation involves flooding an agricultural field with water. This system sees about 20% of the water lost to evaporation and runoff. This can also lead to waterlogging of the soil.

ESSENTIAL KNOWLEDGE

EIN-2.F.4
Spray irrigation involves pumping ground water into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also requires energy to run.

EIN-2.F.5
Drip irrigation uses perforated hoses to release small amounts of water to plant roots. This system is the most efficient, with only about 5% of water lost to evaporation and runoff. However, this system is expensive and so is not often used.

EIN-2.F.6
Salinization occurs when the salts in groundwater remain in the soil after the water evaporates. Over time, salinization can make soil toxic to plants.

EIN-2.F.7
Aquifers can be severely depleted if overused for agricultural irrigation, as has happened to the Ogallala Aquifer in the central United States.

SUGGESTED SKILL

Environmental Solutions

7.C
Describe disadvantages, advantages, or unintended consequences for potential solutions.

Furrow Irrigation

- Trench dug along crops & filled with water
- Easy & inexpensive; water seeps into soil slowly
- ~66% efficient, 33% lost to runoff & evap.

Drip Irrigation

- Most efficient, but also most costly
- Over 95% efficient
- Holes in hose allow water to slowly drip out
- Avoids waterlogging & conserves waters

Flood Irrigation

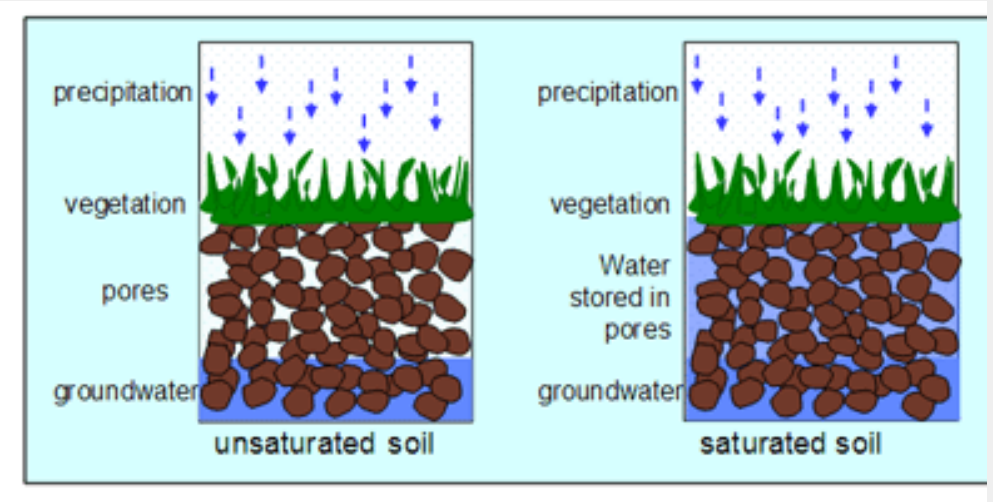
- Flood entire field; easier but more disruptive to plants
- Can waterlog the soil & drown plants
- 80% efficient - 20% runoff/evap.

Spray Irrigation

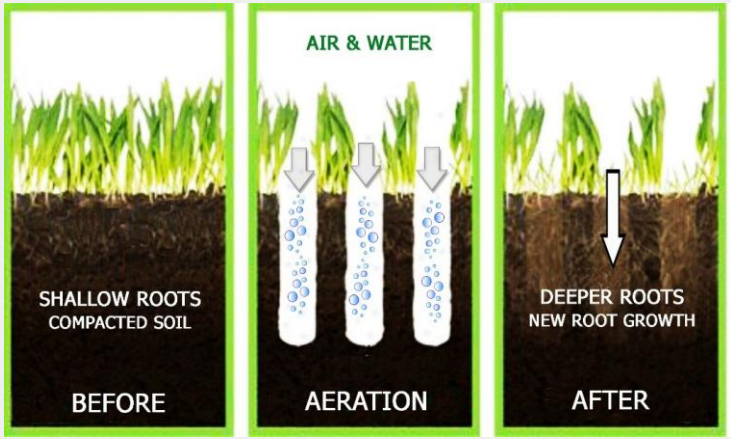
- Ground or surface water pumped into spray nozzles
- More efficient (less water loss) than flood or furrow
- More expensive (requires energy for pumps & movement of sprinklers

Waterlogging

- Overwatering can saturate the soil, filling all soil pore space with water
  - Doesn't allow air into pores, so roots can't take in O_2 they need
  - Can stunt growth or kill crops

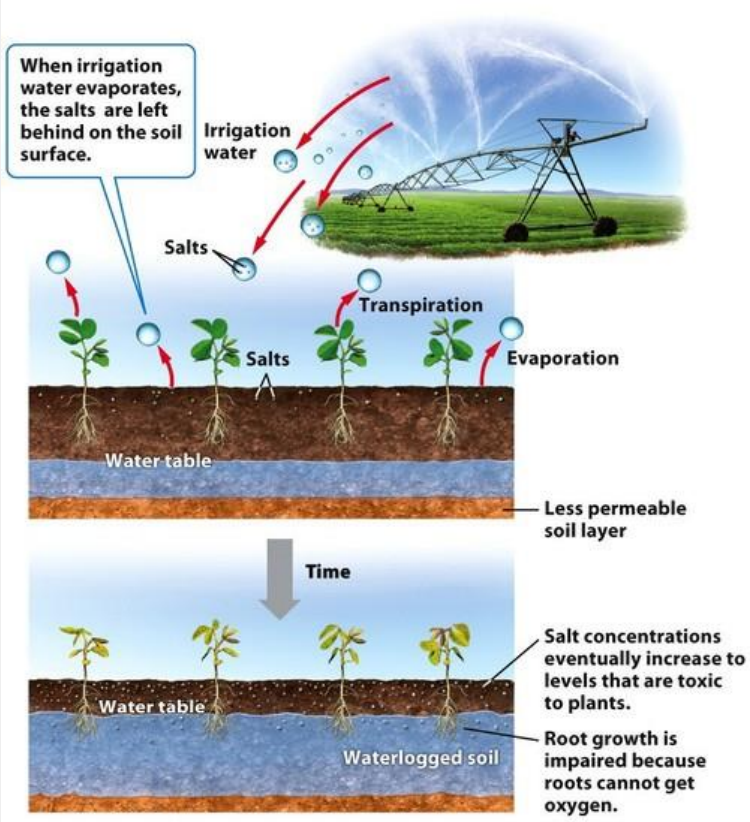


+ **Solution**: drip irrigation, or soil aeration - poking holes or cores in soil to allow air in & water to drain through soil



Soil Salinization

- Salinization is the process of salt building up in a soil over time
- **Groundwater** used for irrigation naturally has small amounts of salt
    - Water evaporates, and salt is left behind in soil. Over time, it can reach toxic levels, dehydrating plant roots & preventing growth



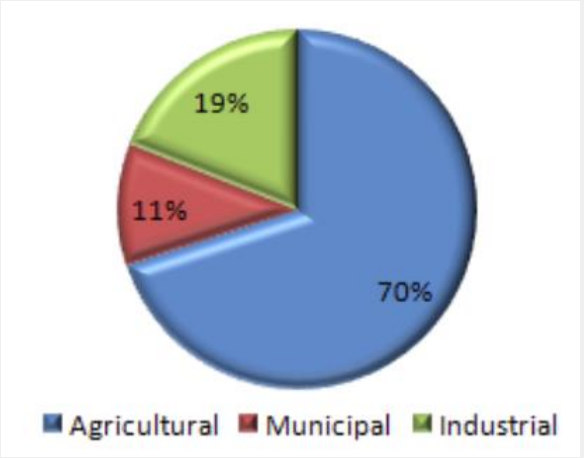
+ **Solution**: drip irrigation, soil aeration, flushing with fresh water, switch to freshwater source

Global Human Water Use

Industrial: power plants, metal/plastic manufacturing

Municipal: households (toilet, shower, drinking water)

Agriculture: water for livestock, irrigation water for crops



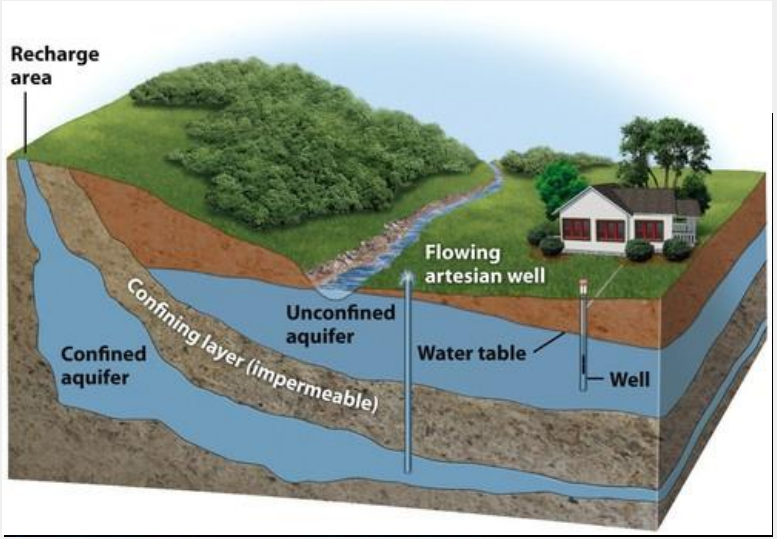
Industrial

Municipal

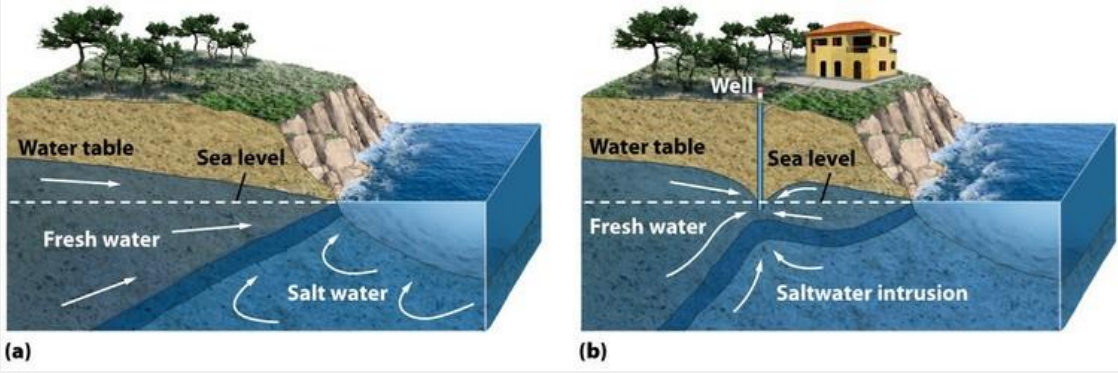
Agricultural

Aquifers & Groundwater

- **Groundwater**: H_2O stored in pore space of permeable rock & sediment layers
- **Aquifers** useable groundwater deposits for humans
- Replenished by **groundwater recharge** (rain water percolating down through soil into aquifer)
- Unconfined aquifers recharge quickly
- Confined aquifers recharge are longer-term water deposits that recharge more slowly

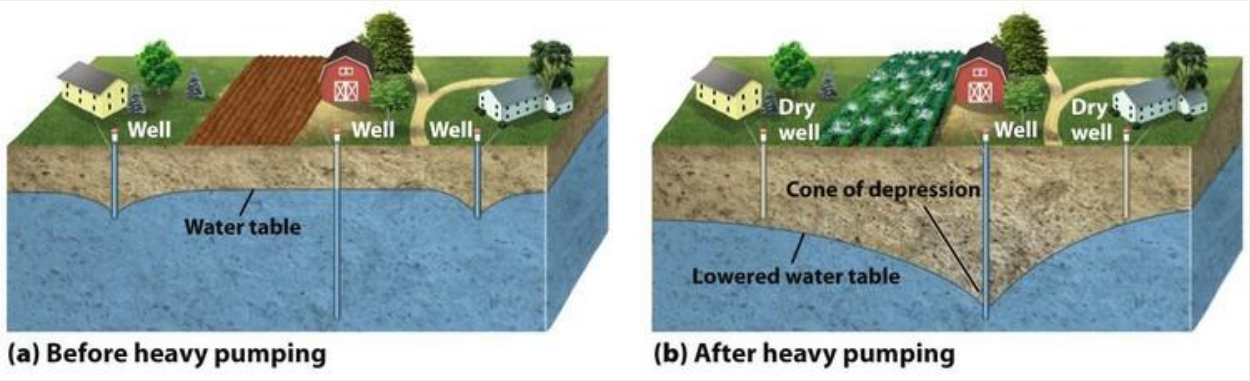


Depletion of Aquifers



- **Saltwater Intrusion**: excessive pumping near coast lowers water table pressure, allowing saltwater to seep into groundwater

- **Cone of depression**: forms when water table is lowered by excessive pumping, depleting water & drying nearby wells



Practice FRQ 5.5

Describe how soil salinization occurs. **Propose a solution** to prevent or remediate soil salinization. **Identify** one disadvantage of the solution you propose.

SUGGESTED SKILL

Environmental Solutions

7.C

Describe disadvantages, advantages, or unintended consequences for potential solutions.

5.6 Pest Control Methods

Objective, EKs, and Skill

LEARNING OBJECTIVE

EIN-2.G

Describe the benefits and drawbacks of different methods of pest control.

SUGGESTED SKILL

Environmental Solutions

7.E

Make a claim that proposes a solution to an environmental problem in an applied context.

ESSENTIAL KNOWLEDGE

EIN-2.G.1

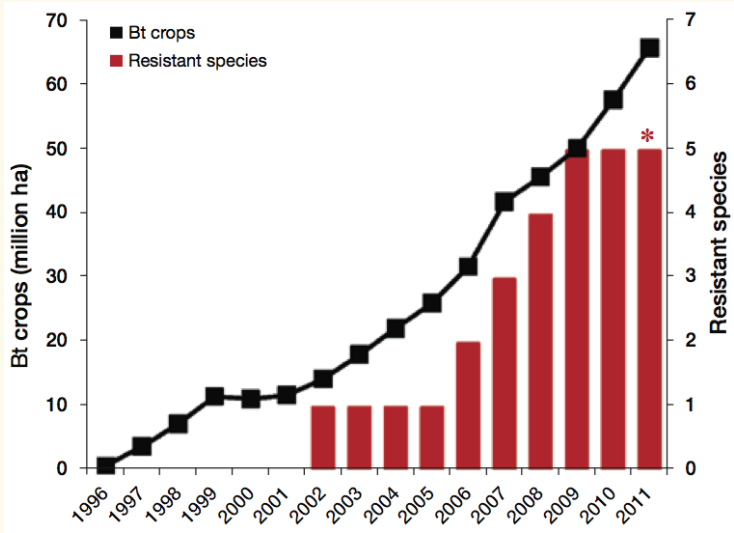
One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pest and increases crop yields.

EIN-2.G.2

Crops can be genetically engineered to increase their resistance to pests and diseases. However, using genetically engineered crops in planting or other ways can lead to loss of genetic diversity of that particular crop.

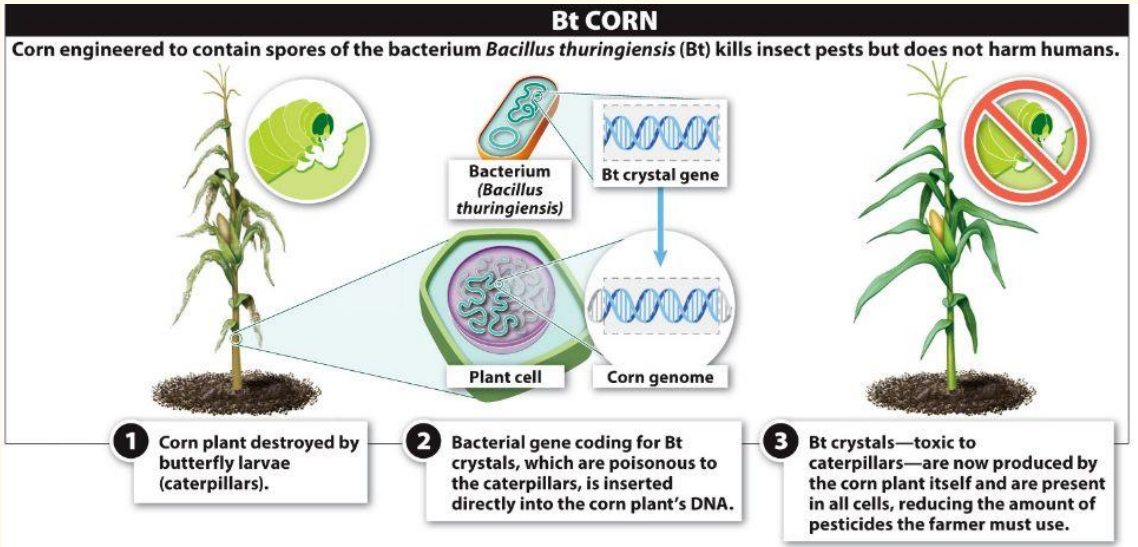
Pesticides

- Chemicals that are toxic to pests
  - Rodenticides kill rodents
  - Fungicides kill fungi
  - Insecticides kill insects
  - Herbicides kill plants
- Can cause pests to become **resistant** to pesticide overuse
  - Genetic biodiversity gives some pests resistant traits to pesticide
  - Pesticide artificially selects for pests with resistance by killing all the non-resistant individuals, leaving only resistant ones



GMOs (Genetic Modification)

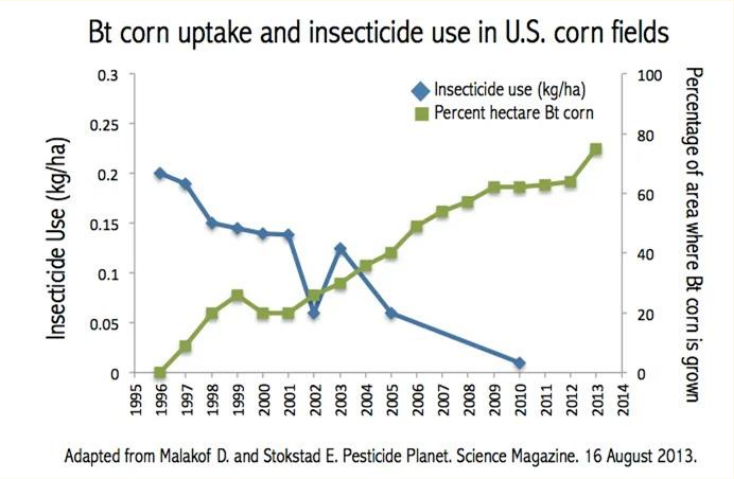
- Gene for pest resistant trait is added to the plant through genetic modification
  - Bt corn with bacteria gene that produces Bt crystals toxic to pests
  - Roundup Ready crops are GM to be resistant to broad herbicide (Roundup) meaning roundup will kill weeds, but not crops

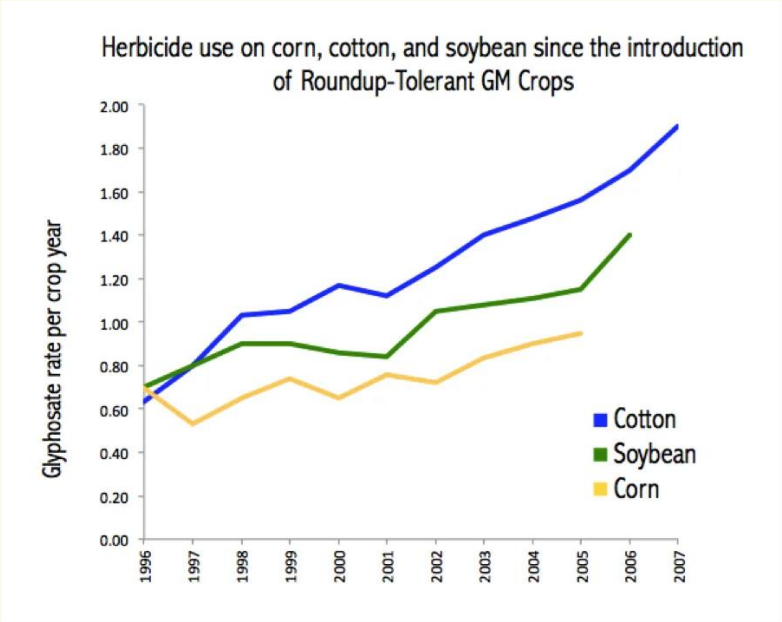


GMOs & Pesticide Use

Roundup Ready crops have **increased** herbicide (glyphosate) use since crops can't be harmed by it

Bt corn has **decreased** insecticide use, since corn makes its own insecticide (Bt crystals)

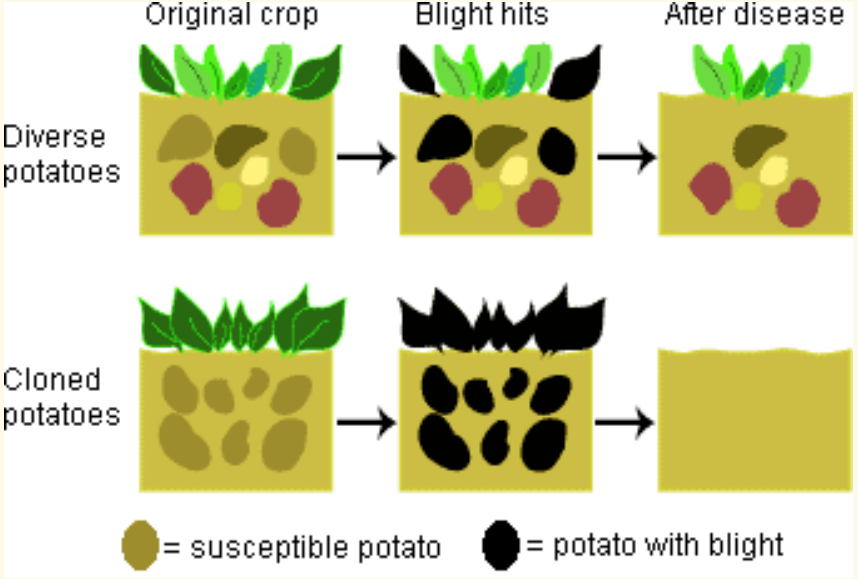




GMOs & Genetic Diversity

GM crops are all genetically identical (clones) so there is no genetic diversity in the pop.

If there is disease or pest that does affect the GM crops, they're all vulnerable and there's no chance of a genetic mutation providing an adaptive trait



Practice FRQ 5.6

SUGGESTED SKILL

Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.

Describe ONE economic advantage and one economic disadvantage of using GM crops.

5.7

Meat Production Methods

Objectives, EKs, and Skills

LEARNING OBJECTIVE

EIN-2.H

Identify different methods of meat production.

EIN-2.I

Describe the benefits and drawbacks of different methods of meat production.

ESSENTIAL KNOWLEDGE

EIN-2.H.1

Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing.

EIN-2.I.1

Meat production is less efficient than agriculture; it takes approximately 20 times more land to produce the same amount of calories from meat as from plants.

EIN-2.I.2

Concentrated animal feeding operation (CAFOs) are used as a way to quickly get livestock ready for slaughter. They tend to be crowded, and animals are fed grains or feed that are not as suitable as grass. Additionally, feedlots generate a large amount of organic waste, which can contaminate ground and surface water. The use of feedlots are less expensive than other methods, which can keep costs to consumers down.

ESSENTIAL KNOWLEDGE

EIN-2.I.3

Free range grazing allows animals to graze on grass during their entire lifecycle. Meat from free range animals tends to be free from antibiotics and other chemicals used in feedlots. Organic waste from these animals acts as fertilizer. Free range grazing requires large areas of land and the meat produced is more expensive for consumers.

EIN-2.I.4

Overgrazing occurs when too many animals feed on a particular area of land. Overgrazing causes loss of vegetation, which leads to soil erosion.

EIN-2.I.5

Overgrazing can cause desertification. Desertification is the degradation of low precipitation regions toward being increasingly arid until they become deserts.

EIN-2.I.6

Less consumption of meat could reduce CO_2, methane, and N_2O emissions; conserve water; reduce the use of antibiotics and growth hormones; and improve topsoil.

SUGGESTED SKILL

Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.

CAFOs

- Also called feedlots - densely crowded method where animals are fed grain (corn) to raise them to as quickly as possible

+ Maximizes land use and profit (most meat production per/unit of area)

+ Minimizes cost of meat for consumers

- Given antibiotics & growth hormones to prevent disease outbreak & speed meat production

- Animals produce large volume of waste which can contaminate nearby surface or groundwater

- Produces large amounts of CO_2, CH_4 (methane), and N_2O (greenhouse gasses → climate change)

Manure Lagoons

- Large, open storage pits for animal waste (manure)
- Waste contains: ammonia (N), hormones, antibiotics, fecal coliform bacteria (e. coli)
- Heavy rain can flood lagoons & contaminate nearby surface and ground water with runoff
- Denitrification of ammonia in manure produces N_2O (extremely powerful GFG)
- Can be emptied and buried in landfills, or turned into fertilizer pellets

- e. Coli → toxic to humans
- Ammonia (N) → eutrophication
- Antibiotics & growth hormones → alter endocrine (hormonal system) of humans

Free Range Grazing

- Animals (usually cows) graze on grass & grow at a natural rate without growth hormones

+ No need for antibiotics with dispersed pop.

+ Doesn't require production of corn to feed animals

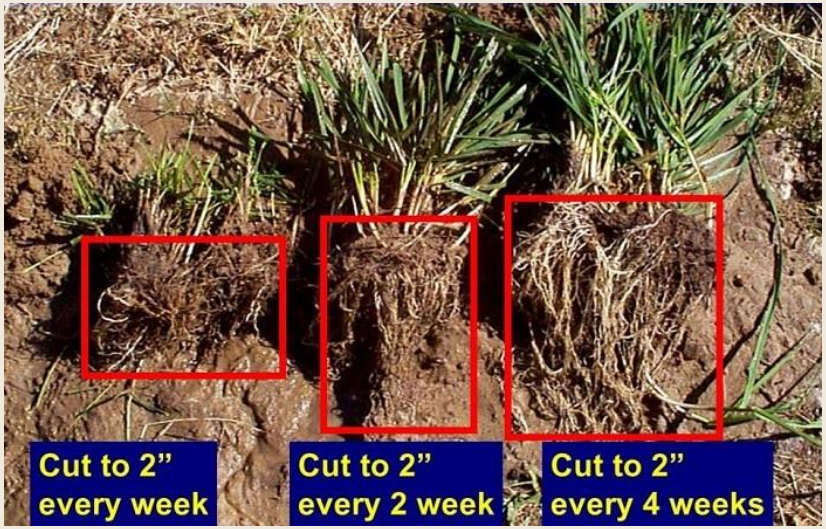
+ Waste is dispersed over land naturally, acting as fertilizer instead of building up in lagoons

- Requires more total land use/pound of meat produced
  - More expensive to consumer

+ Animals can graze on land too dry for most crop growth

Overgrazing

- Too many animals grazing an area of land can remove all the vegetation (grass) which leads to topsoil erosion
- Animals also compact soil, decreasing H_2O holding capacity → more erosion
- **Desertification** can occur if plants are killed by overgrazing & soil is compacted so much that it can't hold enough water anymore



+ Rotational grazing (moving animals periodically) can prevent overgrazing
+ Can even **increase** growth of grass by distributing manure (natural fertilizer) & clipping grass back to size where growth is most rapid

Inefficiency of Meat

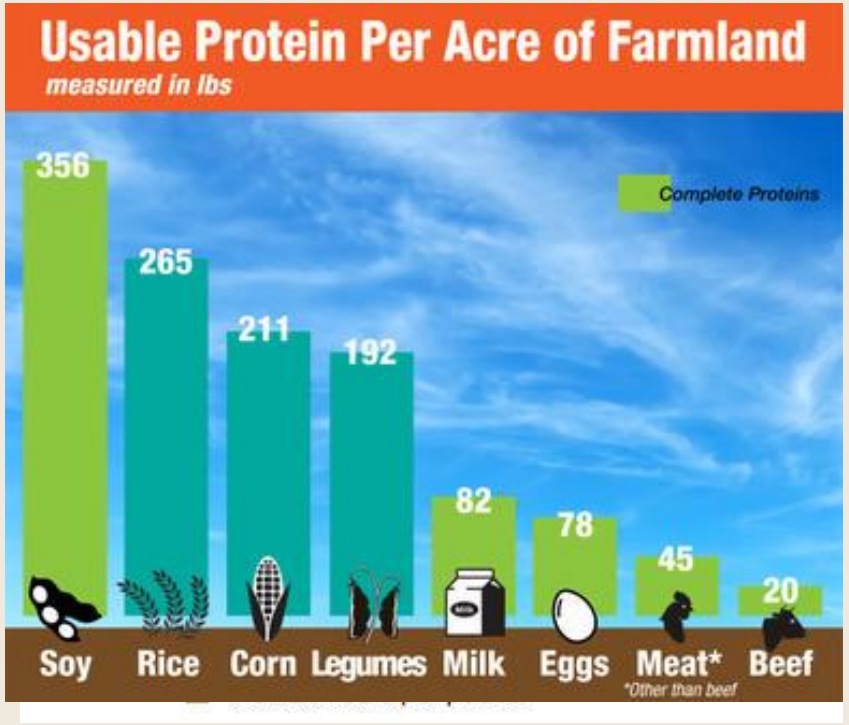
Producing meat for humans to eat is far less efficient than producing plants in terms of energy, land and water use

Energy: all of the energy needed to plant, grow, harvest plants to feed to animals **PLUS:**

- energy needed to bring water to animals
- energy needed to house animals
- energy needed to slaughter & package

Land: all of the energy needed to grow plants to feed animals **PLUS** room the animals take up

Water: all of the water for crops that animals eat **PLUS** the water the animals drink



Practice FRQ 5.7

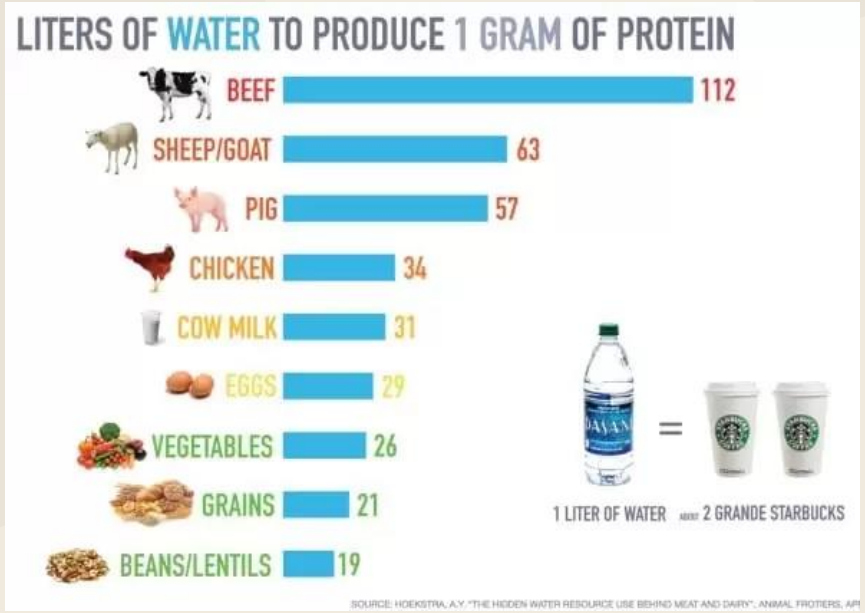
Explain an environmental benefit of eating a plant-based diet, rather than a meat-based diet, using the data below.

SUGGESTED SKILL

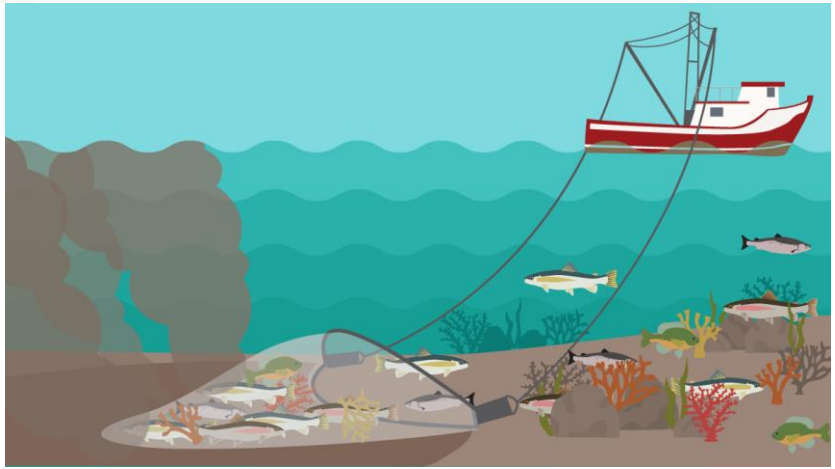
Data Analysis

5.E

Explain what the data implies or illustrates about environmental issues.



5.8 Impacts of Overfishing



Objectives, EKs, Skills

LEARNING OBJECTIVE

EIN-2.J

Describe causes of and problems related to overfishing.

ESSENTIAL KNOWLEDGE

EIN-2.J.1

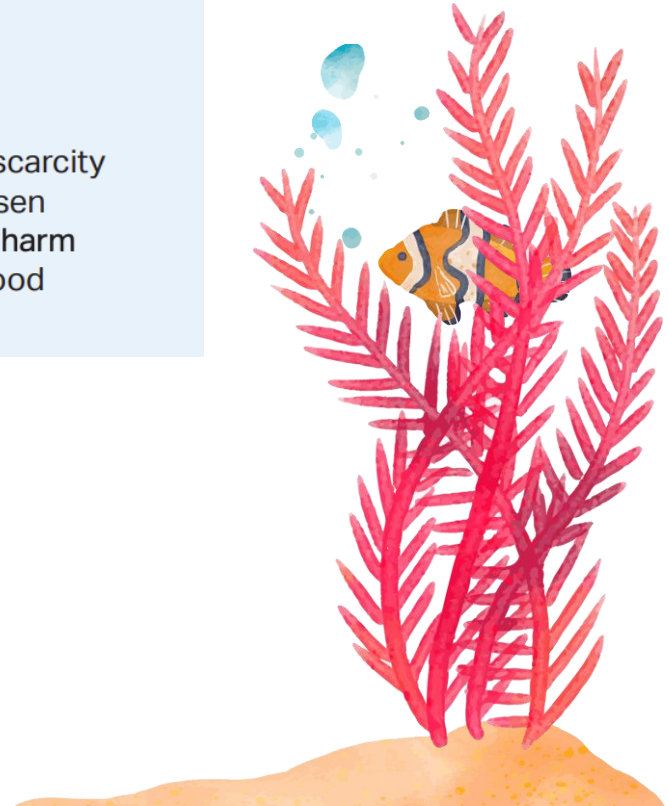
Overfishing has led to the extreme scarcity of some fish species, which can lessen biodiversity in aquatic systems and harm people who depend on fishing for food and commerce.

SUGGESTED SKILL

Environmental Solutions

7.B

Describe potential responses or approaches to environmental problems.



Fisheries & Fishery Collapse

Fisheries: populations of fish used for commercial fishing

Fishery collapse: when overfishing causes 90% population decline in a fishery

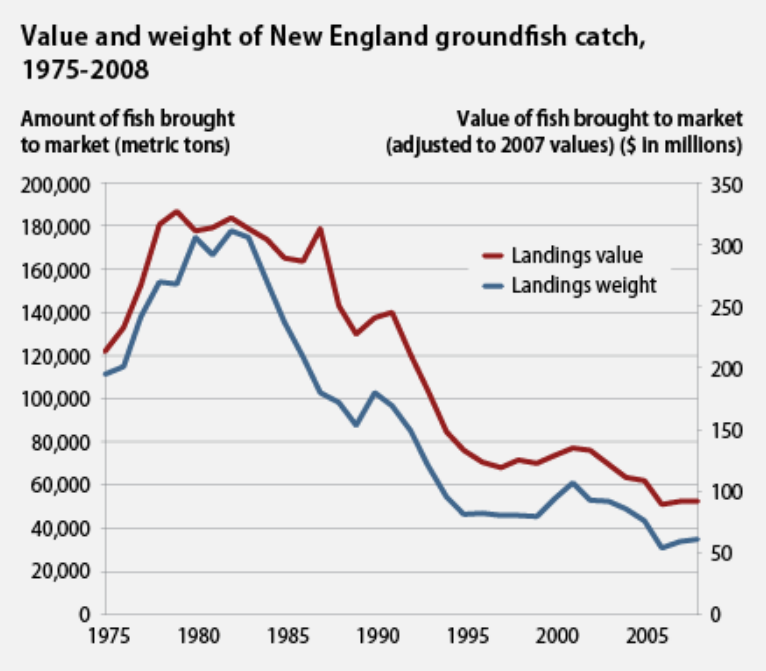
Pop. may never recover from fishery collapse due to: decreased biodiversity, inability to find mates, inbreeding depression

- Decreases genetic biodiversity of fish populations & species biodiversity of ocean ecosystems if species are lost from ecosystem
- **Economic consequences**: lost income for fishermen, lost tourism dollars for communities

Economic Impact

Overfishing in period of 1975 - 1985 leads to sharp loss of profits from 1985 - 2018

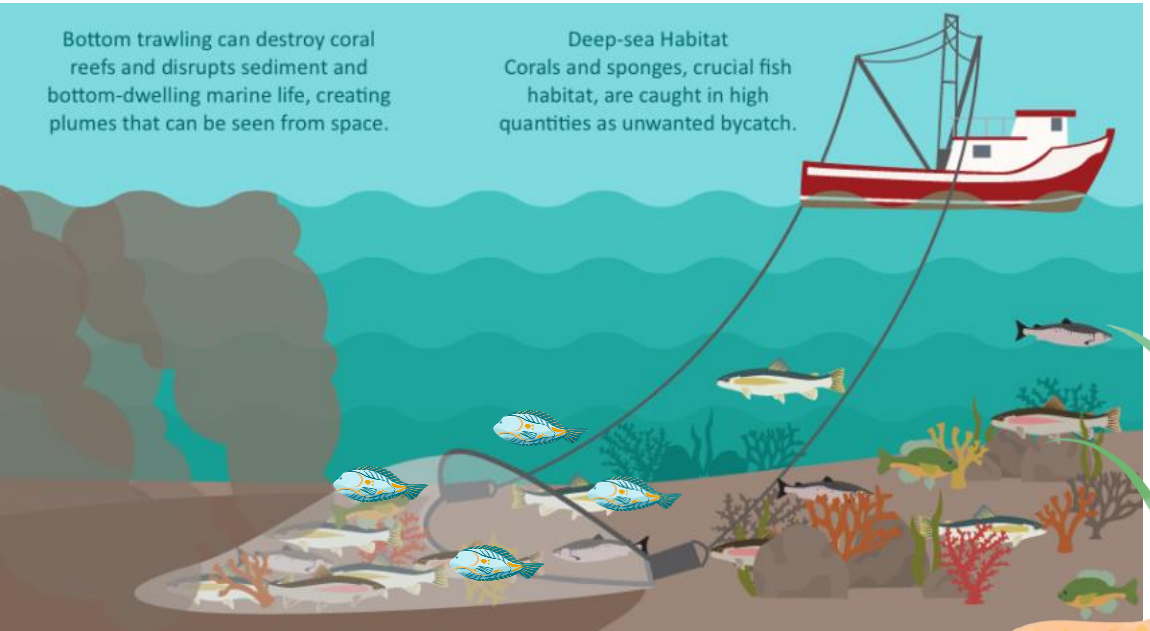
Tragedy of the Commons: no incentive or penalty to prevent overfishing from 75' - 85'



Bottom Trawling

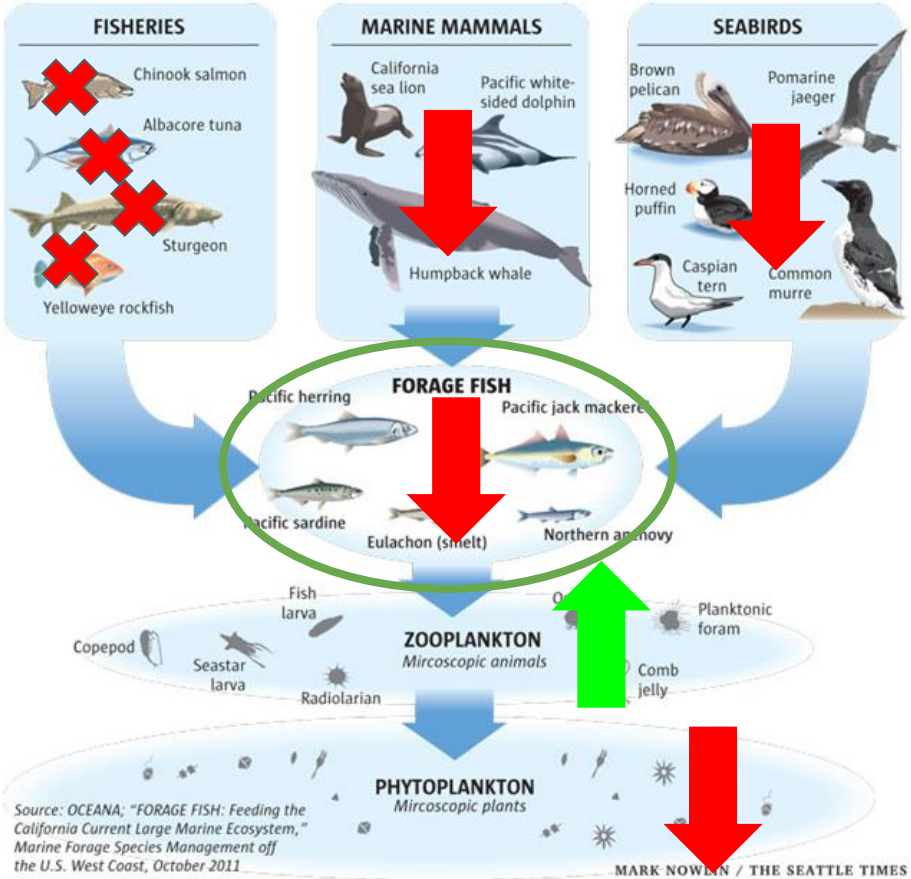
Especially harmful fishing method that involves draggin a large net along ocean floor

- **Bycatch**: unintended species like dolphins, whales, turtles caught in nets
- Stirs up ocean sediment (turbidity) & destroys coral reef structure



- Decreases biodiv. by killing non-target species & removing coral reef habitat

Fishing Down the Food Web & Trophic Cascade



- As we deplete large, predatory fisheries, we move down to smaller fish species
- Depletion of smaller fish pop. limits fishery recovery and decreases food supply of marine mammals & seabirds

Practice FRQ 5.8

Propose a solution to address the issue of fishery depletion.

SUGGESTED SKILL

Environmental Solutions

7.B

Describe potential responses or approaches to environmental problems.

5.9 - Mining

Objectives, EKs, and Skill

LEARNING OBJECTIVE	ESSENTIAL KNOWLEDGE
EIN-2.K Describe natural resource extraction through mining.	**EIN-2.K.1** As the more accessible ores are mined to depletion, mining operations are forced to access lower grade ores. Accessing these ores requires increased use of resources that can cause increased waste and pollution. **EIN-2.K.2** Surface mining is the removal of large portions of soil and rock, called overburden, in order to access the ore underneath. An example is strip mining, which removes the vegetation from an area, making the area more susceptible to erosion.
EIN-2.L Describe ecological and economic impacts of natural resource extraction through mining.	**EIN-2.L.1** Mining wastes include the soil and rocks that are moved to gain access to the ore and the waste, called slag and tailings that remain when the minerals have been removed from the ore. Mining helps to provide low cost energy and material necessary to make products. The mining of coal can destroy habitats, contaminate ground water, and release dust particles and methane. **EIN-2.L.2** As coal reserves get smaller, due to a lack of easily accessible reserves, it becomes necessary to access coal through subsurface mining, which is very expensive.

SUGGESTED SKILL

Environmental Solutions

7.E

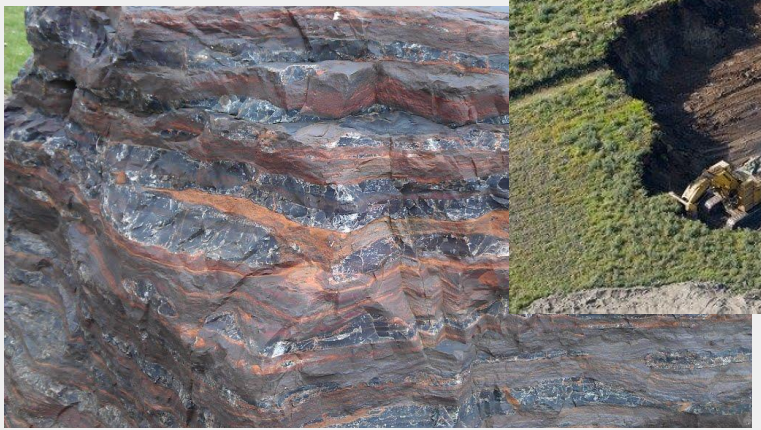
Make a claim that proposes a solution to an environmental problem in an applied context.

Mining Basics

Ore: commercially valuable deposits of concentrated minerals that can be harvested and used as raw materials

Reserve: The known amount of a resource left that can be mined. Usually measured in years left of extraction.

Metals: elements that conduct electricity, heat, and have structural properties for building (found within ores)

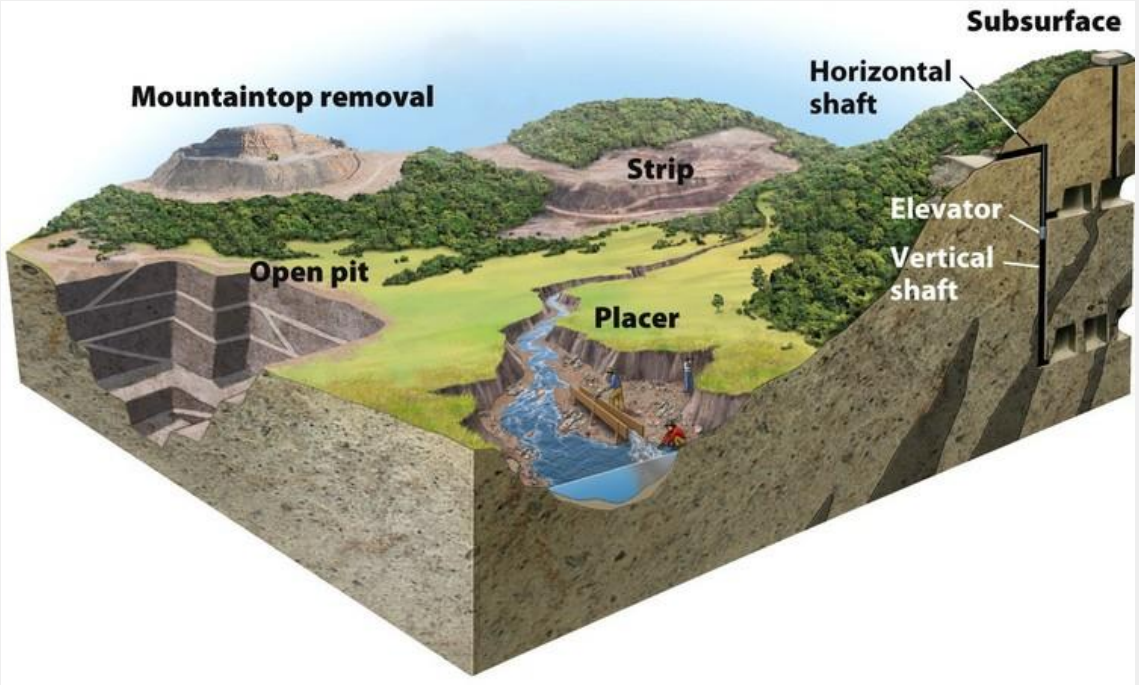


Overburden: Soil, vegetation, & rocks that are removed to get to an ore deposit below

Tailings & slag: leftover waste material separated from the valuable metal or mineral within ore (often stored in ponds @ mine site)

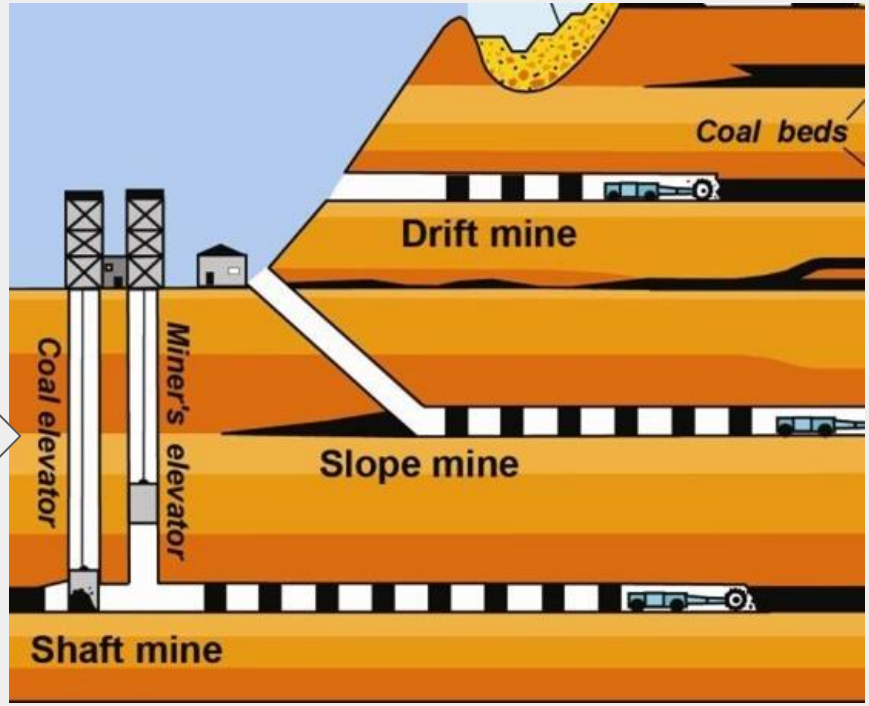
Surface Mining

- Removal of **overburden** to access ore near surface
- Different types: open pit, strip, mountaintop removal, placer
  - Mnt. top removal = esp. damaging to landscape & habitats, streams nearby
- Removal of vegetation & soil
  - Topsoil erosion
  - Habitat loss
  - Increased stream turb.
  - Increase PM in air
- As ore near surface becomes more scarce, mining moves deeper underground to subsurface mining (more dangerous & expensive)



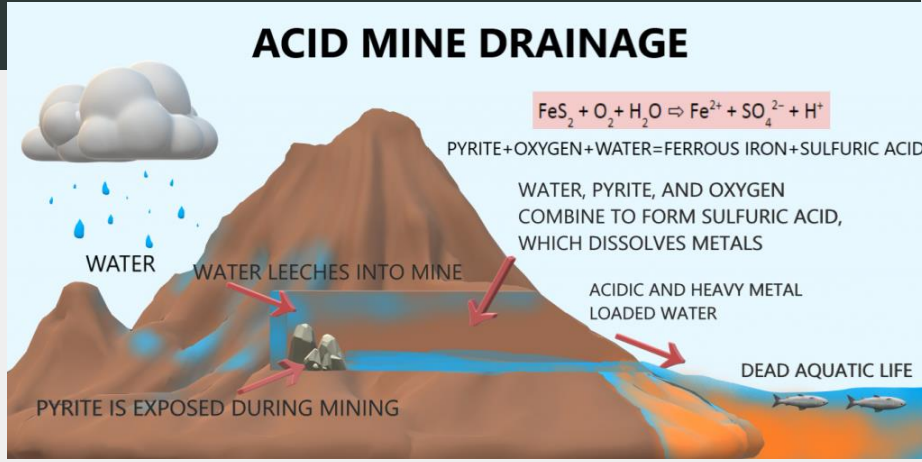
Subsurface Mining

- More expensive due to higher insurance & health care costs for workers
- <u>Risks:</u> poor ventilation leading to toxic gas exposure, mine shaft collapse, injury from falling rock, lung cancer, asbestos, fires, explosions
- Vertical “shaft” drilled down into ground
  - Elevator to carry down workers & transport out resource
  - Often used for coal
- Increasingly used as surface coal deposits are depleted



Environmental Impacts of Mining

Acid mine drainage: rainwater leaks into abandoned mine tunnels & mixes with pyrite, forming sulfuric acid



- Rainwater carrier sulfuric acid into nearby streams, or infiltrates ground water
- Lowers pH of water, making toxic metals like mercury & aluminum more soluble in water sources (killing aquatic org.)

- Methane Release: coal mining releases methane gas (CH_4) from rock around coal
  - Vented out of mine to prevent explosion & continues seeping out after mine closes
  - GHG → climate change

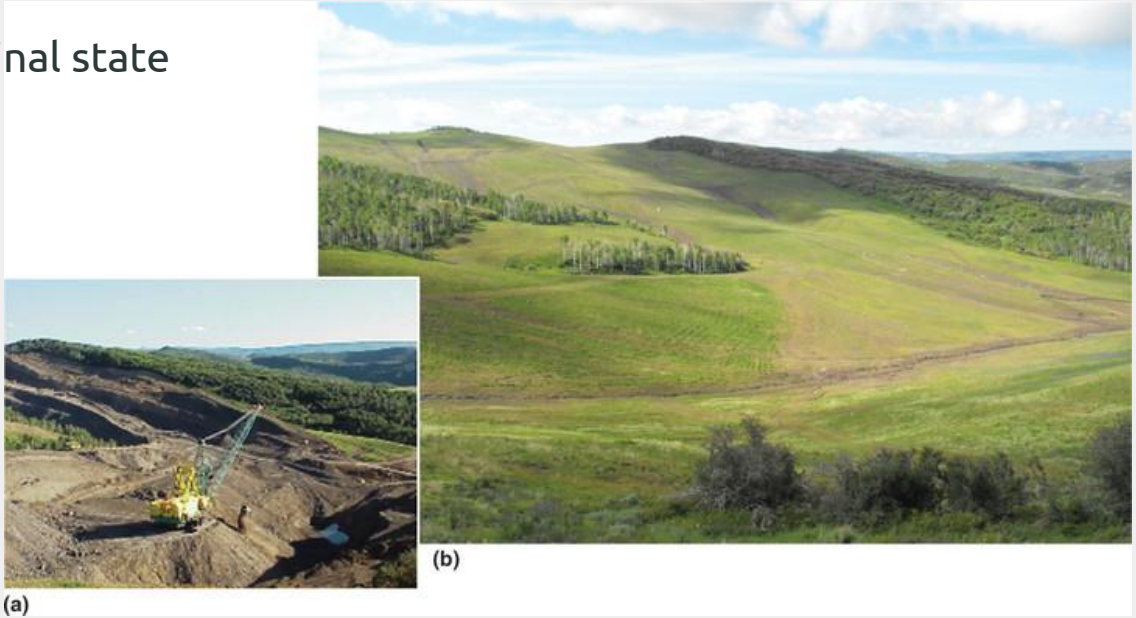
- Topsoil erosion
- Habitat loss
- Increased stream turb.

- PM Release: coal mining especially, releases lots of soot and other particulates that can irritate human & animal lungs

Mine Reclamation

- Process of restoring land to original state after mining has finished
- Includes:

1. Filling of empty mine shafts/hole
2. Restoring original contours of land
3. Returning topsoil, with acids, metals, and tailings removed
4. Replanting of **native** plants to restore community to as close to original state as possible



An abandoned coal mine site has been found to have very high sulfur levels in the tailings and overburden left at the site. **Describe** one environmental impact of the high sulfur content of the overburden and tailings. **Propose a solution** to remedy or reduce this impact.

SUGGESTED SKILL

Environmental Solutions

7.E

Make a claim that proposes a solution to an environmental problem in an applied context.

Practice FRQ 5.9