2021

CIRO EXTRA ACTIVITIES

Co-funded by the
Erasmus+ Programme
of the European Union
ERASMUS+ Programme 2018 – KA2 School Education
Project nº: 2018-1-ES01-KA201-050618

CONTENIDO

ACTIVITY 1. Climate Change

Fill in the form by answering the following questions about climate change:	
1. What are the causes of climate change?	
2. What consequences are can produce?	
3. How does the climate change affect you in your daily life?	
4. Do you think that all people of the world will suffer the same consequences of climate change? Why?	
5. Where does the climate change occur? Why?	
6. When does the climate change?	
7. What are the main solutions to the problem?	
8. Who do you think they have what to act to fight against climate change? Why?	
9. What other problems environmental are related with climate change?	
10. Can you do something to not contribute to climate change?	
11. Where have you heard on climate change during last month (in class, on TV, at the radio, on the Internet, in the press, a book, watching a documentary, etc.)**?**	
12. Do you have any questions or is there something that you do not understand in relation to climate change?	

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ACTIVITY 2. Test in Climate Change

1. **What is the greenhouse effect?**
   - ☐ Certain gases in the atmosphere trap heat and warm the Earth
   - ☐ Life on Earth 'exhales' gas that warms up the atmosphere
   - ☐ The tilt of the Earth changes the amount of solar energy the Earth receives
   - ☐ The Sun is putting out more radiant energy over time

2. **If the greenhouse effect is natural, then why is today's climate change a bad thing?**
   - ☐ A small increase in greenhouse gas concentration can have a large effect of increased warming.
   - ☐ Humans have altered a natural process and exaggerated changes that might normally occur over millions of years.
   - ☐ Once released into the atmosphere, greenhouse gases remain potent for many years, making it difficult to reverse the process.
   - ☐ Abrupt changes to the climate system may have unintended outcomes that may pose challenges for societies, like more extreme weather, spread of diseases, a decline in marine life, or an alteration of ocean circulation patterns.
   - ☐ All of the above

3. **Which activities are the largest contributors of greenhouse gases?**
   - ☐ Deforestation
   - ☐ Electricity generation
   - ☐ Industry
   - ☐ Transportation
   - ☐ Landfills
   - ☐ Agriculture

4. **How much has CO2 in the atmosphere increased since the Industrial Revolution? In the 10,000 years before the Industrial Revolution in 1751, carbon dioxide levels rose less than 1 percent. Since then, they've risen by:**
   - ☐ 11%
   - ☐ 43%
   - ☐ 62%

5. **How has the global average temperature changed since the Industrial Revolution?**
   - ☐ The temperature has gone up and down, but remains overall the same
   - ☐ Warmer by 0.1 degree C (0.2 degree F)
   - ☐ Warmer by more than 1 degree C (2.07 degrees F)
   - ☐ Warmer by almost 2 degrees C (3.6 degrees F)

6. **How does the rate of today's warming compare to previous episodes of rapid climate change on Earth?**

☐ Today's climate warming is about as fast as the temperature swings that have happened in Earth's past.

☐ Past changes in the climate have been faster than the changes we're seeing today.

☐ Today, the Earth's climate is changing much faster than it has changed in the past.

7. **Variations in Earth's orbit, solar output, and other factors cause changes in the climate. If we removed the human impacts of greenhouse gas emissions, what might the climate be doing today, on its own?**

☐ Slight warming

☐ Strong warming

☐ No change

☐ Slight cooling

☐ Strong cooling

8. **When was the last time in Earth's history that CO2 was as high as it is now?**

☐ This is the highest it's ever been

☐ CO2 was at least this high during the warm periods between the ice ages

☐ CO2 has not been this high for almost one million years.

☐ The last time CO2 was this high was 3 million years ago.

9. **Modern instruments have only been around for a little over 100 years. So how do we know what greenhouse gas concentrations (and temperature) were in Earth's past? (select all that apply)**

☐ Air bubbles trapped in ice cores provide detailed records of what the atmosphere was like in the past.

☐ Examining organisms in marine sediments can tell us what the temperature was like in the past.

☐ Pollen in lake beds shows what plant species have lived there during different times. Different plant populations are associated with different types of climates.

☐ Glacial moraines show when and where previous episodes of glaciation occurred.

☐ Tree rings show the history of drought, fire, and other environmental variations.

10. **What proportion of climate scientists has concluded that humans are the primary driver of today's climate warming?**

☐ 34%

☐ 59%

☐ 76%

☐ 97%

Answers with explanation

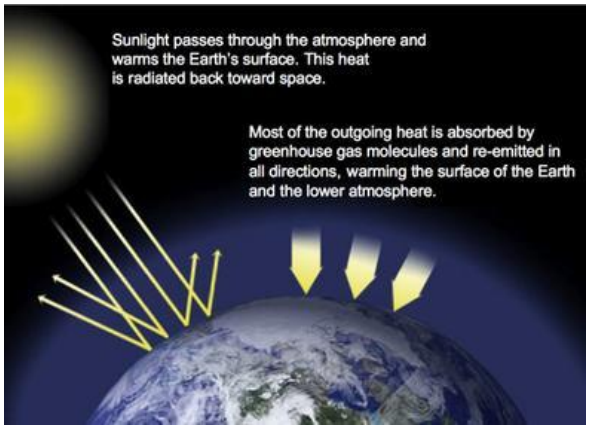
1. Answer - Certain gases in the atmosphere trap heat and warm the Earth

The greenhouse effect is a natural phenomenon. Certain gases in the atmosphere have the ability to absorb radiation that would otherwise escape into space. The greenhouse effect is somewhat like a blanket that retains your body heat and keeps you warm.

Gases that trap heat are called greenhouse gases and they include water vapor, carbon dioxide, methane, and nitrogen oxides. These gases can have potent effects even in small quantities. Without this natural greenhouse effect, the Earth's average temperature would be below freezing!

Note that answer c, 'The tilt of the Earth changes the amount of solar energy the Earth receives,' is also true, but is not related to the greenhouse effect. Variations in the tilt and orbit of Earth do affect how much solar radiation reaches the Earth, and this is one of many natural variations in our climate system.

Note also that answer b, 'Life exhales gas that warms up the atmosphere,' is partly true. Some life forms, like humans and mammals exhale CO2, but this CO2 only recently came out of the atmosphere. Plants use up CO2 to make carbohydrates/sugar/which? animals eat the plants and return the CO2 to the atmosphere. This is an example of a short-term process within the carbon cycle, and it balances out from year to year. By contrast burning fossil fuels rapidly releases carbon that has been stored in Earth's crust for millions of years.



2. Answer – All of the above

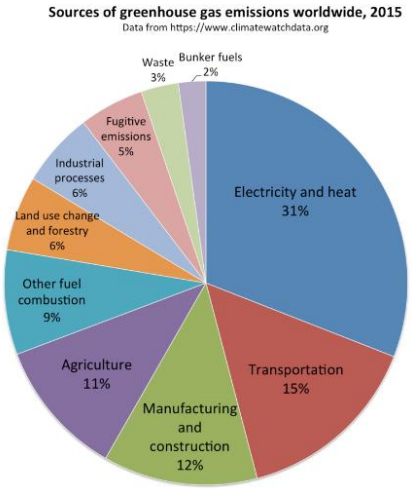
While the greenhouse effect is natural and in fact, helps maintain a climate suitable for life as we know it, humans have altered a natural process.

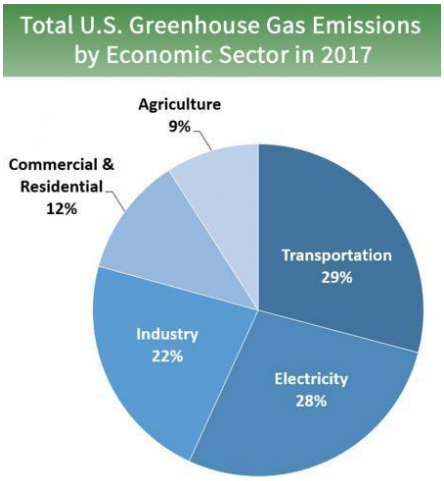
A small change in the amount of greenhouse gases in the atmosphere has a large and long-lasting effect. Furthermore, humans have changed the composition of the atmosphere over a short time span, and the resulting warming us many times faster than natural changes.

We are already seeing consequences like heat waves, melting sea ice, rising sea level, increased wildfires, and increases in extreme weather.

3. Answer – Electricity generation / Transportation

Although all activities on the list cause greenhouse gas emissions, transportation and electricity generation are the biggest causes. In the USA, greenhouse gas emissions from electricity are falling as coal burning is slowly declining. Thus, the proportion of emissions from transportation has grown. These two sectors each account for 28% of total USA emissions in 2017, according to EPA data. Worldwide, the breakdown is similar, although it's hard to make an exact comparison because some uses are categorized differently.

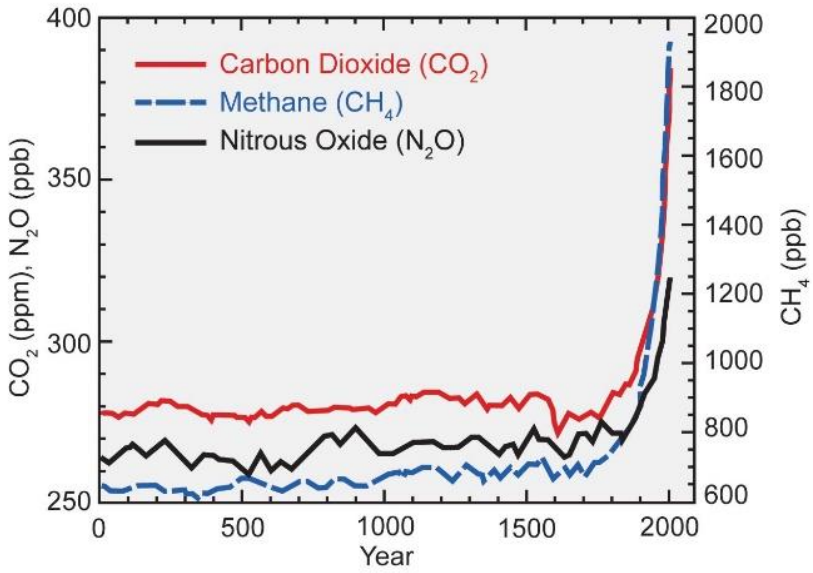




4. Answer – CO2 in the atmosphere has risen 43% since 1751

From 1751-2014, humans added 1,480 billion tons of carbon to the atmosphere in the form of carbon dioxide. Eighty-five percent of all human-produced carbon dioxide comes from burning coal, natural gas, oil and gasoline.

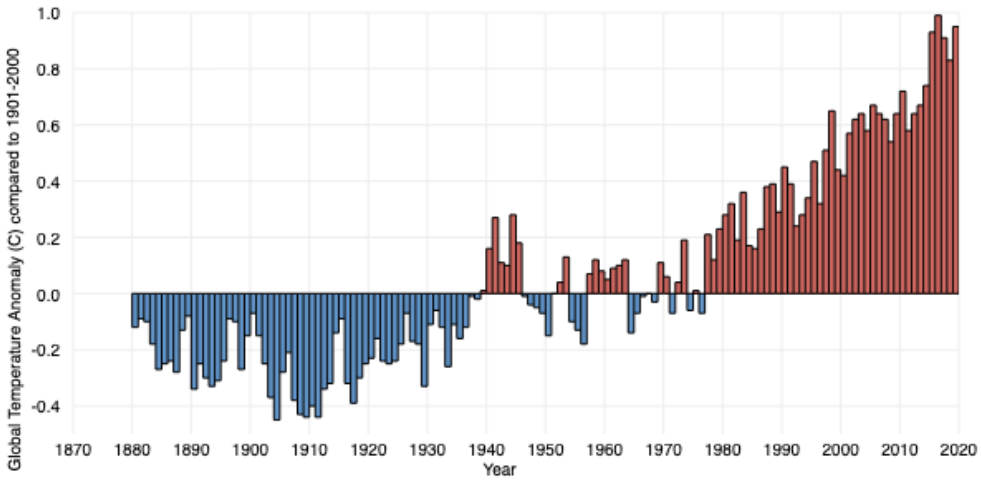
When today's CO2 trend is viewed in the context of 400,000 years of climate data, the result is even more stark. Humans have profoundly changed the composition of Earth's atmosphere, and along with that, the energy balance of the planet.



5. Answer – Warmer by more than 1 degree C (2.07 degrees F)

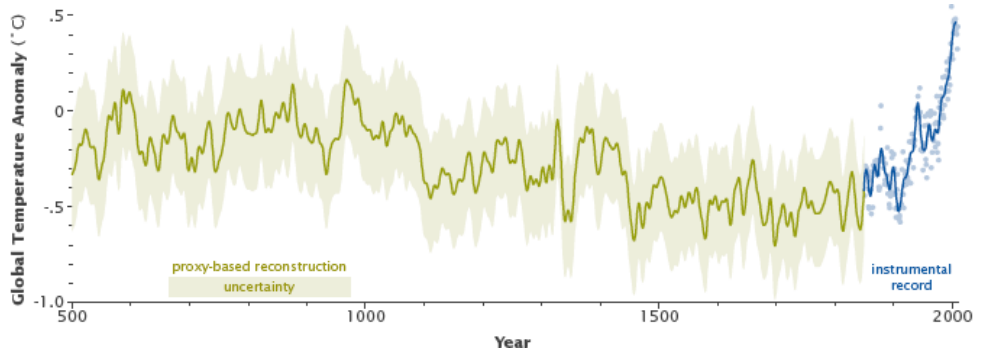
As of early 2020, the Earth's average temperature (considering both land and water) has risen 1.15 degrees Celsius over the pre-industrial average (1880-1900). Furthermore, the rate of temperature change is increasing: "The global annual temperature has increased at an average rate of 0.07°C (0.13°F) per decade since 1880 and over twice that rate (+0.18°C / +0.32°F) since 1981." (Quote from the NOAA page linked below).

NOAA's page about global temperature provides a summary of changing temperatures; this page is updated regularly.



6. Answer – Today, the Earth's climate is changing much faster than it has changed in the past.

We know that the Earth's temperature made big swings as we moved in and out of ice ages. And as rapid as those changes were, today we are warming the climate 10 times faster.



"As the Earth moved out of ice ages over the past million years, the global temperature rose a total of 4 to 7 degrees Celsius over about 5,000 years. In the past century alone, the temperature has climbed 0.7 degrees Celsius, roughly ten times faster than the average rate of ice-age-recovery warming." "Models predict that Earth will warm between 2 and 6 degrees Celsius in the next century. When global warming has happened at various times in the past two million years, it has taken the planet about 5,000 years to warm 5 degrees. The predicted rate of warming for the next century is at least 20 times faster. This rate of change is extremely unusual." (From How is Today's Warming Different from the Past?).

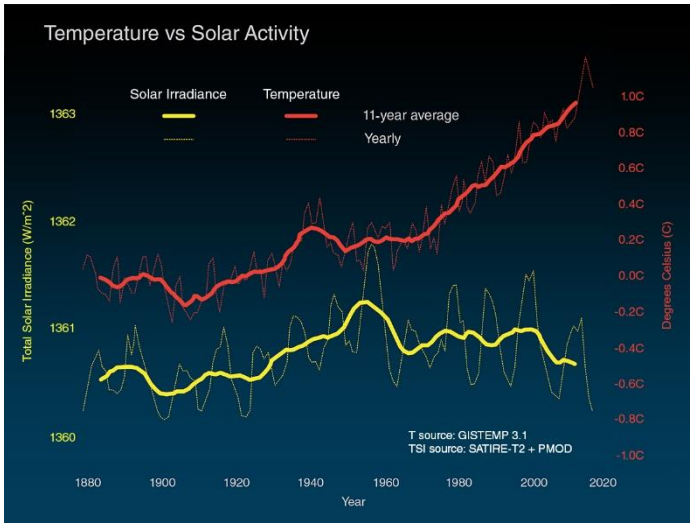
It's even more interesting to note past spikes in temperature in the paleoclimate record (such as the Paleocene-Eocene Thermal Maximum ~55 million years ago) have been associated with

other extreme changes such as rapid ocean acidification which was detrimental to marine life on Earth.

Also, the Permian Mass Extinction was thought to have been initiated by rapid ocean warming leading to reduction in circulation, oceans going anoxic and emission of poisonous hydrogen sulfide into the atmosphere. Earth's geologic history gives us plenty of evidence that rapid swings in climate cause difficult conditions for life.

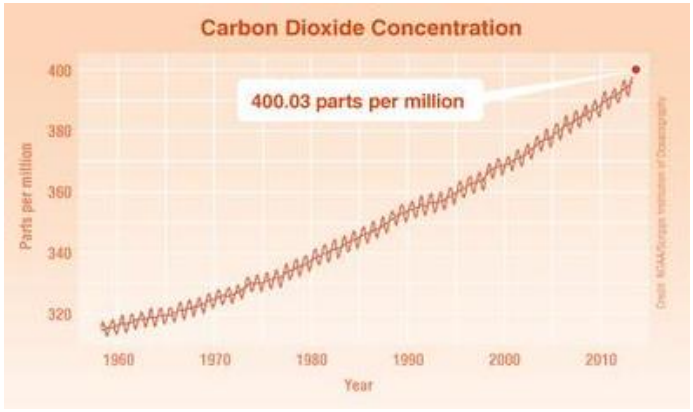
7. Answer – Slight cooling

Left to its own devices, the Earth would be in a minor cooling phase today. But human emissions of greenhouse gases have over-ridden natural effects and tipped the balance toward rapid warming.



8. Answer – The last time CO2 was this high was 3 million years ago.

As of 2020, the atmosphere contained 409 to 416 parts per million of carbon dioxide. This number goes out of date quickly, as CO2 levels continue to rise; check the latest data from Scripps. Throughout all the cool-downs and warm-ups of the last ice ages, CO2 never topped 300 ppm. So, we're way above anything that happened during the ice ages. To look for the last time Earth's atmosphere had more than 400 ppm of CO2 we must go farther back. Way farther back, to the Pliocene, 3 to 5 million years ago. How was the climate back then? The temperature was 2 to 4 degrees Celsius (3.6 to 7.2 degrees Fahrenheit) warmer than today, and sea level was 50 to 80 feet higher.



9. Answer – All of the above

The science of paleoclimatology uses geologic evidence to determine what the climate was like throughout Earth's history. Learn more in the video, Our Shared Climate Future, by scientists at the University of Colorado, CIRES. This specific question is addressed at 2:40 in the 5-minute video.

10. Answer – 97% (or even more)

The majority of climate scientists agree with the overwhelming evidence that humans are causing global warming. The reason there is a consensus of scientists is that there is a consensus of evidence. The scientific consensus was measured by reading the abstracts of nearly 12,000 scientific papers. This exercise is easy for anyone to repeat simply look at published papers in legitimate climate science journals and tally up how many agree with the idea that humans are changing the climate. Or, if reading is not your thing, attend any earth science conference and listen to what scientists are saying. They are in resounding agreement – because the evidence is overwhelming on this fundamental fact.

Most of the claims that dismiss climate science are not based on legitimate science and are not found in peer-reviewed journals. When a paper has been peer-reviewed, that means it has been evaluated by a number of qualified scientists and found to have followed legitimate scientific methods (From the Consensus Project).

ACTIVITY 3. Energy Consumption I

Examples of proposals to limit energy consumption and emissions of greenhouse gases that affect our home. Look for information in Google and explain how much your idea could help to reduce the energy consumption.

Example ideas:

1. Lower the heating thermostat

2. Install an energy efficient shower head

3. Eliminate phantom consumption

ACTIVITY 4. Energy Consumption II

CLASS DEBATE

Please indicate what actions of your demand of energy could get to be made with renewable energy?

Do you think you could use less energy with other kind of habits? How? List some advantages and disadvantages of the solutions that you have raised.

Do you think people are generally concerned about the consequences of climate change? Do you think that young people are more concern about climate change than old people? Why?

What can we do to modify our habits and contribute to reducing energy consumption in our lives? Do you consider it a task easy or complicated? Would you be willing to do it?

ACTIVITY 5. Energy Consumption III

What factors can influence the energy consumption of a centre (building, energy used, energy equipment and installations, people, external factors…)? Make a list.

After that, show the solution to the students and make them go around the school to see how many factors the school has implemented or considering at the same time they gather relevant information about the centre.

SOLUTION:

1. BUILDING

Antiquity (year):

Nº Doors:

Nº Windows:

Other relevant aspects: _____

☐ Thermal isolation

☐ Blinds

☐ Sunscreen elements

☐ Use of natural light

☐ Control and regulation of energy installations

2. ENERGY USED

Type and origin of the energy used by the building's facilities and equipment (renewable, energies, fossil fuels, electricity…):

_____

3. ENERGY EQUIPMENT AND INSTALLATIONS

Type and number of equipment:

Illumination:

Computers:

Printers:

Boilers:

Air conditioning:

Home appliances:

Elevator:

Other relevant aspects:_____

4. PEOPLE

Number of teachers, students and other people who work or visit the building:

Hours of occupation of the building:

Individual habits (turning off the lights or electronic devices before you leave, keeping the light off if there is enough natural light in the room…):

_____
_____
_____

5. EXTERNAL FACTORS

Meteorology and local climatology:

_____
_____
_____

☐ Shadows of nearby buildings

☐ Vegetation in the surroundings

Complete the analysis answering these questions:

What type of energy do the facilities use?

Look at the type of bulbs in the centre: are they incandescent, energy-saving, fluorescent, LED type? Write down if you can, or give an approximate figure, of the number what are there of bulbs of each type and their power.

Are your tables in class oriented so that you can make the most of natural lighting?

What colour are the walls, ceilings, and furniture of the classrooms? (Dark colours means that you need more light in the room)

Where are most of the windows facing (N, W, E, S)? (East will have more light in the mornings and west will have it in the afternoon)

In corridors, toilets, or passageways where there are usually few people, is there any type of lighting control system, such as presence detectors?

Give a general diagnose of the building.

List some measures of saving energy:

ACTIVITY 6. Impact on Climate

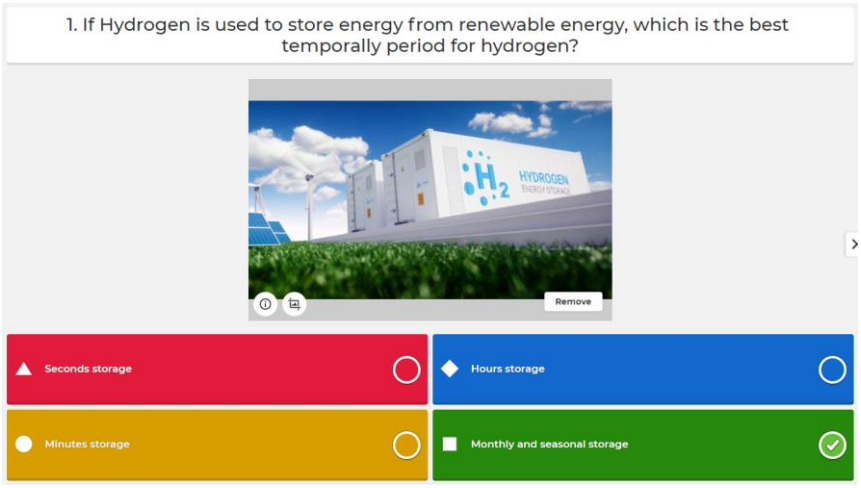
CLASS DEBATE OR WRIITING ACTIVITY

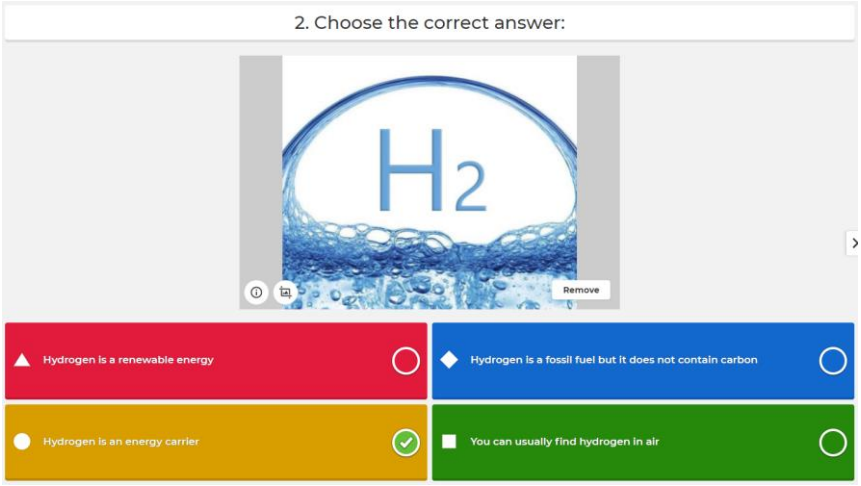
Compare the pictures and make a description of the impact in climate change of both families and their diets. You can include aspects as emissions to produce their food, if it is or not sustainable, if it is or not necessary to use that much package in the food.

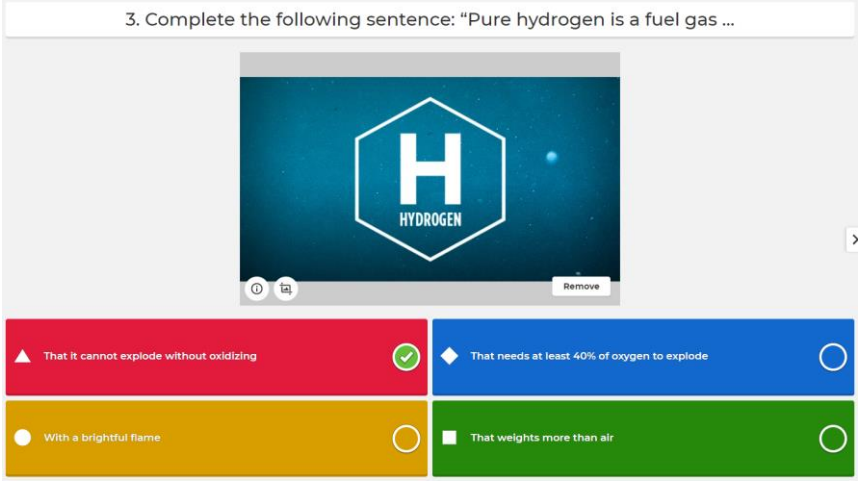
ACTIVITY 7. Trivial about Hydrogen

DINAMIC TRIVIAL IN KAHOOT!:

Enter the following link **and click** **"Continue as a guest"** **then click in "Player vs Player" if you want to play individually or "Team vs Team" if you want to play by teams. After that, the app will generate a PIN to share with the participants and they should access the game introducing that PIN here:** https://kahoot.it/







4. 95 % of H2 production is fossil-fuel based and only 4 % of global H2 supply is produced via electrolysis.

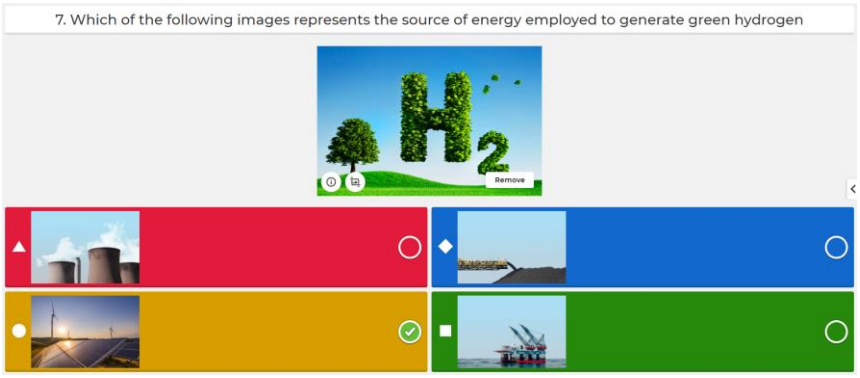
- True
- False

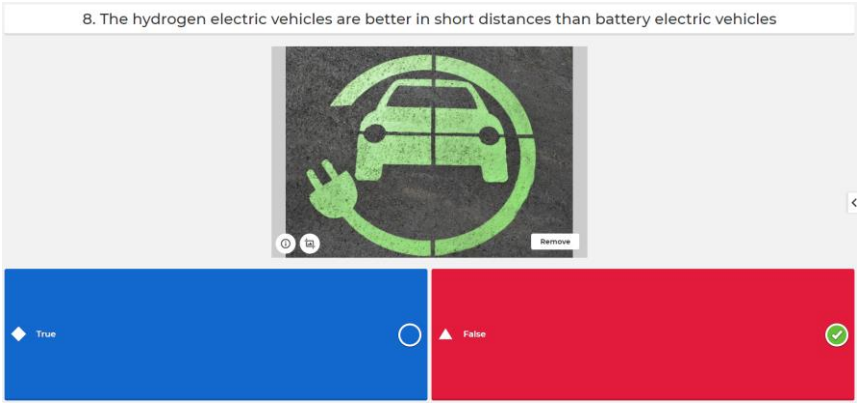
5. What is the main application of hydrogen gas nowadays?

- Transport
- Energy storage in gas grid
- Feedstock for chemical industry
- Domestic use

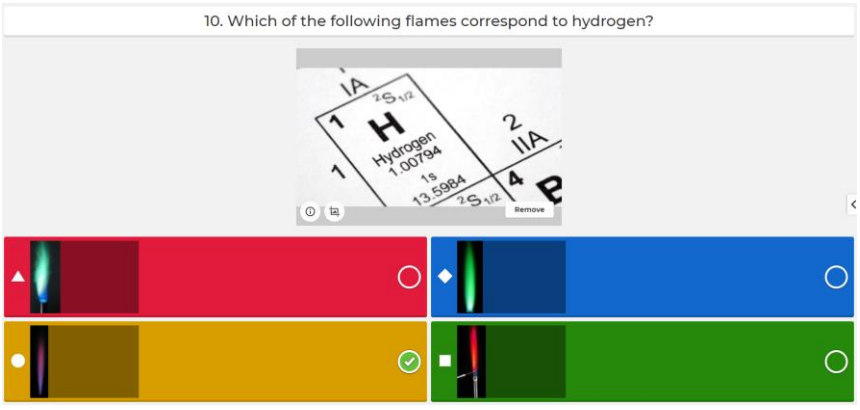
6. What inputs are required for the production of hydrogen via electrolysis

- Alcohol + CO2 + electricity
- Water + electricity
- Water + heat
- Ammonia + heat


7. Which of the following images represents the source of energy employed to generate green hydrogen
Remove


8. The hydrogen electric vehicles are better in short distances than battery electric vehicles
Remove
True
False


9. What is the traditional method of production of hydrogen?
PRODUCTION
Remove
PEM Electrolysis
Steam methane reforming
Photoelectrocatalysis
Hydrothermal reforming


10. Which of the following flames correspond to hydrogen?
IA
IIA
H
Hydrogen
1.00794
Remove

ACTIVITY 8. Loss of Glacial Ice

PRACTICAL ACTIVITY

In this activity the teacher individually, or the class in groups might have two identical plastic containers, ice cubes, water, food colouring (optional) and a timer. Then each group or the teacher individually should place an equal number of ice cubes in each container (regular ice cubes or ice cubes with coloured water) and just in one of them a small amount of water. Then set the timer and watch which one melts first.

While waiting, the teacher can ask some questions:

1. **What part of the activity set-up is different?**

   Room temperature water is added to one container.

2. **Why do you think we have changed this variable (water)?**

   To make it a fair test and to demonstrate the differing effects of air and water on ice melt.

3. **We are using the equipment to model how contact with water causes glaciers to melt more quickly. What do the different parts of the model represent – the container, the ice and water?**

   Container – a part of the world. Ice – a glacier. Water – a stream, river or lake at the terminus of a glacier.

4. **What do you think will happen in each model?** *(Answers will vary).*

Explanation to students:

- **Colouring ice cubes** makes no difference to melting, it simply makes it easier to see:
  1. The ice as it melts.
  2. The effect of the sweet water melting into water and the change of the initial concentration. The ocean's concentration changes with these sweet ice melting into the ocean's salty water.
- **Background:** Climate change causes variations in both temperature and snowfall. Warming temperatures cause glaciers to melt faster than they can accumulate new ice. Warming temperatures also mean some areas will get rain, rather than snow, further lessening ice accumulation. When glaciers lose more ice in the warmer months than they gain in the colder months, they retreat or recede. As a glacier melts, a river or lake may form at its end. Contact with the water causes the ice to melt more quickly. It can also cause ice cliffs to calve.
- **Why ice melts:** Changes of state always involve a transfer of energy. Ice melts when heat energy causes the frozen water molecules to move faster. When ice meets with warmer air or water, it absorbs the surrounding energy (heat). The air and water molecules bump against the ice molecules and transfer some of their energy. The increased energy causes the ice molecules to break away, and the water changes state from a solid to a liquid. Ice melts more quickly in water than air because water is denser – has a greater

concentration of molecules – than air. When ice is in water, more molecules bump against it and transfer more heat energy.

- **New Zealand's glaciers:** New Zealand has over 3,100 known glaciers – 18 are on Mt Ruapehu with the rest in the South Island. From the 1970s to the 1990s, small glacial lakes began to form at the terminus of the big glaciers. These lakes increase ice loss as ice at the front of the glacier calves (breaks off) into them. Many glaciers – such as the Tasman and Murchison Glaciers – are losing ice as their lakes grow. Tasman Lake began as small meltwater ponds in the 1970s, and it is now more than 7 km long.
  The articles Glaciers, Disappearing glaciers and Climate change, melting ice and sea level rise have additional background information.

After the explanation, the teacher can ask some questions:

1. **Were the predictions correct?**

   Answers will vary.

2. **What difference does contact with water make to either ice cubes or much larger masses of ice like glaciers and ice shelves?**

   Contact with water causes ice to melt more quickly.

3. **Why does ice melt faster when it is in contact with water than with air?**

   When ice comes into contact with warmer air or water, it absorbs the surrounding energy (heat). Water is denser than air, so its molecules transfer heat at a faster rate than air.

4. **What impacts has the melting glaciers in New Zealand? (Consider irrigation, tourism, hydroelectricity production and sea level rise.)**

   As glacier ice mass declines, less melt water is available for irrigation and/or hydroelectricity production. Tourists visit glaciers, so glacier loss will impact locations like Franz Josef or Fox Glacier. Freshwater melt from glaciers and ice sheets will cause sea level rise.

5. **In the article Disappearing glaciers, it says, "Most glaciers are now out of balance with the climate system, and they would continue to retreat even if climate remained stable." What does this mean?**

   Glacial lakes – like those in front of New Zealand's Tasman and Murchison Glaciers, increase glacial ice loss. Glaciers require ice accumulation to balance ice melt. Even if the present climate remains stable, it may not be enough to slow ice loss.