

Climate Change Misconceptions

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▶ **What is a misconception?**

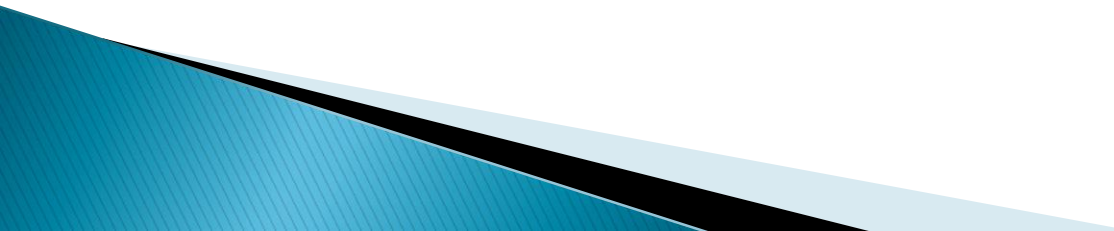
A view or opinion (conclusion) that is incorrect because it is based on incorrect facts, faulty thinking or understanding

▶ Why should we talk about misconceptions?

- Awareness of what your audience may or may not know and opportunity to provide correct information in a variety of ways
- In the classroom to be able to address them early and correct them

- ▶ **Have you encountered misconceptions about climate and climate change?**

▶ Examples from both children and adults

- The moon makes its own light (the same way the sun does)
 - The Earth is closest to the Sun in the summertime or it is warmer in the summer because Earth is closer to the Sun
 - The sun goes around the Earth
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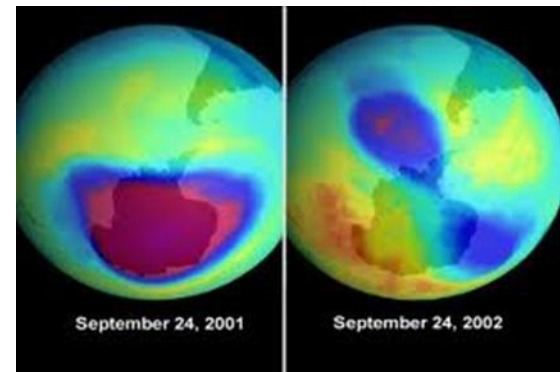
Misconception 1:

Depletion of the stratospheric ozone layer (“ozone hole”) is a **direct cause** of global warming.

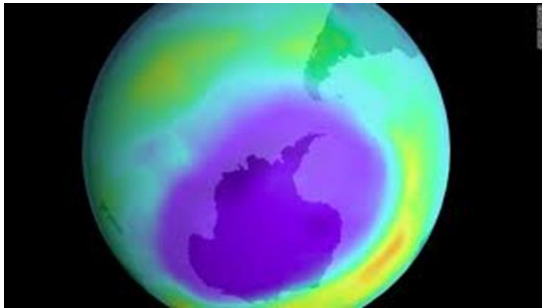
or

Global warming is **caused** by the ozone hole because the hole lets in more radiation.

Confusion between “ozone hole” and global warming has been widely reported in age groups ranging from fifth-graders to university students and among the general public.

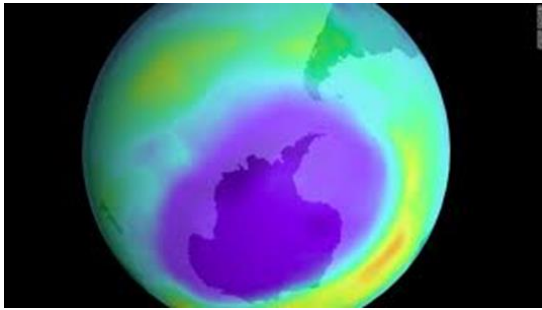


Facts



- ▶ **Ozone hole** is the *thinning* of the ozone layer 20 miles above the Earth. Depletion occurs seasonally and is caused by CFCs
- ▶ **Global warming** is a worldwide temperature increase due to increasing concentrations of GHGs and includes CFCs.

Facts



Ozone Hole

- ▶ Occurs 20 mi above earth
- ▶ Occurs at the poles
- ▶ Seasonal
- ▶ CFCs (chlorofluorocarbons)

Global Warming

- ▶ Occurs in the lower 8 mi of the atmosphere
- ▶ Occurs worldwide
- ▶ All seasons
- ▶ GHGs (greenhouse gases)

The ozone hole and global warming are a result of two different processes.

Misconception 2:

All types of pollution cause global warming.
(*aerosols, acid rain*).

- ▶ *Confusion about the difference between air pollution, litter and global warming.*



Facts

- ▶ All types of pollution do not affect temperature in the atmosphere causing global warming (*aerosols, acid rain*).
- ▶ Most pollutants (*visible, soot carbon monoxide, organic carbons, sulfate, nitrogen oxides*) are from industrial processes are not GHGs.
- ▶ Carbon dioxide and other GHGs contribute to warming by trapping heat.

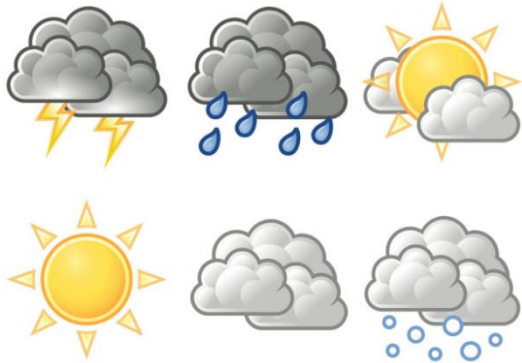
Many students believe that what they generally understand to be pollution and toxic chemicals are major contributors to climate change.



Misconception 3:

Weather and climate are the same.

Confusion between weather and climate exists because all of our direct experience is with the weather. It is difficult to accept that small changes can have a big influence.



Facts

- ▶ The difference between *weather* and *climate* is a measure of **time**.
- ▶ **Weather** is the day to day variation in atmospheric conditions.
- ▶ **Climate** is the average atmospheric condition over a long period of time (30+ years).





- ▶ **Climate** helps you to decide what clothes to buy.
- ▶ **Weather** helps you decide what clothes to wear.

- ▶ **Climate** is what you **expect**.
- ▶ **Weather** is what you **get**.



Misconception 4:

The atmosphere is so vast that humans cannot affect it.

Human activities are rapidly increasing the atmospheric concentration of GHGs as well as adding new heat-trapping gases that are not found in nature.

Humans do affect the atmosphere and the ocean!




Misconception 5:

The temperature changes are so small and so gradual that plants and animals can adapt.



Facts

- ▶ The projected rate of climate change is more rapid than any that has occurred in the last 10,000 years and may overwhelm the ability of plants and animals to adapt.
 - ▶ We are seeing changes in temperature, sea ice extent, sea level rise, migration patterns in marine mammals and fisheries, rate of glacial retreat and bloom dates for key plants that provide food for hatching insects, birds and reptiles.
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Misconception 6:

The atmosphere is large and small amounts of carbon dioxide or a few degrees of temperature change can't make much difference.



Facts

- ▶ Small changes in the atmosphere's composition or temperature can have a large effect, especially on the marine environment.
- ▶ A 6-degree-Celsius rise in water temperature caused global biomass to decrease by 50% (O'Connor 2009)
 - Krill reproduce in smaller numbers in warmer water
 - Global warming can cause stronger storm systems and disrupt the ocean's current system
- ▶ Warming reduces the solubility of CO₂ and therefore reduces uptake of CO₂ by the ocean.
- ▶ Increasing atmospheric CO₂ decreases pH. Research shows that CaCO₃ forming animals have higher mortality rates among spat and poor shell development with an increase in pH.

Misconception 7:

The climate is changing due to natural variability rather than human activity.

or

The climate is always changing or it has changed many times in the past before humans began burning coal and oil. So there is no reason to believe humans are causing global warming today.

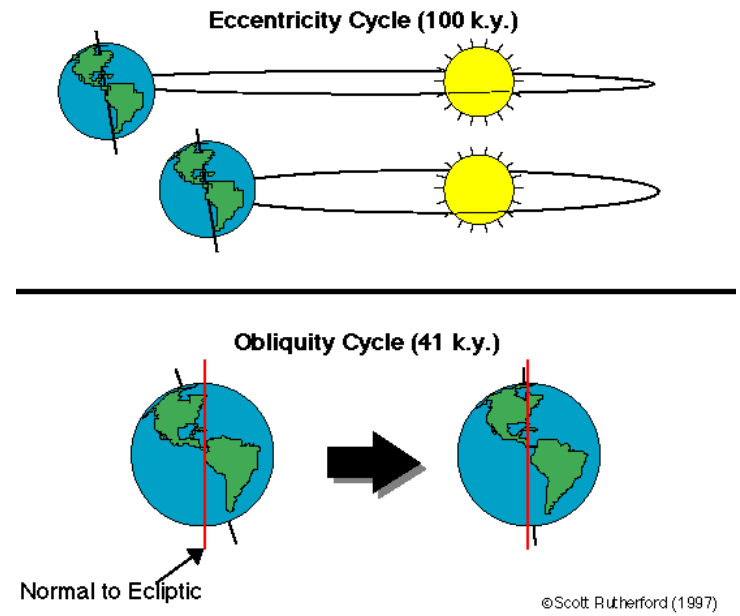
Confusion about the anthropogenic contributions to atmospheric warming due to a general misunderstanding of the time frame over which natural variations occur.

Facts

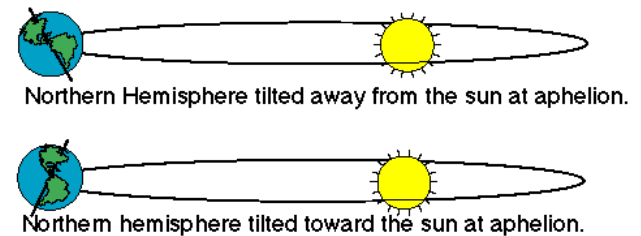
Naturally occurring variations in the planet's climate can be explained through Milankovich cycles.

- Shape of earth's orbit (eccentricity, 100,000 yrs.)
- Earth's tilt of the axis (obliquity, 40,000 yrs.)
- Earth's wobble (precession, 26,000 yrs.)

These cycles 1) affect the amount of solar radiation reaching the earth and 2) result in long term fluctuations in the energy that reaches the earth.

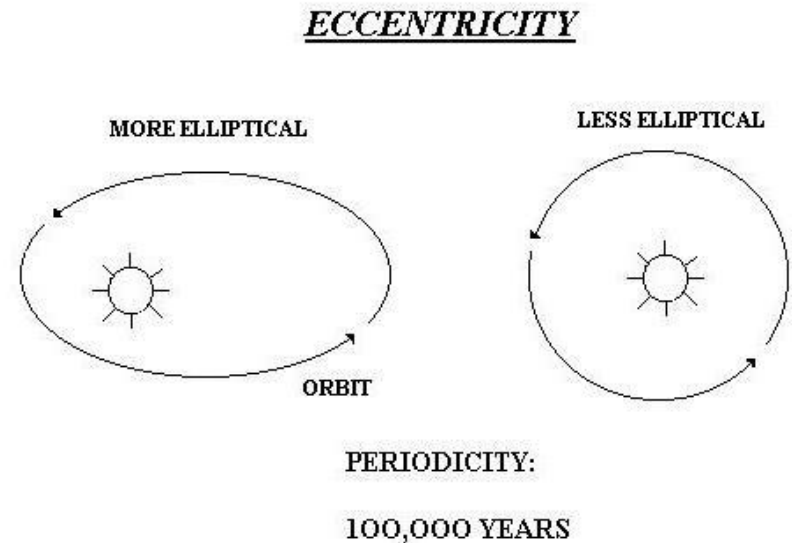


Precession of the Equinoxes (19 and 23 k.y.)



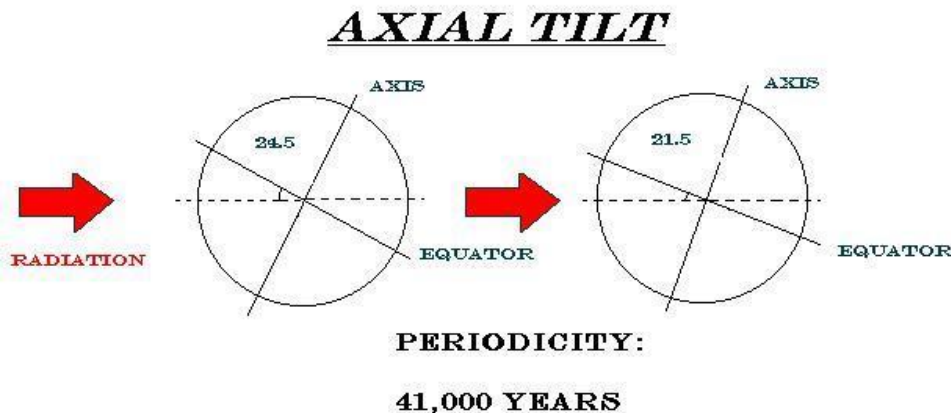
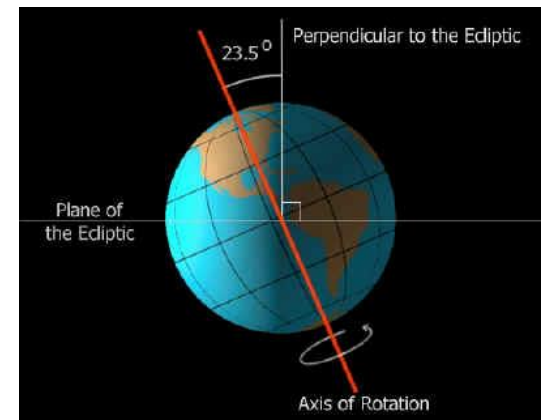
Orbital Cycles: Shape of the orbit

- ▶ **Eccentricity/shape of orbit:** Orbit changes from more elliptical to less elliptical (exaggerated here)
- ▶ 100,000 year cycles
- ▶ 0–5% difference in distance from the sun
- ▶ Changes amount of radiation



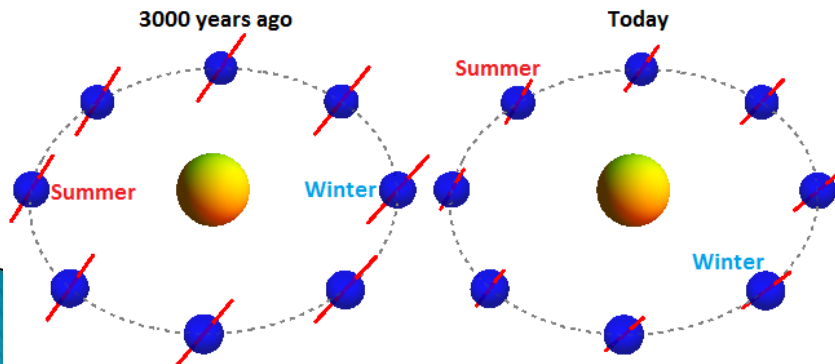
Orbital Cycles: Axial tilt

- ▶ **Obliquity/Axial tilt:** change in Earth's tilt from 21.5–24.5°
- ▶ 41,000 year cycles
- ▶ Affects amount of radiation

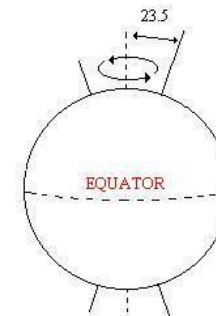


Orbital Cycles: Earth's wobble

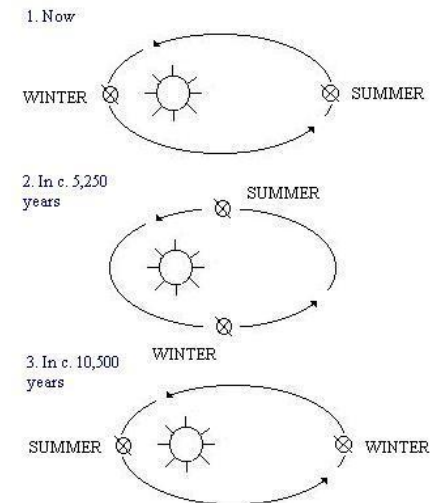
- ▶ **Precession/wobble:** Earth's slow wobble as it spins on its axis
- ▶ 23,000 year cycles
- ▶ Affects solar radiation



PRECESSION



PERIODICITY:
C. 23,000 YEARS

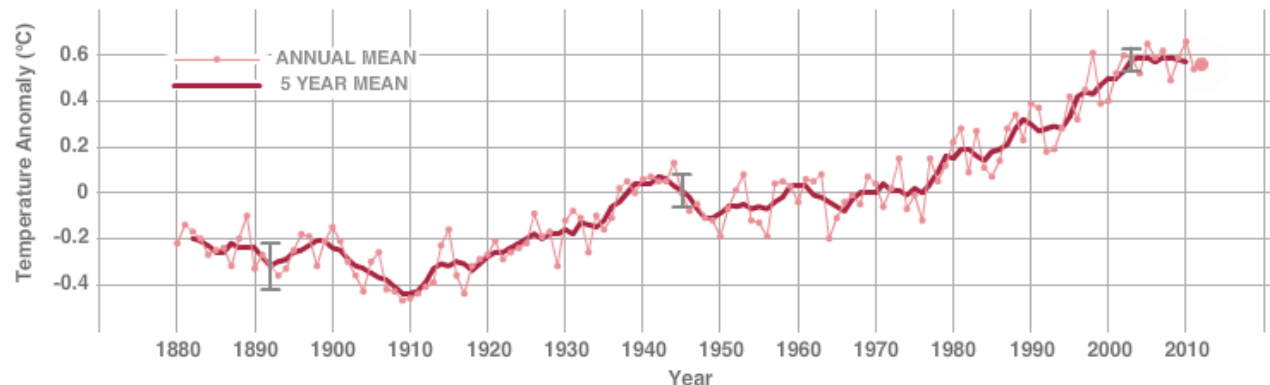


Facts

- ▶ Several of the factors driving current warming are human-made, not natural.
- ▶ Satellite measurements have shown that the sun has not become more active recently.
- ▶ Human-made CO₂ can be distinguished from natural CO₂ in the atmosphere.
- ▶ Natural factors have changed very little in the past 30 years, but the rate of global temperature change has gone up drastically.

GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: [NASA's Goddard Institute for Space Studies \(GISS\)](#) This trend [agrees with other global temperature records](#) provided by the U.S. [National Climatic Data Center](#), the Japanese Meteorological Agency and the Met Office Hadley Centre / [Climatic Research Unit](#) in the U.K. Credit: [NASA/GISS](#)



Misconception 8:

The only greenhouse gas emitted by human activities is carbon dioxide from burning fossil fuels.


Confusion about the role of other GHGs due to the media focuses on carbon dioxide and the rarely mentions other GHGs.

Greenhouse Gases Producing Greenhouse Effect

- ▶ Carbon dioxide 50% 30–95 years
- ▶ Methane 20% 8.4 years
- ▶ Nitrous oxide 15% 114 years
- ▶ CFCs 15% 55 years
- ▶ Ozone <1% 36–130 years
- ▶ Water vapor up to 3% 9 days

GHS= 0.04% of gases in
atmosphere. Water vapor ~ 2%

Facts

- ▶ **Carbon dioxide** from deforestation, fossil fuel use for transportation, industry, heating and cooling.
 - ▶ **Methane** from agriculture, natural gas distribution, landfills. Growth rates of methane in the atmosphere have slowed.
 - ▶ **Nitrous oxide** from fertilizer use, fossil fuel burning.
 - ▶ **Halocarbons** from refrigeration agents and other industrial processes (chlorofluorocarbons, CFCs). Abundance is decreasing due to international regulations.
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Misconception 9:

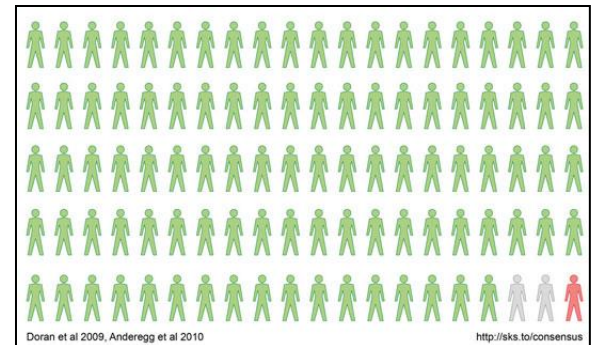
Climate change is a deeply contested issue among scientists.

A 2012 Yale study found that 41% of Americans “believe there is a lot of disagreement among scientists” about climate change and global warming.



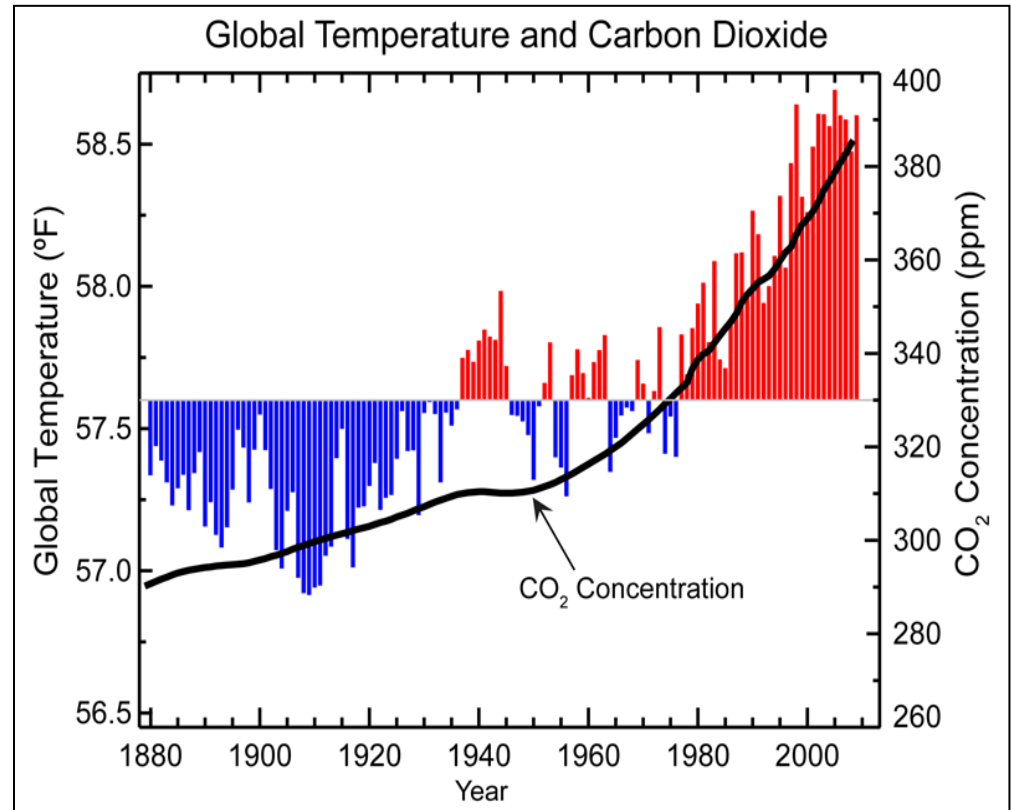
Facts

- ▶ However, **97%** of climate scientists agree that humans have had an effect on the climate.
- ▶ Many scientific organizations from around the world have issued statements in support of the idea that humans can affect the climate.
- ▶ Media focus on dissent among scientists can lead public to believe there is less consensus than actually exists



Misconception 10:

We should wait and see who is right before we act.



Facts

- ▶ **Greenhouse gases** stay in the atmosphere between 50 and 200 years.
- ▶ A **2-degree increase** is the maximum increase scientists believe to be safe.
- ▶ The International Energy Agency warned in 2009 that we have less than 5 years to cut emissions to stay within a 2-degree increase.
- ▶ Since 1990, U.S. greenhouse gas emissions have increased by about 8%.
- ▶ We don't have time to wait.



Misconception 11:

There is little an ordinary citizen can do to prevent or affect climate change.

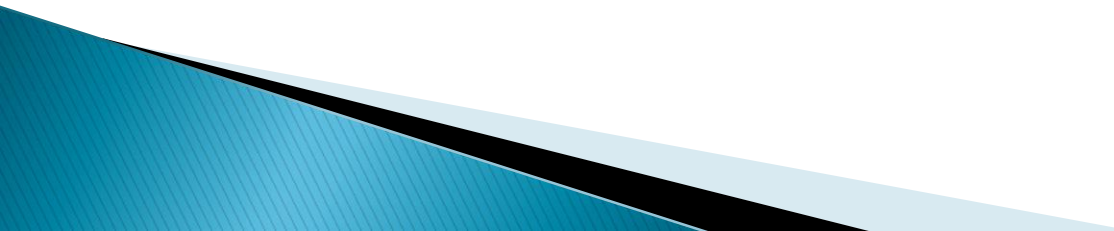


Facts

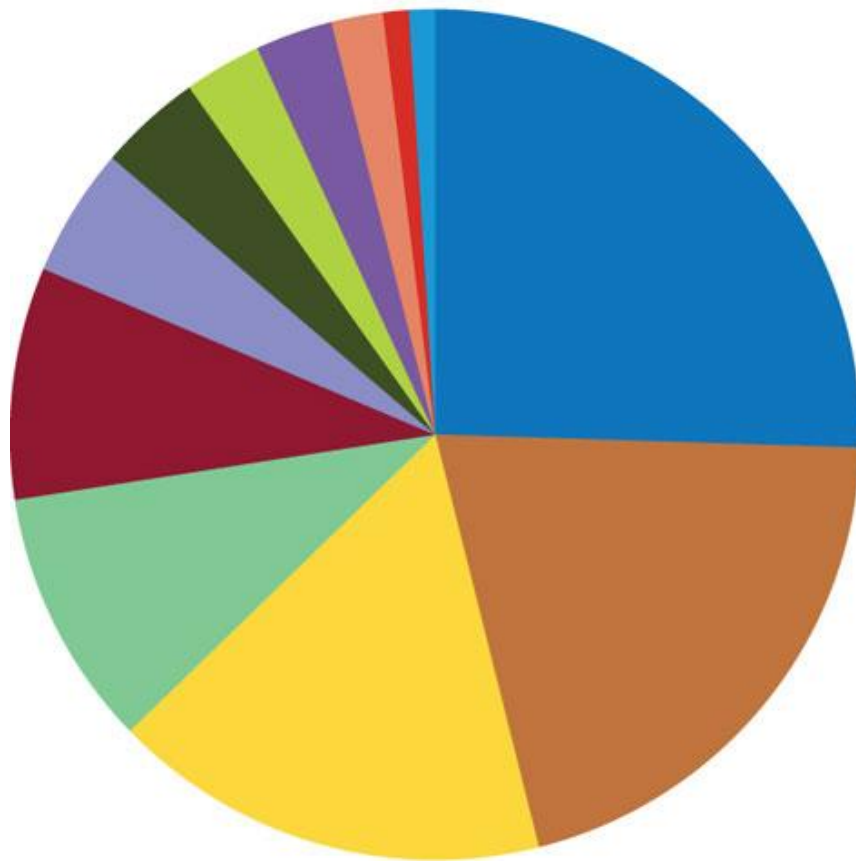
Individuals and households can make significant contributions to the climate change issue. Some examples are:

- ▶ Using electric and hybrid cars
- ▶ Energy efficient appliances
- ▶ Turning off lights
- ▶ Conserving water
- ▶ Efficient insulation
- ▶ Lobbying governments
- ▶ Voting for progressive candidates who support alternative energy plans
- ▶ Contributing to public debates

Industry can make significant changes

- ▶ Industries can reduce emissions of heat trapping gases
 - ▶ Industries can reduce fossil fuel dependence with new technologies i.e. fuel cells.
 - ▶ Government can increase efficiency standards
- 

US teens' answers on the main cause of global warming



- Cars and trucks
- Burning fossil fuels for electricity
- The ozone hole
- Toxic wastes
- Deforestation
- Nuclear power plants
- The Sun
- Cows
- Aerosol spray cans
- Volcanic eruptions
- The space programme
- Acid rain

Only 5 of these are causes

From *Nature*

<http://www.nature.com/nclimate/journal/v2/n5/images/nclimate1494-f2.jpg>

THE END

