Animals Eating (30 gigatons per year) from plants into animals

Plant and Animal Decomposition (30 gigatons per year)

Natural Leakage and Breakdown of Fossil Fuels (.05 gigatons per year)

Gas from Decomposition (30 gigatons per year)

Animal Respiration (30 gigatons per year)

Photosynthesis (120 gigatons per year)

Atmosphere to Ocean (90 gigatons per year)

Ocean to Atmosphere (90 gigatons per year)

Plant Respiration (60 gigatons per year)

Photosynthesis (120 gigatons per year)
Flow
Atmosphere to Ocean
CO₂ from the atmosphere dissolves in ocean water.

Flow
Animals Eating
Animals eat plants and/or other animals. All cells of every plant and animal contain carbon.

Flow
Animal Respiration
When animals break down the food they eat, they breathe out CO₂ into the atmosphere.

Flow
Ocean to Atmosphere
CO₂ moves out of ocean water and into the atmosphere.

Flow
Natural Leakage and Breakdown of Fossil Fuels
Small amounts of fossil fuels (natural gas, crude oil, or coal) leak from underground to the surface. At the surface, the fossil fuels naturally break down into CO₂, which flows into the atmosphere.

Flow
Gas from Decomposition
Decomposers, such as bacteria and fungi, give off carbon to the atmosphere as CO₂ or CH₄ when they break down carbon from dead animals and plants into their different nutrients.

Flow
Plant Respiration
Plants need to use up some of their sugars to survive. Plants give off CO₂ into the atmosphere as they break down their own sugars for life processes. This happens during the day and at night.

Flow
Plant and Animal Decomposition
After plants and animals die, decomposers break them down into their different nutrients, which enter the soil. This is a way carbon flows into the soil reservoir.

Flow
Photosynthesis
Land plants take in CO₂ from the atmosphere and H₂O from the soil to make sugars.
Photosynthetic organisms in the ocean take in dissolved CO₂ from the water to make sugars.
Animals Eating from plants into animals (30 gigatons per year)
**Flow**

**Volcanic Eruptions**
Volcanoes release CO₂ into the atmosphere from rocks that are deep in Earth’s crust.

**Flow**

**Surface Ocean to Deep Ocean**
Dead organisms, shells, and the carbon they contain, sink to deep ocean water.

**Flow**

**Deep Ocean to Sediments & Sedimentary Rocks**
Dead organisms and shells settle to the seafloor. As layers build up over time, these materials may be changed into sedimentary rocks or fossil fuels.

**Flow**

**Deep Ocean to Surface Ocean**
Carbon can remain in the deep ocean for hundreds of years. However, mixing can bring deep water with carbon back to the surface.

**Flow**

**Weathering of Rocks**
Carbon from CO₂ is removed from the atmosphere when it combines with rainwater and reacts with the chemicals in rocks. The products from the reactions, such as carbonate (CO₃²⁻), can be used by plankton or can settle on the seafloor and are eventually buried.

**Flow**

**Sedimentation & Burial**
Carbon in the ground (originally from dead organisms), which is not consumed, can be buried under layers of earth. Under high pressures and temperatures and over millions of years, the material is changed into fossil fuels.

**Flow**

**Human Industry: Making Cement**
Limestone is heated to make cement, and this releases limestone’s carbon (as CO₂) into the atmosphere. In the last ~100 years, more and more cement has been made, releasing more and more carbon as CO₂ into the atmosphere.

**Flow**

**Human Industry: Land-Use Change**
When forests are cut down or burned so the land can be used another way, such as building cities and roads or raising cows and crops, there are fewer trees to absorb carbon through the process of photosynthesis. The overall result is that more carbon ends up in the atmosphere.

**Flow**

**Human Industry: Combustion of Fossil Fuels**
In the last ~100 years, humans have taken more and more crude oil and other fossil fuels from underground and used them to power cars, machines, and more. The fossil fuels are burned, and carbon is released into the atmosphere as CO₂.
Animals Eating (30 gigatons per year)

Flow

Residence Time: 60 days

Animals (5 gigatons)

Residence Time: 94,000 years

Atmosphere (800 gigatons)

Residence Time: 3.6 years

Fossil Fuels: Coal (3,800 gigatons)

Residence Time: 94,000 years

Limestone & Other Rocks (40,000,000 gigatons)

Residence Time: 800,000,000 years

Plants (600 gigatons)

Residence Time: 5 years

Residence Time: 94,000 years

Residence Time: 94,000 years

Residence Time: 94,000 years

Residence Time: 370 years

Deep Ocean Water (37,000 gigatons)

Residence Time: 11 years

Ocean Surface Water (1,000 gigatons)

Residence Time: 5 years

Ocean Surface Water

OCEAN SURFACE WATER

37,000

DeeP OCEAN Water

37,000

Residence Time: 800,000,000 years

Residence Time: 3.6 years

Residence Time: 3.6 years

Atmosphere

(800 gigatons)

Residence Time: 11 years

Atmosphere

(800 gigatons)

Residence Time: 3.6 years

Atmosphere

(800 gigatons)

Residence Time: 3.6 years

Fossil Fuels: Crude Oil (680 gigatons)

Residence Time: 94,000 years

Fossil Fuels: Crude Oil (680 gigatons)

Residence Time: 94,000 years

Fossil Fuels: Natural Gas (570 gigatons)

Residence Time: 94,000 years

Fossil Fuels: Natural Gas (570 gigatons)

Residence Time: 94,000 years
Reservoir

Fossil Fuels: Coal
In watery environments on land, some dead plants get buried rather than decomposing right away. Under high pressures and temperatures and over millions of years, much of this old plant matter becomes coal.

Reservoir

Fossil Fuels: Crude Oil
At the bottom of the ocean, some dead organisms get buried rather than decomposing. Under high pressures and temperatures and over millions of years, much of what remains of these dead organisms becomes crude oil.

Reservoir

Fossil Fuels: Natural Gas
In watery environments on land and at the bottom of the ocean, some dead organisms get buried rather than decomposing. Under high pressures and temperatures and over millions of years, some of the buried material becomes natural gas, and the rest becomes coal or crude oil.

Reservoir

Limestone and Other Rocks
Calcium carbonate (CaCO$_3$) shells from dead ocean organisms collect on the ocean floor. Over millions of years, they are buried and form limestone. Carbon in limestone may change into other rocks, such as marble.

Reservoir

Deep Ocean Water
Carbon in dead organisms slowly falls from the surface to the deep ocean (marine snow).

Reservoir

Plants
Plants are built of sugars (C$_6$H$_{12}$O$_6$) that they make through photosynthesis, using CO$_2$ and H$_2$O. The sugars are then changed into cellulose and other materials to make different plant structures. Every cell of every plant contains carbon.

Reservoir

Ocean Surface Water
Carbon dioxide (CO$_2$) from the atmosphere dissolves into ocean water at the surface. Some of the carbon combines with calcium to form calcium carbonate (CaCO$_3$) in shells.

Reservoir

Atmosphere
The atmosphere is a layer of gases surrounding the planet. The atmosphere is mostly nitrogen and oxygen gases, with less than 1% CO$_2$ (carbon dioxide), CH$_4$ (methane), and other gases.

Reservoir

Animals
Every cell in every animal has carbon in it. Animals get their carbon by eating plants or other animals.

Reservoir

Atmosphere
The atmosphere is a layer of gases surrounding the planet. The atmosphere is mostly nitrogen and oxygen gases, with less than 1% CO$_2$ (carbon dioxide), CH$_4$ (methane), and other gases.
Animals Eating (30 gigatons per year) from plants into animals

Flow

Sediments & Sedimentary Rocks (20,000,000 gigatons)

Soil (1,600 gigatons)

Residence Time: 53 years

Residence Time: 1,000,000 years

Precipitation (.1 gigatons per year)

Residence Time: 1,000,000 years

Carbon

Carbon
Reservoir

Sediments and Sedimentary Rocks

Sediments and sedimentary rocks are formed from the breakdown of rocks, such as granite and basalt, and from the buildup of dead organisms, including CaCO$_3$ shells.

Reservoir

Soil

Some carbon from decomposing organisms and decomposers ends up in the soil. This carbon stays in the soil for as little as a few weeks to as long as tens of thousands of years. Soil with more carbon in it is richer (more productive).

Flow

Precipitation

As rainwater falls, it dissolves small amounts of atmospheric CO$_2$ to form carbonic acid (H$_2$CO$_3$). This weak acid can react with the chemicals in rocks and break them down. In some rocks, this can ultimately cause the release of carbonate (CO$_3^{2-}$) into the waterways.