Save Our Earth

JCC

Workshop #1

Event Rules

Teams will be tested on their knowledge and awareness of the major problems that are causing harm to our environment. Topics included are: extinction of species, future energy shortage and cost, acid rain, greenhouse effect, ozone depletion, air, water and soil pollution, waste treatment and disposal.

A partnership of 2 will work through a test regarding these topics. Today, we will cover species extinction, energy, and the greenhouse effect!

Species Extinction

Key terms

- **Species**
  - A “type” of animal, for example, the domestic dog or the eastern bluebird.
  - Every member of the same species faces the same challenges. For example, they eat the same food, and are eaten by the same predators.
- **Ecosystem**
  - A community of many different species and their habitats across an area.
  - Can you think of an example?
- **Biodiversity**
  - The characteristic of ecosystems have a large amount and variety of different species
  - Why is biodiversity important?

What is extinction?

Can you name an example of an extinct species?
What about an endangered one?

The Conservation Status Scale

- **Least Concern**
  - Can you think of an example?
- **Near Threatened**
- **Vulnerable**
- **Endangered**
  - Can you think of an example?
- **Critically Endangered**
- **Extinct in the Wild**
  - Can you think of an example?
- **Extinct**

Why would a species go extinct?

Human causes of extinction

- Hunting/poaching
- Climate change + global warming
- Pollution
- Introducing **invasive species**
  - **Invasive species:** A species that is not native to an area but is able to outcompete native species, and negatively affect an ecosystem
  - How could they be introduced?
- Habitat destruction
  - Urbanization
  - Agriculture

What happens when a species is removed?

Scenario 1 - Yellowstone Wolves

- Went locally extinct due to hunting and habitat loss
- The elk population skyrocketed - why?
- These elk began **overgrazing** on the trees in the park
- This caused many birds to lose their habitats
- Can you think of any other cascading effects? Draw out a food web!

Key Terms

- The yellowstone wolves were a **keystone species**
  - This means that their removal had extremely potent effects on the rest of the ecosystem
  - Can you think of other keystone species?

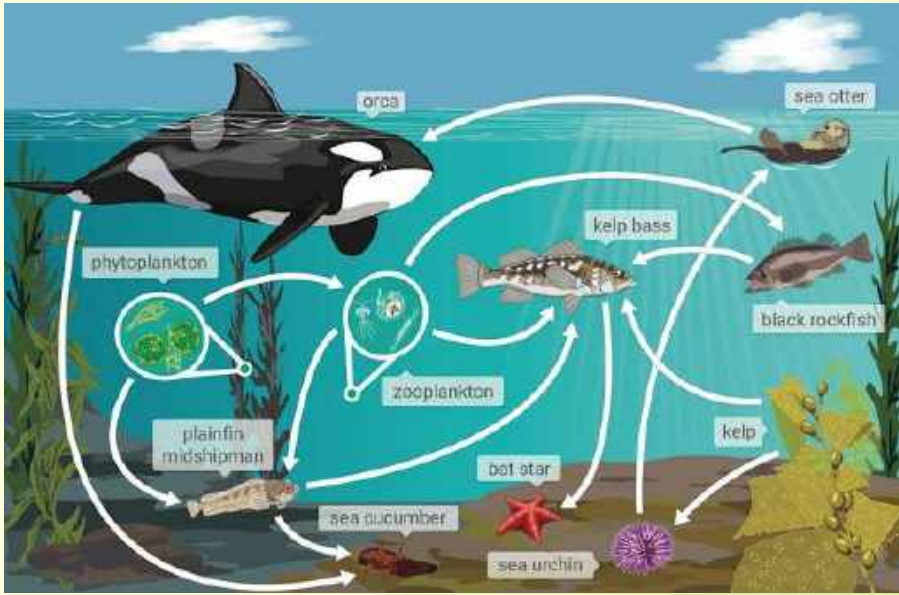
- Their removal caused a **trophic cascade**
  - There was a butterfly effect that spread throughout the entire ecosystem/**food web**
  - Ultimately, every species in the ecosystem became worse off

Scenario 2 - Sea Otters

- Went nearly extinct
  - Poaching for fur
  - Pollution/oil spills
  - Orca populations that hunt them moving north (why?)
    - What kind of species does this make the orcas?
- Take a look at the food web to the right >
- What effect would the loss of the otters have on other species' in the ecosystem?

- Take a look at the sea urchins
- How would their population change if the otter population decreased?
- How would that affect the kelp?
  - How would this affect the ecosystem?

- What kind of species is the otter?



Kelp forests -> Urchin barrens

Scenario 3 - Wild Bees

- The population of many species of native wild bee are declining
  - Habitat loss
  - Pesticide usage
  - Climate change

- Bees are important **pollinators**

- How would their decline impact plant populations?
  - Relate to **biodiversity**
- How can this affect us humans?

- Can you think of another issue that the loss of bees would cause?

The Widespread Effects of Extinction

- Biodiverse ecosystems provide many important **services**
  - Water purification
  - Air purification
  - Pollination
    - Food security through crops
  - Disease control
  - Cultural significance

- The collapse of these delicate communities will have a catastrophic effect on not only the environment, but human society

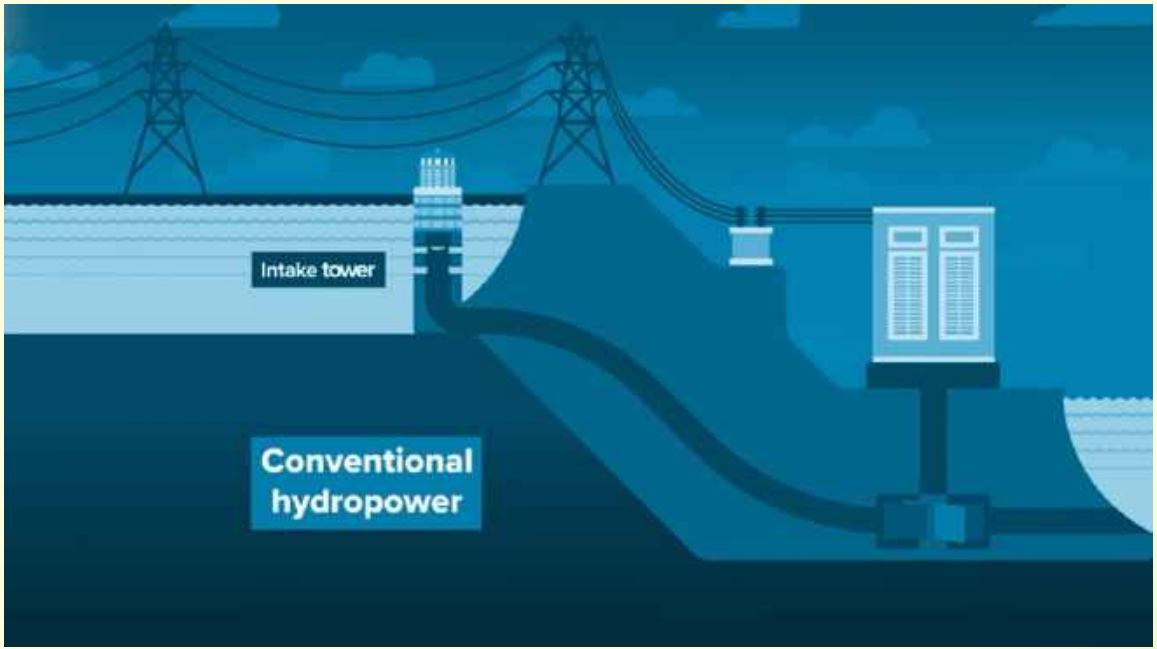
- Even if it didn't affect us, we have an obligation to **protect our planet**

Energy Production

Hydroelectric

- Most common source of renewable energy worldwide

📍What's the largest dam in the world?



Can you name any other large dams?

Environmental Impacts

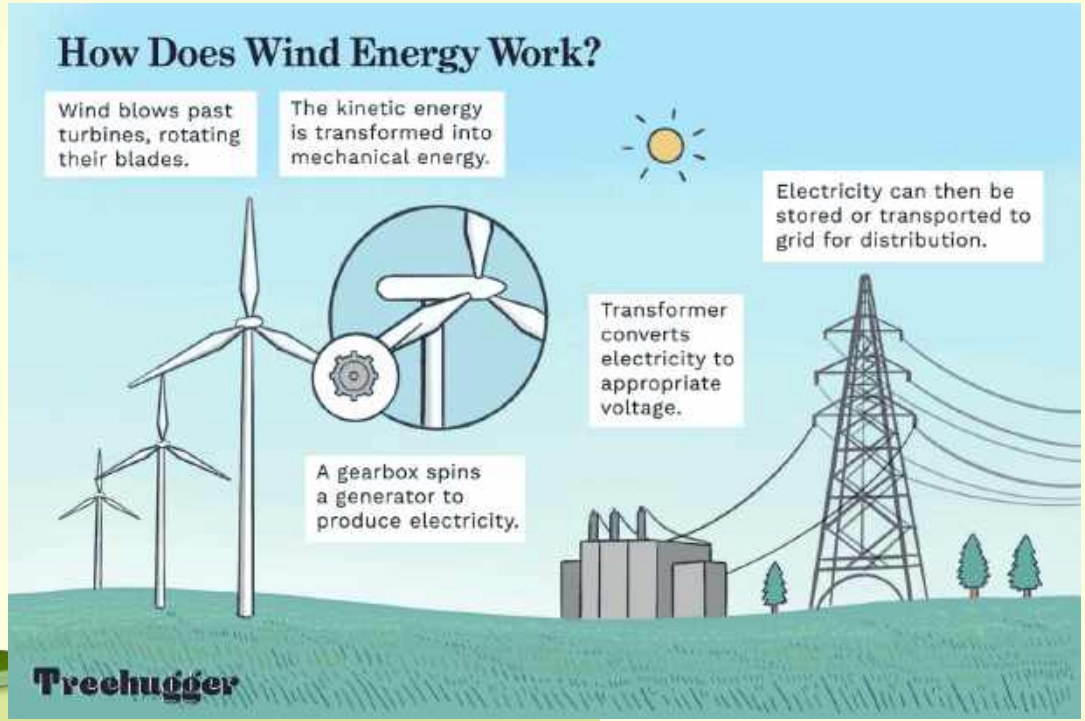
Habitat destruction

Alters migration patterns

Reduces river flow

Wind

- Most common renewable energy source in the US
  - Fun Fact: the world's largest wind farm is the Gansu Wind Farm in China



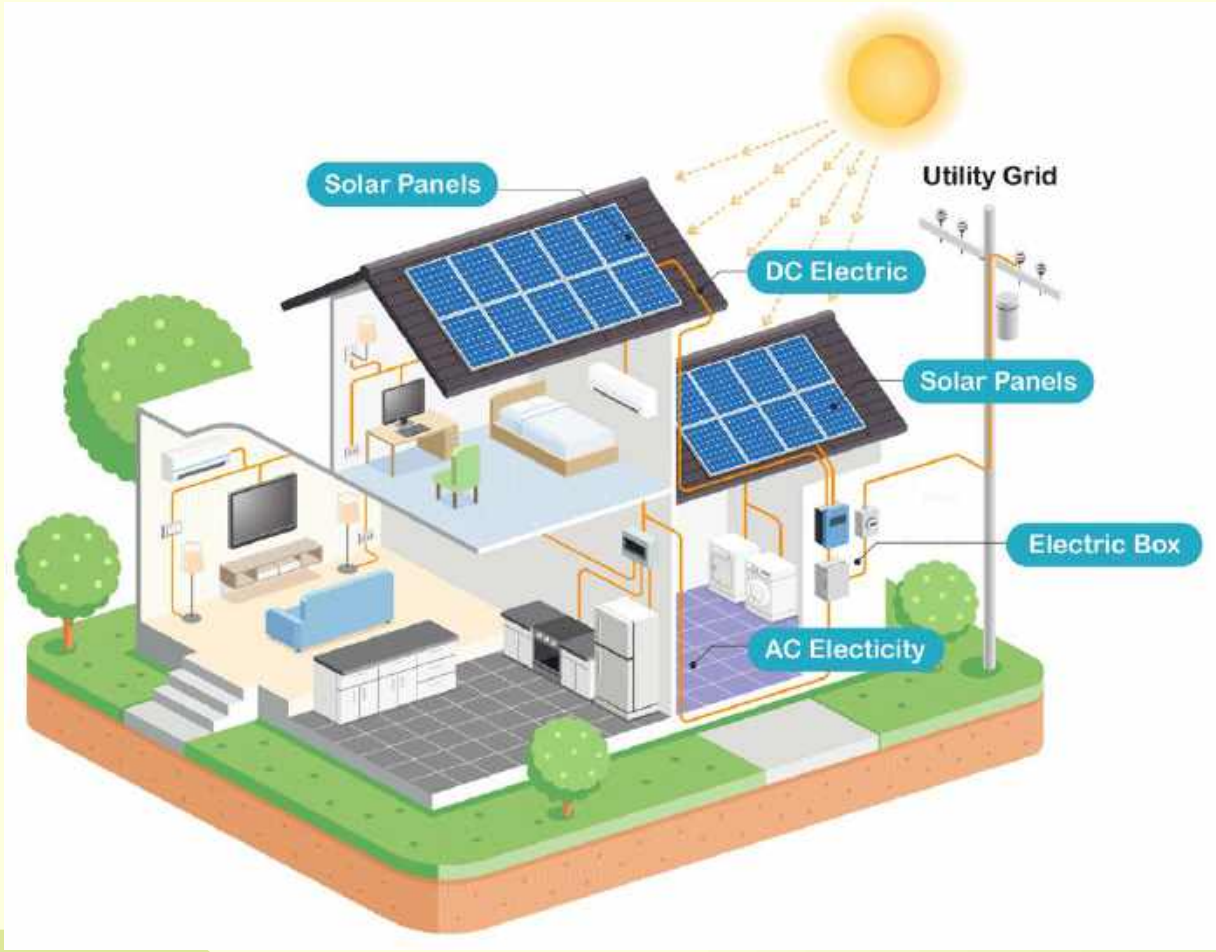
Environmental Impacts

Habitat destruction

Hinders bird flight

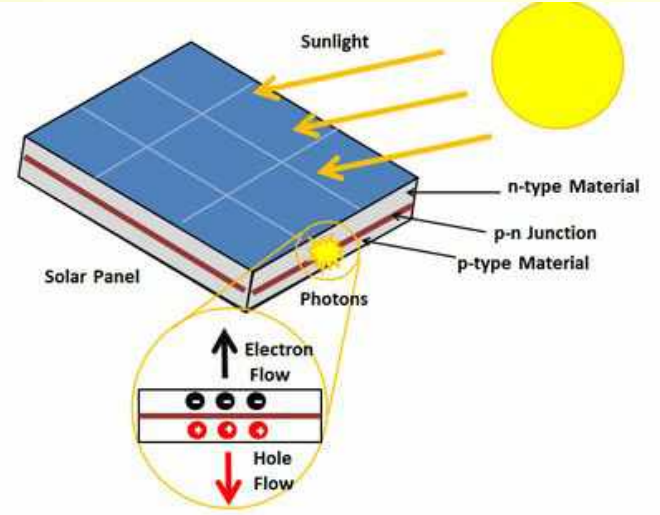
Noise pollution

Solar


Solar Panels
Utility Grid
DC Electric
Solar Panels
Electric Box
AC Electicity

Key Components

Photovoltaic Cell



Inverter

Environmental Impact

Why Don't We Cover the Desert with Solar Panels?

Key Points:

- Conventional solar cells have an efficiency of about **23%**
- Heat that isn't converted to energy or reflected is absorbed, raising temperatures
- Possible alternative: concentrated solar energy
- Manufacturing solar panels often harms the environment

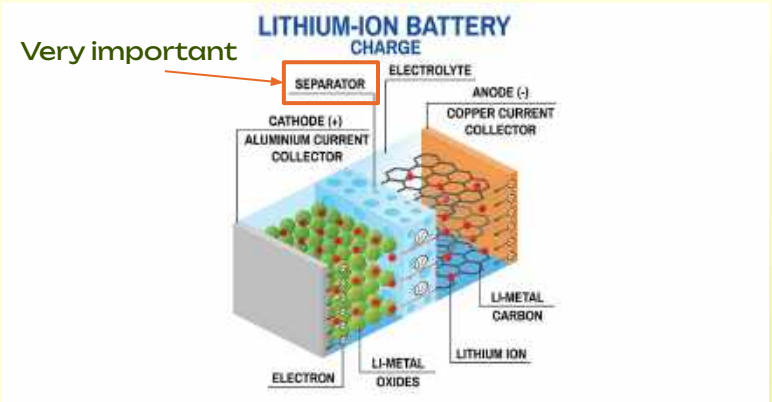
Energy Storage

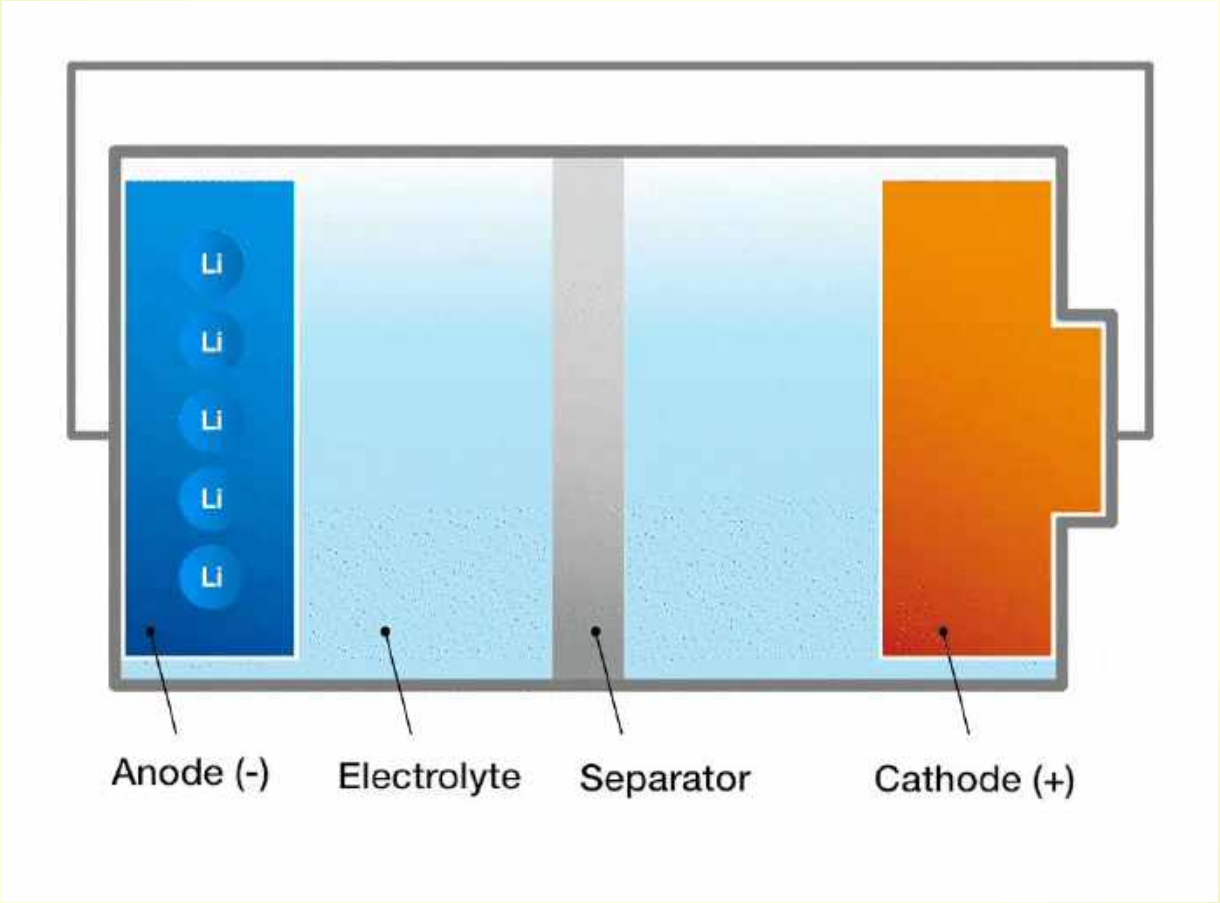
Why do we need to store energy?

Lithium Ion Batteries

- Found in small electronics (phones, laptops, watches, etc.)
- Powered by redox reactions between LiCoO2 and graphite!

Pros	Cons
• Lightweight • High energy density	• Short lifespan • Lithium is very reactive



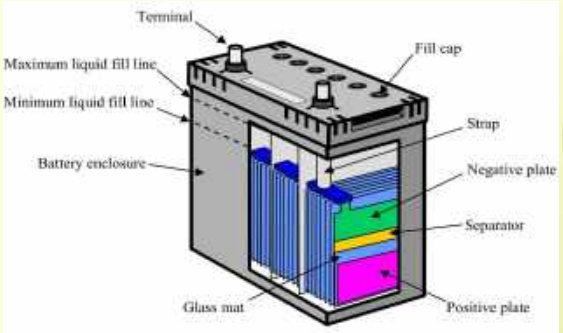


Li – ion battery exploding

Lead Acid Batteries

- Used in vehicles
- Powered by redox reactions between lead and lead(IV) oxide in sulfuric acid

Pros	Cons
• Low cost • High energy density	• Toxic acid • Lead exposure

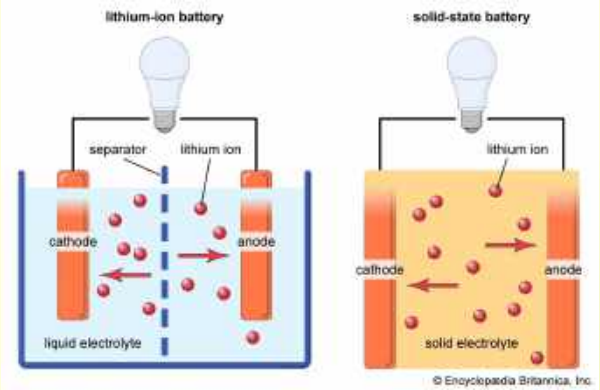


Emerging Technologies

Solid State Batteries

- They use solids as electrolytes (like metallic lithium, ceramics, & solid polymers)
- They're being implemented in EVs

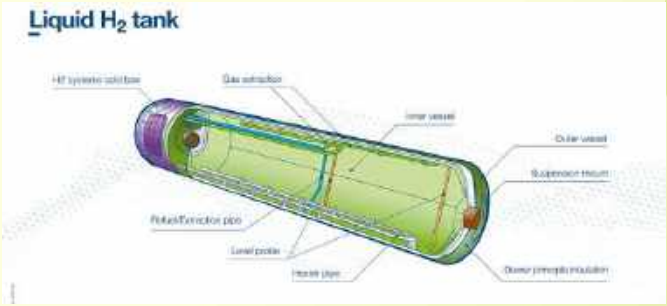
Pros	Cons
• Can charge fast • VERY High energy density	• Expensive • Sensitive to temperature extremes



Hydrogen Storage

- Hydrogen Gas: stored in geologic formations like caves, depleted oil/natural gas fields, and aquifers
- Liquid Hydrogen: cooled to a liquid and transported in supercooled tanks (NASA uses these for its rockets!)
    - Take a guess, how cold is liquid hydrogen?

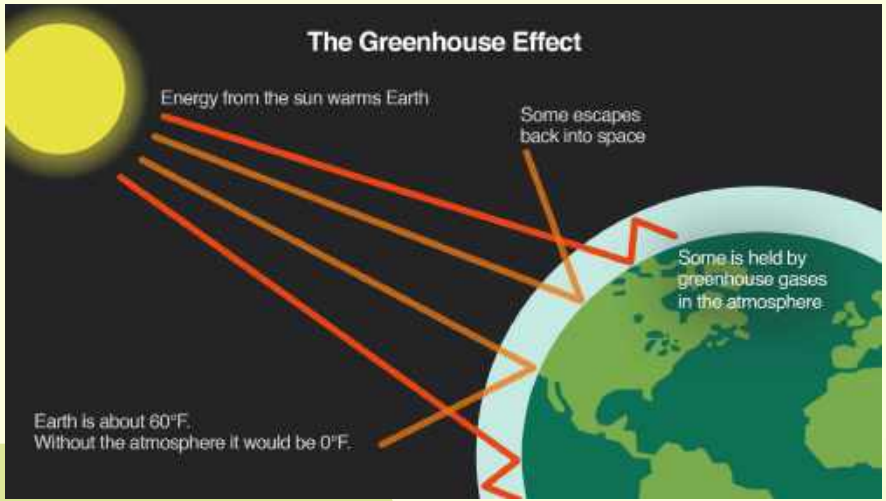
Pros	Cons
• Renewable • High energy output	• Expensive • Cooling process is energy intensive



What would happen if the Earth was as cold as space?

Greenhouse Effect

- The greenhouse effect is when **greenhouse gases** trap heat near the Earth's surface. This keeps the Earth warm!
  - Why can this be both a good and bad thing?
  - Can you think of some examples of greenhouse gases?



Greenhouse Effect Steps

1. Sunlight reaches the Earth.

2. Some energy is reflected back into space.

3. Some energy is absorbed and radiated as heat.

4. Most of the heat is absorbed by the greenhouse gases and radiated in all directions, making the Earth warm.
    a. Greenhouse gases consist of carbon dioxide, methane, ozone, nitrous oxide, chlorofluorocarbons, and water vapor.

What gases contribute the most to the greenhouse effect?

Order the gases from greatest amount to least amount! Put a number in each box. 1 is the greatest and 5 is the least.
The ranking depends on how good the gas is at trapping heat, and how much of it is in the atmosphere

	nitrous oxide (N_2O)
	water vapor (H_2O)
	ozone (O_3)
	carbon dioxide (CO_2)
	methane (CH_4)

What is a fossil fuel?

Can you name some sources?

Global Warming

What elements do fossil fuels release into the atmosphere?

Global Warming

- Fossil fuels release large amounts of **carbon dioxide** , which is very good at trapping heat.
  - They are also **nonrenewable –** why is this important?

- The high numbers of carbon dioxide in the atmosphere are trapping in lots of heat, which increases the Earth's temperature. This is global warming!

- For the last 40 years, we've seen the global annual temperature rise by 0.2° Celsius (0.36° Fahrenheit) per decade. This might not seem like a lot, but the Earth is billions of years old!

Global Warming

- Global warming happens because excessive greenhouse gases trap too much heat in the atmosphere. The natural greenhouse effect is important to keep the Earth warm, but too much of it is not good, either.

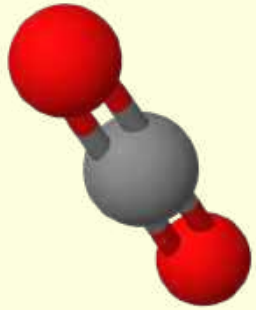
- Think back to when we ordered the gases – methane and nitrous oxide were towards the bottom of the list. Methane and nitrous oxide are very good at trapping heat, so they are high causes of global warming.

Global Warming: Gases

- Carbon dioxide
- Methane
- Nitrous oxide
- Fluorinated greenhouse gases

*All these gases are covered by the Kyoto Protocol and the Paris Agreement, which are working to reduce climate change.

Carbon Dioxide (CO_2)



- Naturally produced by animals through decay and respiration (breathing)
  - We breathe out carbon dioxide
- Also produced through fossil fuels and other chemical reactions
- Plants absorb carbon dioxide to use in photosynthesis, which can help combat global warming
- Represents a majority of greenhouse gas emissions

Methane (CH_4)

- A main component of natural gases
- Results from the production and transport of coal and oil
- Released from landfill decay of organic waste
- Comes from animals (cows!)
- Its leaks can promote dangerous explosions

Nitrous Oxide (N_2O)

- Produced from microbial action (actions carried out by little organisms) in soil
- Released from fertilizers containing nitrogen, the burning of timber, and chemical production
- Emitted in the combustion (burning) of fossil fuels and chemical waste

Fluorinated Greenhouse Gases

- Man-made gases used in industry
- They are several times stronger than carbon dioxide in global warming.
- Examples: Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6), and Nitrogen trifluoride (NF_3)
- Often used as substitutes for ozone-depleting substances (we will learn about this later!)
- They don't account for as much of greenhouse gases, but they trap much more heat so they are more harmful.

Fluorinated Greenhouse Gases

- Used as coolants (in refrigerators, for example) because they were so good at holding heat. This also means that they are the most powerful greenhouse gases.

- **Hydrofluorocarbons (HFCs)** = compounds that contain hydrogen, fluorine, and chlorine
  - They represent about 90% of fluorinated gas emissions.

- **Perfluorocarbons (PFCs)** = compounds that contain fluorine and carbon
  - Commonly used in industrial manufacturing

Fluorinated Greenhouse Gases

- **Sulfur hexafluoride (SF_6)**
  - Commonly used in the installation of power lines

- **Nitrogen trifluoride (NF_3)**
  - Used as a chamber-cleaning gas in production processes → cleans up unwanted buildup on circuit parts as they are being constructed

The GWP scale

The Global Warming Potential scale is a measure of how much energy the emission of 1 ton of a gas will absorb over a given period of time, relative to the emission of 1 ton of carbon dioxide (CO2)

GHG	GWP for 100 years
CO_2	1
CH_4	23
N_2O	296
HFC - 23	12 000
HFC – 134a	1 300
SF_6	22 200

Source: *IPCC Third Assessment Report* (2001).

What is ozone?

What is ozone?

- **Ozone (O_3)** is both a natural and a man-made product that is in the Earth's upper atmosphere (stratosphere) and the lower atmosphere (troposphere).

- The **ozone layer** reduces the amount of harmful radiation that reaches Earth.
  - It keeps the good heat in, which keeps us warm, and the bad radiation out, which keeps us safe.

Ozone Depletion

- **Ozone depletion** is the reduction of ozone in the ozone layer.

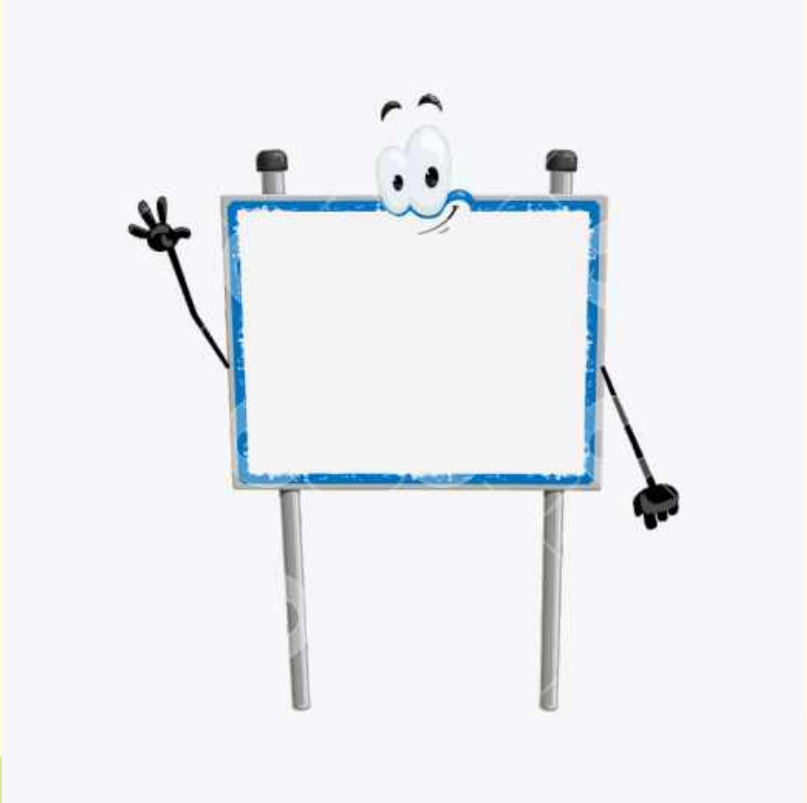
- **Ozone-depleting substances** = human-made chemicals reach the upper atmosphere and destroy the ozone layer
  - They often contain bromine and fluorine.

- Since the 1970s, a large decrease of ozone in the stratosphere has been observed in the springtime in polar regions. This is known as the **ozone hole** .

Ozone-Depleting Substances

- Chlorofluorocarbons (CFCs)
  - CFCs were the cause behind the ozone hole
    - Gaseous CFCs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by strong ultraviolet radiation, release chlorine atoms, and then react with ozone molecules.
  - They are found in many household items
    - Hairspray
    - Refrigerators
    - Foam

Whiteboard Time!!!



A population of bears in a forest starts to decline due to hunting. Write down one way this would affect any part of the forest ecosystem.

The Asian Carp is an invasive fish found in the Mississippi River. How would it affect biodiversity?

(+1 for effect, +1 for explanation)

What is one negative effect of losing biodiversity in an ecosystem?

Write down one example of a keystone species, then define the term.

CHALLENGE: What is the difference between reintroduction and relocation? Provide an example of each

Write down one way pollination is important to either the environment or to humans

Between a temperate deciduous and tropical rainforest, which ecosystem is more diverse and why?

What is renewable energy? List 3 examples

(Bonus point if it wasn't in this presentation!)

Which source of renewable energy is most common worldwide?

Describe a specific example of an animal that's harmed by dams

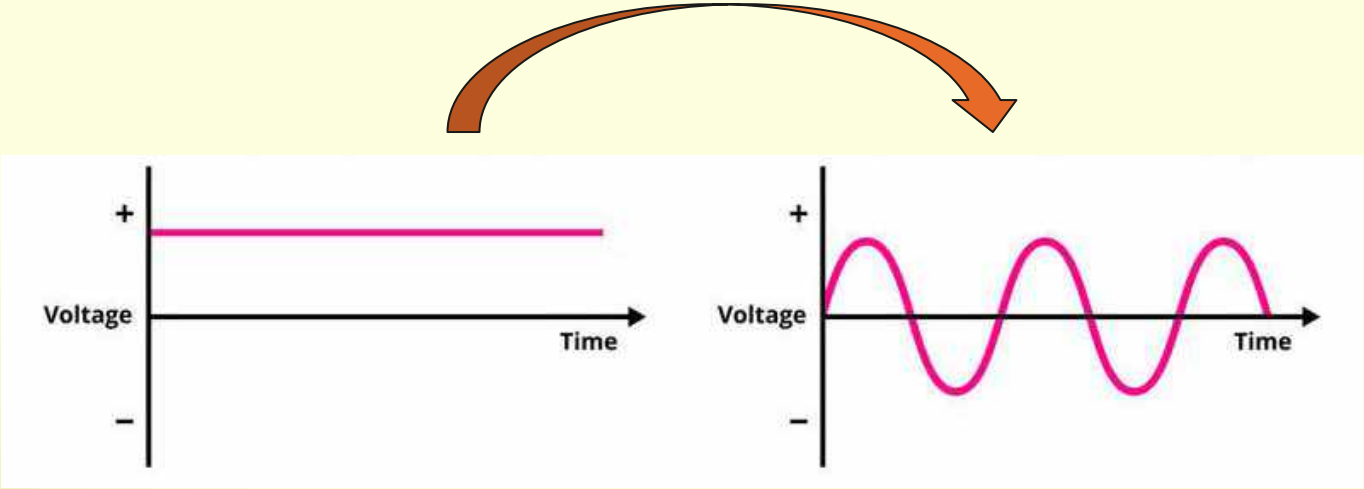
Wind turbines convert _____ energy to _____ energy

List 3 cons of wind energy

(Bonus point if it wasn't in this presentation!)

Solar panels are made of _____ cells.

What component of solar panels achieves the following change?



What is concentrated solar energy? Name a facility that produces this

How efficient are conventional solar panels?

List 2 types of batteries used to store energy

Ann Zhao is desperate for some warmth in life, so she leaves her laptop by the window in full sunlight. After a few hours, it explodes. What caused this?

(+1 for component, +1 for phenomenon)

CHALLENGE: name a specific chemical that solid state batteries made of

Describe 2 ways that hydrogen can be stored, and list a con for each

Why is ozone important? What can cause it to disappear?

CHALLENGE: what layer of the atmosphere is the ozone layer in?

Name three examples of greenhouse gases.

Videos

POLLUTION:
https://www.youtube.com/watch?v=kdDSRRCKMiI

ECOLOGY:
https://www.youtube.com/watch?v=5eTCZ9L834s