

2-1 Global Warming

Main Reading text

One of the first questions we must ask ourselves in any understanding of global warming is; Where does the world's heat come from? Well, almost all of it comes from the sun, with a very small amount coming from inside the earth itself; which is why we have volcanoes. Measurements have shown that about 1300watts/square meter comes from the sun and only about 90 watts/square meter comes from inside the earth. This is about the amount of heat from a small light bulb, so if we relied only on the earth's heating, we would be very, very cold.

Some of the sunlight that reaches the Earth is **reflected** from the tops of the clouds, by the oceans and by the ground itself. About one third of the incoming sunlight is reflected this way, which is why the earth looks like a beautiful blue marble from space.

Only about two thirds of the sunlight that reaches us can be used to heat the earth. But that is not the end of the story. If that energy just kept heating and heating then very soon the oceans would boil and our planet would be too hot to support life (in fact, just like the planet Venus).

Most of the energy from the sun is **re-radiated** back into space in the form of heat (known as '**infra-red**' radiation). Now here is where it gets a little complicated. Let's talk in terms of 'energy' not sunlight, and let's see what happens to this energy as it reaches the ground. As the energy comes through the **atmosphere** it will make the atmosphere warmer; we say the energy is **absorbed** by the atmosphere (thus making it warmer). Most of the sunlight will hit the ground and the oceans, and a lot will be absorbed (making the ground and the oceans warmer).

Because the ground and oceans are now warmer, they will re-radiate some of that energy back into the atmosphere, which in turn will re-radiate it back into space.

From this very simple model we can see that there is a balance between the amount of energy (in the form of sunlight) coming in and the amount of energy (in the form of heat and reflection) going out. It is this balance that keeps the temperature of the world just right.

However, there are other effects that cause variations. Some happen over a very long time, such as the earth's position as it **orbits** the sun. Over tens of thousands of years the earth gets a little farther away from the sun, and then a little closer. Which is why we have ice-ages. Sometimes the weather patterns change over periods of hundreds of years, and sometimes they change over tens of years. All this is quite natural and is part of the normal life of the planet.

But now we come to that big problem of the earth: humans.

The effect we humans have had on the global climate includes warming of the atmosphere and the ocean, changes in the global water cycle, reductions in snow and ice, global sea level rise, and changes in some climate extremes.

But how have we caused these changes?

These changes are being caused by the **production** of '**greenhouse gases**'. Greenhouse gases are various **molecules** that catch the heat being re-radiated from the ground and stop it escaping into space, thereby heating the atmosphere more.

The most important **contributors** to the greenhouse effect are: water vapor, carbon dioxide, methane and nitrous oxide.

Water vapor occurs whenever water becomes warm. The vapor rises and eventually forms clouds, which then fall as rain. So it is always in the atmosphere and is a normal part of the water cycle on earth. An increase in temperature will lead to an increase in the amount of water vapor in the atmosphere and thus more rain. But much of this may fall over the oceans or become storms.

From the beginning of the Industrial Revolution (around 1750) until 2012, the burning of carbon-based **fuels** such as wood, coal, oil, and natural gas, making **cement**, and **extensive** cutting down of forests have all contributed to the 40% increase in the amount of carbon dioxide in the atmosphere.

Another important greenhouse gas is methane. Methane is a natural product of **decaying** plant and animal material. But since we have started farming millions and millions of cows, sheep and grass-eating animals, the amount of methane has increased dramatically.

Grass, leaves and similar plant material is very difficult to **digest**. So animals that eat plant material have **bacteria** in their stomachs that help to breakdown the food. One of the results of this bacterial action is the production of methane, which comes out from one end, or the other, of the animal.

Rice fields also generate large amounts of methane during plant growth.

Methane **emissions** are an important greenhouse gas because methane is more than twenty times as effective as carbon dioxide at trapping heat in the atmosphere. Fortunately it is produced in much smaller amounts.

According to recent research, the concentrations of carbon dioxide and methane have increased by 36% and 148% respectively since 1750. These levels are much higher than at any time during the last 800,000 years, the period for which we have reliable **data**.

The other important greenhouse gas is nitrous oxide. Nitrous oxide is produced by bacteria in soils and oceans, and is thus a natural part of Earth's atmosphere. The main sources of human-produced nitrous oxide are; cultivating soil, the use of nitrogen **fertilizers**, and animal waste. All these **stimulate** naturally occurring bacteria to produce more nitrous oxide. Cows, chickens, and pigs produce 65% of human-related nitrous oxide. Industry **sources** make up another 20%, and the rest comes from the production of nylon, and the burning of oil and gas (petrol) in engines.

Overall, we cut down forests and burn the wood (carbon dioxide) we plant fields of grass, maize and other food for cows and pigs (nitrous oxide) and then we feed all these animals (methane). Then we kill them, drive to burger bars (carbon dioxide, nitrous oxide), eat burgers and chat on our cell phones (carbon dioxide from burning **fossil fuels** in the production of electricity).

Global warming not only warms the earth, it also changes weather patterns, resulting in floods, storms, **drought** and **extreme** weather, resulting in less food being produced.

If the present trends continue, by 2030, maize production in southern Africa could **decrease** by up to 30%, while rice, millet and maize in South Asia could decrease by up to 10%.

By 2080, food production in developing countries could decrease by 10% to 25% on average, while India could see a drop of 30% to 40%.

By 2100 the world population is expected to double, but rice and maize in the **tropics** is expected to decrease by 20-40% because of higher temperatures. This is without **considering** the decrease in production as a result of soil **moisture** and water supplies affected by rising temperatures.

Vocabulary

1. WATTS/SQUARE METER (n.) 瓦特/平方公尺

A unit of measure for the energy of the sunlight arriving at the surface of the earth.

2. REFLECT (V.) 反射；反照

Of light, sound, etc. that moves in one direction, hits a surface, and then quickly moves in a different and usually opposite direction.

The snow covered mountain is reflected in the still water of the lake.

3. RED-RADIATE (adj) 紅外線輻射的

To radiate again; especially to give out energy in the form of radiation after absorbing (taking in) energy.

4. INFRA-RED (n) 紅外線

Of light that cannot be seen by humans, but which can be felt as heat.

Rattle snakes (from the USA) have infra-red sensors on their heads which can detect the body heat of the small animals they hunt at night.

5. ATMOSPHERE (n.) 大氣層

a. The whole mass of air that surrounds the Earth.

Shooting stars burn up as they pass through Earth's atmosphere.

b. The overall feeling or effect of a place or work of art etc.

The food was good but the restaurant has no atmosphere.

6. ABSORB (v) 吸收

a. To take in something, such as a liquid, in a natural or gradual way.

The sandy beach quickly absorbed the coffee I spilt.

The walls are made of a material that absorbs sound.

- b. To learn something.

She is good at absorbing information.

7. ORBIT (v.) 環繞

To go round something in a more-or-less regular path.

The earth orbits the sun.

The London orbital motorway

8. PRODUCTION (n.) 產品

- a. The process of making something naturally.

The body's production of red blood cells.

- b. The process of making or growing something for sale or use.

He has a job in television production.

9. GREENHOUSE (n.) 溫室

A building with glass walls and a glass roof and that is used for growing plants. Therefore a building that is usually warmer inside compared to the outside air.

GREENHOUSE GASES: gases, such as carbon dioxide (CO₂), that have the effect of increasing the temperature of the atmosphere

10. MOLECULE (n.) 分子

The smallest possible amount of a particular substance that has all the characteristics of that substance.

A molecule of water has two hydrogen atoms and one oxygen atom (H₂O). A molecule of salt has one atom of sodium and one atom of chlorine (NaCl).

11. CONTRIBUTE (v.) 貢獻出；捐贈；投稿

- a. To help to cause something to happen.

The cold, rainy day contributed to her feeling miserable.

- b. To give something, such as money, goods, or time, to help a person, group, cause, or organization

The volunteers contributed their time towards cleaning up the park.

12. FUEL (n.) 燃料；刺激物

- a. Any material, such as coal, oil, or gas, that is burned to produce heat or power

There was no electricity because the power station ran out of fuel.

- b. Something that gives support or strength to something (such as argument or angry feelings).

These latest problems will only add fuel to the difficulty.

13. CEMENT (n) 水泥

- a. A soft gray powder that is mixed with water and other substances to make concrete. Also the hard substance that is made when cement is mixed with water and allowed to dry.

There is a layer of cement between the bricks.

I admire her artistic integrity.

- b. Any substance that is used to make things stick together.

What kind of cement works best on glass and pottery.

14. EXTENSIVE (adj.) 廣大的

Having a wide or large range, distance, or space that is covered or affected by something or included in something. A lot of something.

The storm caused extensive damage.

15. DECAY (v.) 腐爛；衰減

- a. To be slowly destroyed by natural processes. To be slowly broken down by the natural processes that destroy a dead plant or animal.

The dead plants and leaves are decayed by bacteria.

The horrible smell of decaying rubbish.

- b. Of a building, area, etc., to go slowly from a bad condition to a worse condition.

The city's inner areas are decaying

16. DIGEST (v.) 消化

To break down food you have eaten so that the body can make use of it.

He has trouble digesting certain foods.

17. BACTERIA (n.) 細菌

Very small (microscopic) single-celled organisms that can be found in almost every environment on earth. Some cause diseases, many are harmless and some are essential for life.

18. EMISSION (n.) 發射物

The act of producing or sending out something, such as energy, sound, gas, etc. from a source

Trying to reduce the emission of poisonous gas from engines.

The sun emissions of energy were higher than usual in 2012.

19. DATA (n) 數據；資料

Facts or information used usually to calculate, analyze, or plan something. (plural data singular datum)

We will think about a plan when we have all the data.

20. FERTILIZER (n.) 肥料

Plant food. Substances, such as manure or a special chemicals, that are added to soil to help the growth of plants.

We only use organic fertilizer in our gardens.

21. STIMULATE (v.) 激勵

a. To make something more active. To cause or encourage something to happen or develop.

Paying our workers more money might stimulate tem to work harder.

The movie stimulated her to read the book.

b. Something done with all of your strength or energy and with little hope of succeeding.

They made one last desperate attempt to fight their way out.

22. SOURCE (n.) 來源

- a. Someone or something that provides what is wanted or needed.

The college has its own electricity source.

His job is the family's main source of money.

- b. The cause of something; such as a problem.

Cutting down the mountain forests is the source of the floods.

23. FOSSIL FUELS (n.) (煤、石油、天然氣等)礦物燃料

Fuel that comes from under the ground, such as oil, coal, gas. This material is the remains of very ancient forests that millions of years ago covered the earth. Burning this fuel creates a lot of pollution and greenhouse gas.

24. DROUGHT (n.) 乾旱

A long period of time during which there is very little or no rain.

The drought caused serious damage to crops.

25. EXTREME (adj.) 極端的

Very serious or severe. Very great, strong, fast, etc.

Although the tree is very strong, it is sensitive to extreme heat and cold.

They are living in extreme poverty.

These strange fish live at extreme depths in the ocean

26. DECREASE (n.) 減少

To get less, or smaller.

The driver decreased her speed as she approached the curve.

Visitors decreased by five percent this year/

27. TROPICS (n.) 熱帶地區

The region of the world that is near the equator, where the weather is very warm. Technically from 23.5degrees north to 23.5 degrees

south.

✓ 28. CONSIDER (v.) 認為；考慮

To think about something or someone carefully especially in order to make a choice or decision.

He seriously considered changing careers.

We never considered the possibility that the plan could fail.

29. MOISTURE (n.) 水分

A small amount of a liquid (usually water) that makes something wet.

These flowers grow best with moisture and shade.

Review exercise

Choose the best word or phrase to complete the following sentences taken from the text.

1. Some sunlight that reaches the Earth is _____ from the tops of the clouds.
(A. reflected B. produced C. given D. reproduced)
2. We say the energy is _____ by the atmosphere.
(A. to give B. produced C. absorbed D. from the sun)
3. Sometimes the weather _____ change over periods of hundreds of years.
(A. shapes B. designs C. patterns D. forms)
4. It is this balance that _____ the temperature of the world just right.
(A. has B. keeps C. fixes D. will be)

5. These changes are being _____ by the production of 'greenhouse gases'.
(A. caused B. began C. arrived D. given)
6. Greenhouse gases are various molecules that _____ the heat being re-radiated from the ground.
(A. catch B. hold C. stop D. block)
7. Water vapor occurs _____ water becomes warm.
(A. whoever B. however C. whenever D. whichever)
8. But much of this rain may _____ over the oceans or become storms.
(A. rise up B. become C. stay D. fall)
9. Methane is an _____ greenhouse gas.
(A. recent B. important C. big D. nowadays)
10. Global warming not only warms the earth, it also _____ weather patterns.
(A. changes B. gives us C. contrasts D. designs)

True or False

1. We have ice-ages because the earth orbits farther from the sun. T/F
2. A lot of our heat comes from inside the earth. T/F
3. All sunlight passes straight through the clouds. T/F
4. Present day global warming started at around the time of the

industrial revolution.

T/F

5. Infra-red radiation looks bright red to humans. T/F
6. Before global warming, weather patterns almost never changed. T/F
7. Global warming will cause the sea level to rise. T/F
8. Methane is a more important greenhouse gas than carbon dioxide. T/F
9. Bacteria stop animals digesting leaved, grass and similar foods. T/F
10. We could help stop global warming by eating less meat. T/F

Reading Comprehension - choose the best answer

1. () The earth does not get very hot because,
 - a. Most of the energy from the sun is in the form of light, not heat.
 - b. There is a balance between the amount of energy we get from the sun and the amount of energy that re-radiates back into space.
 - c. The sunlight that hits the earth is converted into energy which is absorbed by the earth and heats the inside, thus giving us volcanoes.
 - d. The earth is too far from the sun to get very hot.
2. () The main effects of man-made global warming will be?
 - a. The rise in temperature and rainfall will mean more regions will be able to grow more food.
 - b. As the global warming increases we will get fewer and fewer typhoons and less and less desert areas.
 - c. Sea levels will rise, some small islands may disappear, changes in weather patterns could bring storms and droughts, less food will be produced.
 - d. Sea levels will rise a little and a change in weather patterns will bring more rain to desert regions, so more food will be able to be

produced and forests will grow better.

3. () Global warming can only be reduced by:

- a. Changing the way we produce plant and animal food because a lot of greenhouse gas comes from animal waste and nitrogen fertilizers. We also have to stop burning fossil fuels.
- b. Building smaller cities so we don't need to use so many cars, trucks and motorbikes to travel around.
- c. Global warming is a natural part of the normal changes in weather patterns, we can not stop it. We just have to learn to live with it.