Global Warming and Man-made Climate Change

This is a short summary of key points about the damage we are causing to the Earth's climate. Much better sources are available on the web. Previously, the best information came from the United States government agencies, particularly NOAA and the EPA, but recent political pressure has muted that information and other sources such as those from Europe may now be better.

Earlier editions of your textbook actually called man-made global warming a myth, and presented decade-old data about the Earth's temperature in its Earth Sciences chapters. It argued that water vapor is the most important greenhouse gas and that CO_2 (carbon dioxide) is much less important. Water vapor is controlled by the average temperature of the Earth's oceans, and without any increase in CO_2, the water vapor effect would be constant. As we cause atmospheric CO_2 to increase, however, the direct warming of that CO_2 is magnified because the ocean temperatures are increased and therefore the amount of water vapor in the atmosphere also increases. The text has moderated that error in recent editions, but is not a good source of information about global warming.

Radioactive decays inside the Earth keep its interior liquid, but at the surface, the Sun is our primary source of energy. Its radiation arrives as ultra-violet rays, visible rays, and infrared rays. Extreme ultraviolet rays are absorbed by ozone in our upper atmosphere, less powerful ultraviolet rays reach us and cause sunburn and skin cancer. Visible light easily penetrates the atmosphere and warms the earth. Infrared rays are largely reflected by CO_2, CH_4 (methane), H_2O (water vapor). Infrared rays from the sun are reflected away from the Earth.

Because the Sun's surface is extremely hot, it emits "black-body" radiation primarily as visible light. By contrast the much lower temperature of the Earth's surface emits infrared radiation.

Glass, like the CO_2, CH_4, and H_2O in our atmosphere, also allows the passage of visible light and reflects infrared rays. The greenhouse effect occurs when visible light can enter through the glass walls of a greenhouse heating up the interior, but the infrared rays from the heated interior are reflected back by the glass trapping most of the heat inside the greenhouse.

Plants absorb CO_2 and expel O_2 when growing. They use visible light to convert the carbon in the CO_2 to organic molecules like starch and cellulose. At night they, like animals, take in O_2 from the atmosphere and expel CO_2 to recover energy from some of that stored starch energy. The net result, however, is that while they are growing, they remove much more CO_2 than they expel.

When plants die, their stored organic matter might decay and become CO_2 once again. But, if they are buried in the earth or under deep water, they cannot decay and become our fossil fuels – coal, oil, and methane. If we mine these fossil fuels and burn them for energy, we then release that stored carbon as CO_2. Our burning of fossil fuels undoes in decades what nature buried over millennia.

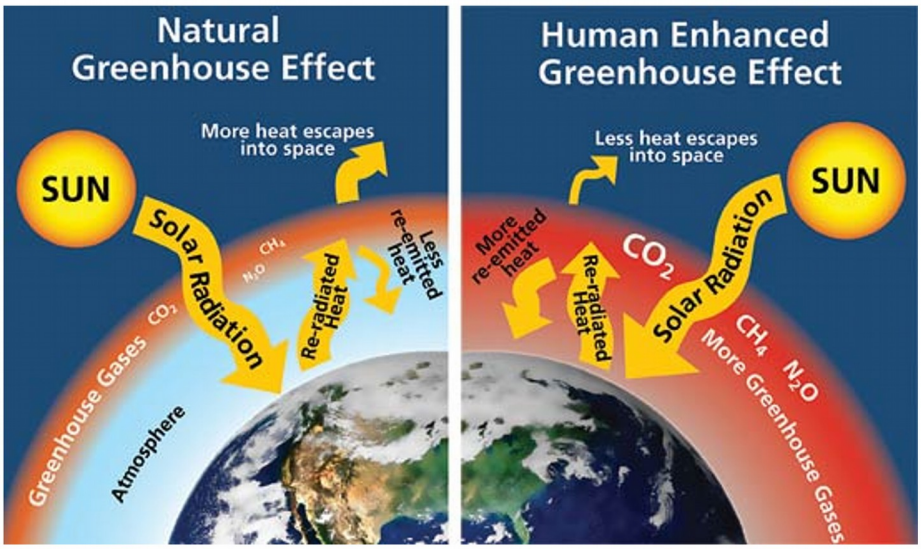
Some of that stored methane is trapped at the bottom of places in the ocean and in the Arctic permafrost. That methane will be released if the oceans and Arctic become sufficiently warm.

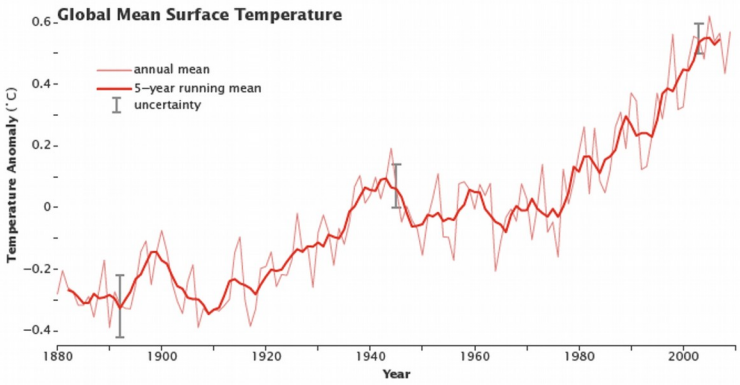
The oceans slowly absorb CO_2, but much slower than we generate it from burning fossil fuels. In doing so, however, they become more acidic and less hospitable to shelled marine creatures. Ocean acidification from this process is a danger to the food chain in the ocean.

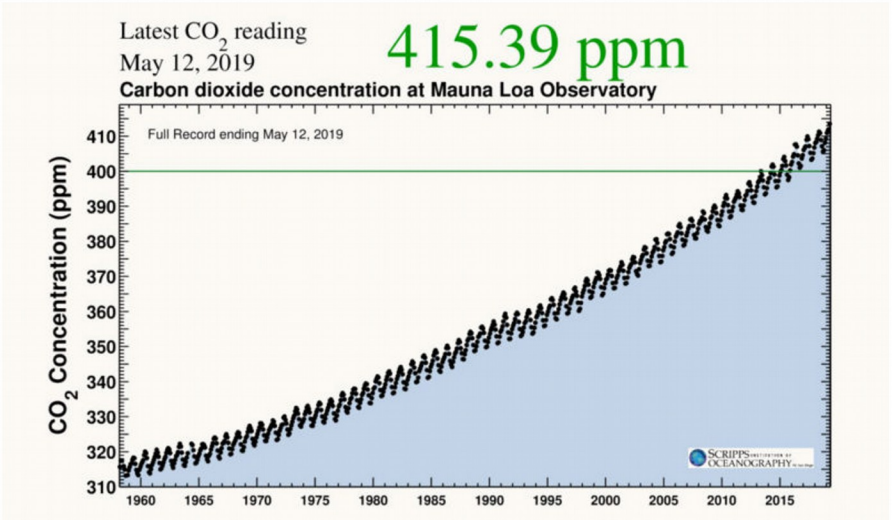
As the earth warms, the glaciers on land and sea ice melt more each summer. Melting glaciers add water to the oceans and are gradually increasing the sea level. Sea ice melting has no effect on the seal level, but causes weather patterns to move more slowly because those patterns are driven in part by the temperature difference between the Earth's poles and equator. Winter storms, summer rains, and summer heat spells will tend to last longer. Hurricanes, that are powered by warm ocean temperatures, are expected to become more powerful and move more slowly.

Study the images on the next page for a better understanding of some of these facts.

The two images below are from:
https://socratic.org/questions/how-is-the-greenhouse-effect-related-to-global-warming







See https://www.youtube.com/watch?v=Z43FQCSg4Ow for animated Keeling curve.

The latest Arctic Ice Coverage Data along with previous decade averages and the record low 2012 year are shown in the chart below. This year's minimum is just slightly lower than 2007 and 2016, making it the 2nd lowest on record. We seem headed toward having an ice-free September in the Arctic within your lifetimes as a result of CO_2 already in the atmosphere.

The Arctic ice is just starting to reform now, and will reach a maximum at next year's vernal equinox in mid March.

This interactive chart is from *https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph/* .