

Review Outline for Exam 3, Geology 001 Bennington

Organic Carbon Cycle

Carbon in various Earth systems reservoirs – CO₂ in atmosphere, organic carbon in animals, plants, soils, fossil fuels.

Exchange of carbon from atmosphere to organic matter via photosynthesis.

Exchange of carbon from organic matter to atmosphere via oxidation.

Removal of CO₂ from the atmosphere due to burial of organic carbon in the crust of the earth – formation of fossil fuels (coal, oil, natural gas).

Burning of fossil carbon (coal, oil, natural gas) and changes in land use (deforestation) increase atmospheric carbon dioxide– fossil carbon removed from the atmosphere in the past is being returned to the atmosphere by human activities at a very rapid rate.

Inorganic Carbon Cycle

Transfers carbon between atmosphere, oceans, rock, and mantle

Solubility pump – oceans can dissolve 50X more CO₂ than atmosphere can hold
CO₂ is transferred to the deep ocean by vertical circulation. As CO₂ dissolves in the ocean, the ocean acidifies.

Carbonic acid – causes chemical weathering, which converts CO₂ in the atmosphere to bicarbonate ion in the oceans (chemical reaction of carbonic acid with minerals during chemical weathering of rock)

Bicarbonate ion is converted in the oceans to carbonate rock (limestone). The formation of carbonate rock occurs primarily in tropical ocean waters and is mediated by organisms such as plankton, coral, and algae.

Carbonate rock is metamorphosed in subduction zones, putting CO₂ into the mantle.

CO₂ is released back into the atmosphere by volcanic eruptions.

How does the carbon cycle regulate the climate of the Earth over geologic time?

When the Earth starts to warm up, how does this affect the removal of CO₂ from the atmosphere via the inorganic carbon cycle?

When the Earth starts to cool down, how does this affect the removal of CO₂ from the atmosphere via the inorganic carbon cycle?

What is the role of volcanoes in regulating the climate of the Earth?

Why is this an example of a negative feedback loop?

Global Warming

Evidence for rising levels of CO₂ in the atmosphere: pre-1959 – samples of air from ice cores drilled in Antarctica and Greenland. Post 1959 – direct measurement of atmosphere (e.g. station on top of Mona Loa).

CO₂ is a greenhouse gas – traps heat radiated from the surface of the Earth, preventing it from being lost to space.

Current CO₂ levels approaching double highest level of past 400,000 years.

CO₂ is correlated with global temperature for the past 400,000 years.

Evidence that the global climate is warming due to CO₂:

Temperature records show increasing average global temp.

Climate zones are shifting north – growing seasons are changing.

Weather patterns and precipitation patterns are changing.

Lower atmosphere is heating up more than upper atmosphere.
Computer models show close fit between predicted and actual change in temperature when CO₂ is incorporated as a greenhouse gas.
Some evidence for increasing intensity of hurricanes and other storm events.
Observation that glaciers, ice shelves, and sea ice are melting at unprecedented rates.

Why global warming and climate change is a problem:

Change is expensive to deal with – infrastructure is based on past conditions.

Melting ice causes rising sea level – coastal flooding.

More extreme weather and storms – droughts and floods.

Poor nations and poor people at greater risk.

Adapting to climate change will be very costly.

Ways to prevent or moderate CO₂ emissions and associated climate change:

Increase efficiency of energy use – less waste = less fuel burned.

Switch to non-carbon-producing energy sources – solar, wind, nuclear.

Carbon sequestration – bury CO₂ emissions from fossil fuels.

Cap and Trade – cap CO₂ emissions and allow companies to sell unused emissions credits.

Carbon tax – tax carbon emissions to create an economic incentive to reduce

Carbon offsets – do something (e.g. plant trees) to uptake CO₂ to balance CO₂ emitted by burning of fuels.

Ways that YOU can reduce your personal carbon emissions? (Think about it!)