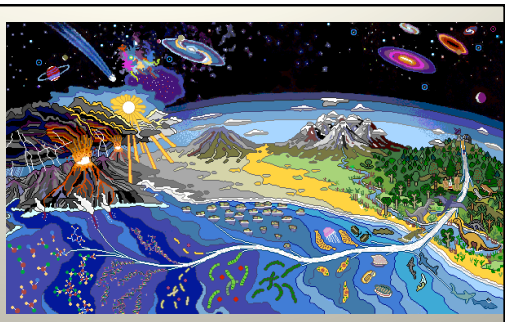
Class 8:
Earth
Habitability

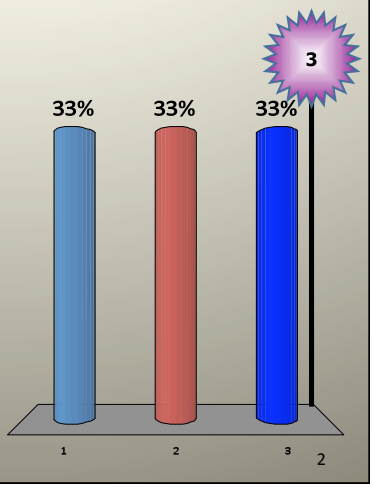


How is plate tectonics important for regulating the Earth's temperature?

What is it about Earth that makes it habitable for life?

Which of today's learning objectives are most difficult?

1. Diagram of the Greenhouse effect, describe mechanism.
2. CO_2 Cycle, explain its feedback system to maintain temperatures.
3. List five physical conditions on earth leading to habitability.



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Greenhouse Gases
&
~~Global Warming~~
Climate Change

What should you believe?

http://www.youtube.com/watch?v=I_kODETmro8

Let's first try and understand the 'effect'.

3

Map out the ``greenhouse effect''

1) What are the relevant items? What will we need to include in our diagram?

2) Where is the initial energy generated?

3) How is that energy transported and where does it 'land'?

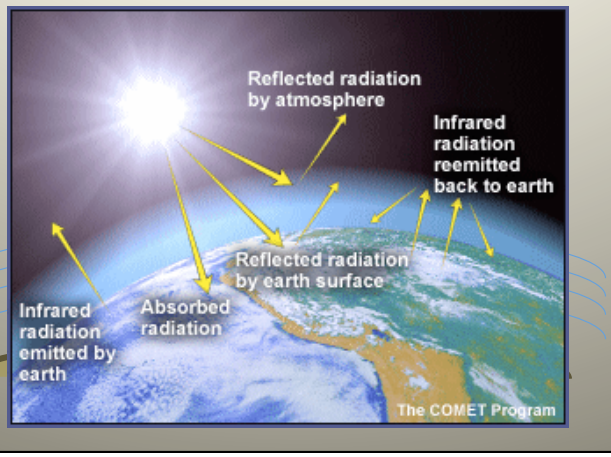
4) Now where is the energy? What does it do?

5) How is *that* energy transported and where does it 'land'?

6) What is trapped by the atmosphere and what escapes?

4

Does yours look something like this?



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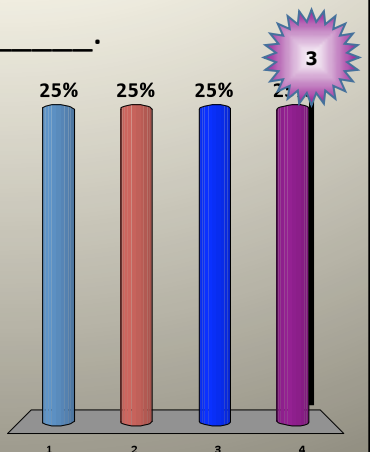
The earth's greenhouse effect is driven by the fact that _____.

1. Infrared light can not pass through the Earth's atmosphere.
2. The Sun's radiation heats the Earth.
3. The atmosphere blocks all forms of radiation.
4. All of the above.



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Are greenhouse gases bad?

How much warmer is the Earth because of its greenhouse gases?

30 °F → 59 °F (or about 30 °F warmer!)

Without Earth's greenhouse gases, life might not have formed!

What are the important greenhouse gases on Earth?

Water (H_2O) Carbon Dioxide (CO_2)
Methane (CH_4 <- extremely effective)

With regards to **Global Climate Change** There are some important questions

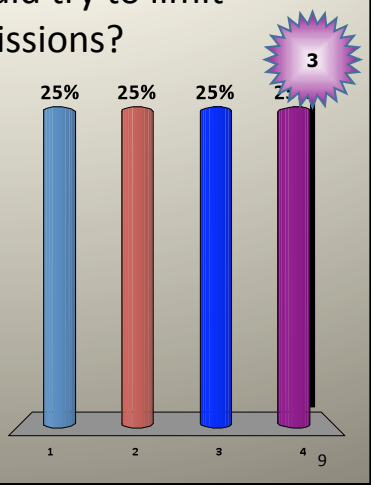
Is the Earth experiencing a rapid change in its climate or climate stability?

If so, have man-made, industrial pollutants driven most of this climate change?

If so, how can the world address the problem equitably and without causing enormous economic damage?

Do you feel we should try to limit greenhouse gas emissions?

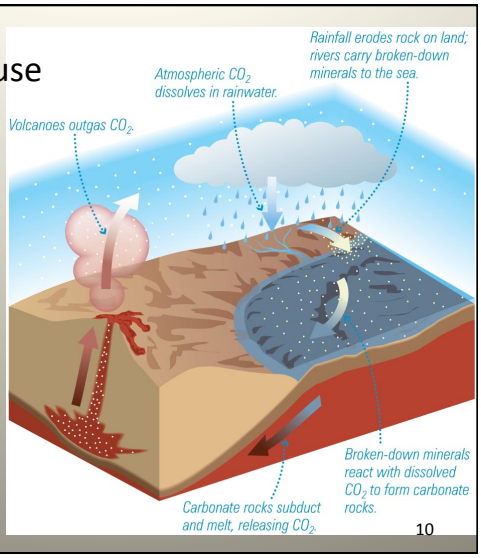
1. **Yes**, it might make a difference with time.
2. **Yes**, but I don't think its likely to happen globally.
3. **No**, it will only cause economical strife and won't help the situation.
4. **No**, I don't believe it's a real issue needing action.



Is the Greenhouse Gas, CO_2, bad?

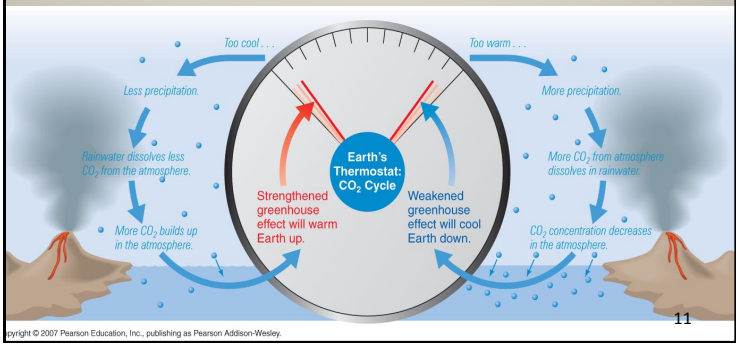
Here is the CO_2 Cycle on Earth

What does it do?
How does it work?



The CO_2 cycle

Regulates Earth's temperature through a negative feedback process



Let's draw a simple, CO_2 Cycle model

1. Draw a triangle.
2. In the three corners label the three primary conditions or locations one finds CO_2 on Earth.
3. Draw arrows moving the CO_2 from one spot to the next and label how that motion occurs.
4. Can the cycle go both ways or only one way?

Let's 'test run' our CO_2 Cycle model

Take the condition where atmospheric temperatures increase. How does this change the precipitation (rain) level?

Follow all the way through the cycle.

What will happen to global temperatures at the end of the cycle?

_____

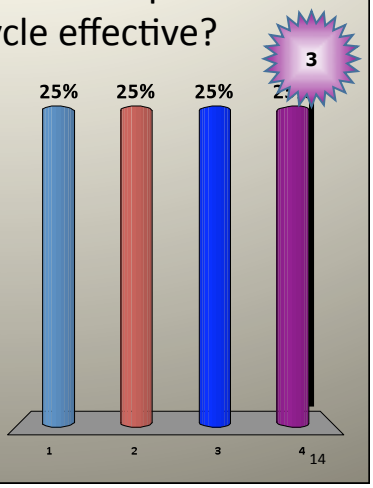
Take the condition where atmospheric temperatures decrease. How does this change the precipitation (rain) level?

Follow all the way through the cycle.

What will happen to global temperatures at the end of the cycle?

Over what time scale for temperature change is the CO_2 cycle effective?

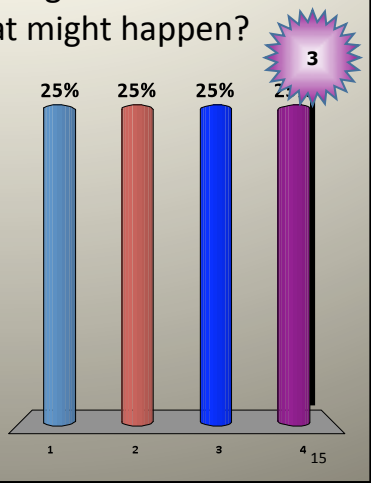
1. 400 years
2. 4,000 years
3. 400,000 years
4. 4 million years



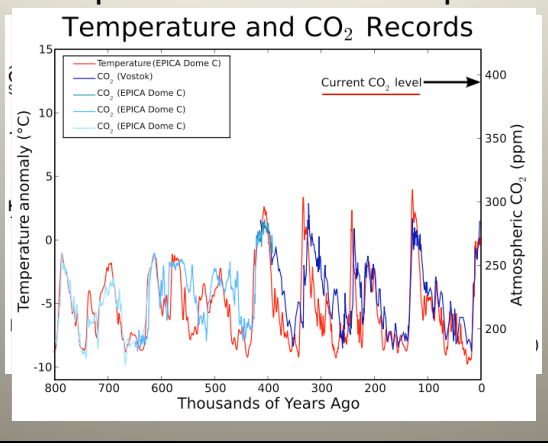
If we double atmospheric greenhouse gases in 100 years, what might happen?

1. Average global temperatures could rise.
2. Some areas may be cooler.
3. Weather may become more extreme.
4. All of the above.

<u>All of the above!</u>
This is why its now called 'Climate Change'

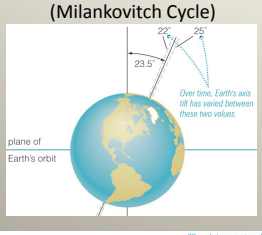


How stable has the Earth's temperature been in the past?



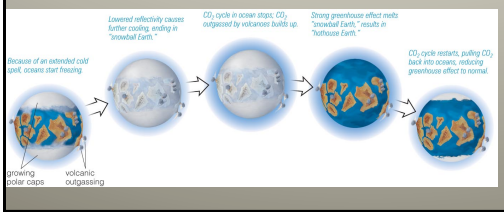
Why the cycle of Ice Ages?

(Milankovitch Cycle)



1) Changing tilt of Earth axis vs. orbital plane. Small tilt = weaker summers and oceans stay cold and freeze over.

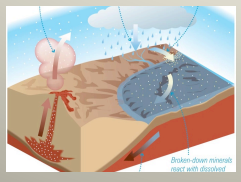
2) The CO_2 may have gone through very rapid or cataclysmic changes (extreme volcanism, meteoritic impact)



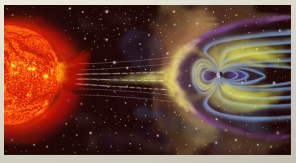
Runaway effect of growing polar caps might have lead to Snowball Earth. The CO_2 cycle should stop the runaway.

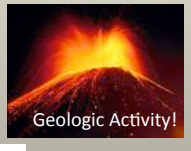
The Long-Term habitability of Earth.

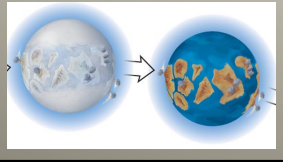
What makes Earth such a great place for life?

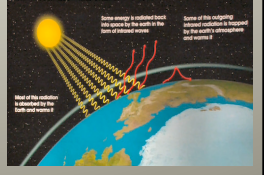


How are these related?









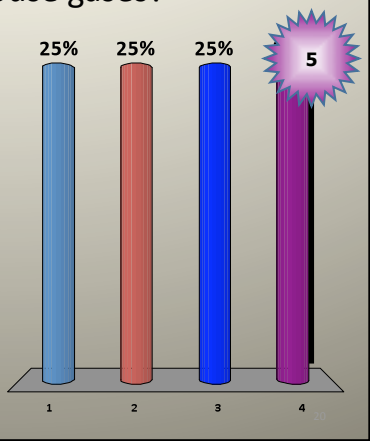
Put all your materials on the floor and place your PRS clicker in front of you.

Please: use just one clicker for yourself.

Take care that others can not view your selection

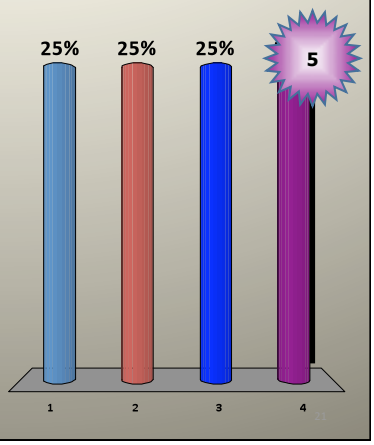
1. How much warmer is our Earth due to it's current greenhouse gases?

1. About 5 °F
2. About 10 °F
3. About 30 °F
4. About 50 °F



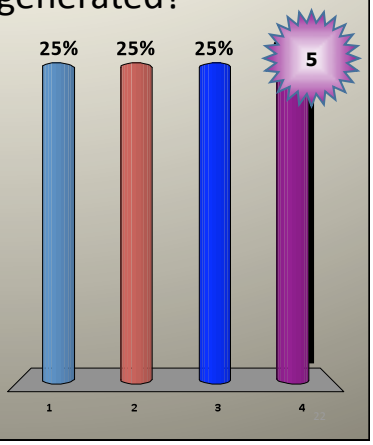
2. Where is most of the CO_2 stored on Earth?

1. In the surface rock
2. In the atmosphere
3. In the oceans
4. About equal amounts are found in all three.



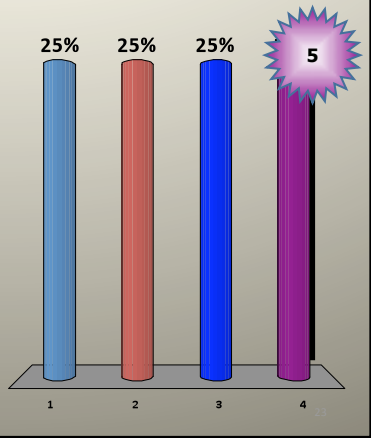
3. In the CO_2 cycle, at which stage are carbonate minerals generated?

1. At the base of the ocean
2. In the atmosphere during precipitation.
3. During subduction
4. During volcanic outgassing



4. What appears to be causing the Ice Ages?

1. Varying Solar radiation.
2. Varying volcanism.
3. Variations in the Earth's axis tilt.
4. Variations in CO_2 in the atmosphere



5. The habitability of the Earth is most strongly tied to its _____

1. Magnetic field
2. Atmosphere
3. Plate tectonics
4. Geological Activity
5. Oceans