Read this excerpt from Chapter 9 of *Climate Change: The Science of Global Warming and Our Energy Future (2nd Edition)*, p.265:

> Global warming is not a theoretical construct. Rather, the fact that the Earth is warming is based on *observations*. The warming has been measured on land, in the atmosphere, in the ocean, and even in the ground. If that's not enough, the ice caps are melting, and sea level is rising, the latter due to both the melting of ice on land and the thermal expansion of the warming ocean. In other words, *all* the physical components of Earth's climate system (atmosphere, hydrosphere, geosphere, and cryosphere) have been gaining heat. Accordingly, we begin this chapter by documenting the warming since the middle of the nineteenth century.
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> We then explore some consequences of warming. We limit our discussion mainly to physical consequences, including drought, decreased water supplies, extreme and unusual weather events, and rising sea level. As we shall see, some of these consequences could bring momentous harm to human society. How they will play out remains uncertain, however, as only now are many of the effects beginning to reveal themselves. The biological consequences are equally momentous but not covered in detail here. They include decreased biodiversity, increased susceptibility of plants and animals to pests and diseases, shifts in species ranges, numerous phenological changes (referring to the timing of life-cycle phenomena, such as egg laying, flower blooming, and spring migration), and the spread of human diseases.
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> If there is one place that the effects of warming are in full and accelerated display, it is the Arctic. This is because the Arctic has warmed at more than double the rate of the rest of the planet, making many of the changes in marine and terrestrial environments plainly evident. For those of us who do not live in the far north, we see it most dramatically in images of the steady disappearance of sea ice and of polar bears clinging to what remains of their frozen habitat. In concert with the decline in sea ice, permafrost is thawing, and this is having a cascading, in some cases profound, effect on high-latitude ecosystems. We therefore conclude this chapter by investigating the steady decline of Arctic sea ice, the thawing of Arctic permafrost, and the real and potential effects of these changes on the global climate.

This week, we're going to look at documented warming and other changes that have occurred since the middle of the nineteenth century. You and your partners can use ***scientifically sound*** websites, pictures, diagrams, videos, etc. to help answer the guiding questions below, but remember to make your information *useful to the other students in the class*. Please select one topic to investigate:

A Century of Warming - Ollie, Ryker & Kaysia

- the warming at the surface
- the warming of the troposphere and the cooling of the stratosphere

- the warming of the ocean
- other signals of warming (e.g., retreat of mountain glaciers, terrestrial boreholes)

Precipitation, Drought and Storms - Eli, David & Mayara

- how warming affects precipitation and drought (e.g., Kansas 1934)
- the drought prognosis for the American southwest
- forest fires
- why some water supplies are in jeopardy
- severe storms and other extreme events (e.g., Europe 2003, hurricanes, Texas 2021)

The Sensitive Arctic - Katherine, Anabelle, Finley & Gia

- the Arctic Oscillation (AO) and sea ice
- the loss of sea ice
- Arctic warming and other impacts of sea-ice loss
- the thawing of permafrost and the effect of thawing permafrost on climate
- methane hydrate and other changes in the Arctic environment

Here are some guiding questions your presentation should answer in the context of changes in our climate:

- what change is happening, specifically?
- how do scientists know the change is happening? what measurements have been taken and what observations have been made?
- what impact(s) does this change have? how does it impact other parts of the planet's climate system that we've learned about so far (e.g. atmosphere, ocean, carbon cycle, etc.)
- what is expected in the future? will this change continue to happen, will it increase, or will it slow down and eventually stop? how do we know?

Remember, these are guiding questions to help you assemble information about your topic. You aren't expected to answer every single question, but if you do, you'll have a deeper understanding of your topic, and you'll be better able to explain it to the rest of us. Make sure to keep track of your sources so you can share them with us!