Weather

There IS a graphic organizer for this lesson.

"We are running the most dangerous experiment in history right now... to see how much carbon dioxide the atmosphere can handle before there is an environmental catastrophe" – Elon Musk

Overview

Weather and **climate** are often used interchangeably in day-to-day language, but it is important to understand the difference between the two to understand our planet and how it changes over time. Weather refers to short term **atmospheric** conditions while climate is the weather of a specific region averaged over a long period of time. Climate change refers to long-term changes. **Meteorologists**, also called weather forecasters, are people who study the weather and predict weather patterns in the coming days. **Climatologists** study the climate, or weather patterns over long periods of time.

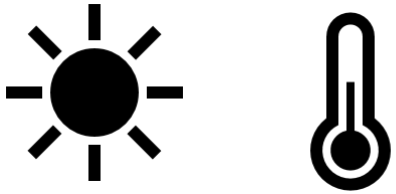
The scientific community is certain that the Earth's climate is changing because of the trends that we see in the climate record and the changes that have been observed in physical and biological systems. The instrumental record of climate change is derived from thousands of temperature and precipitation recording stations around the world. We have very high confidence in these records as a whole. The evidence of a warming trend over the past century is certain. The questions we have left to answer this cycle are what is causing this warming? What are its impacts? And what can we do about it?*

What is the difference between weather and climate?

Weather

- State of the atmosphere at a place and time as regards temp, humidity, cloud cover, wind, precipitation, etc.
- When we talk about weather, we are usually talking about conditions within days or weeks or season.
- "The forecast says there is a high chance of rain tomorrow." Weather conditions can vary greatly from day-to-day.

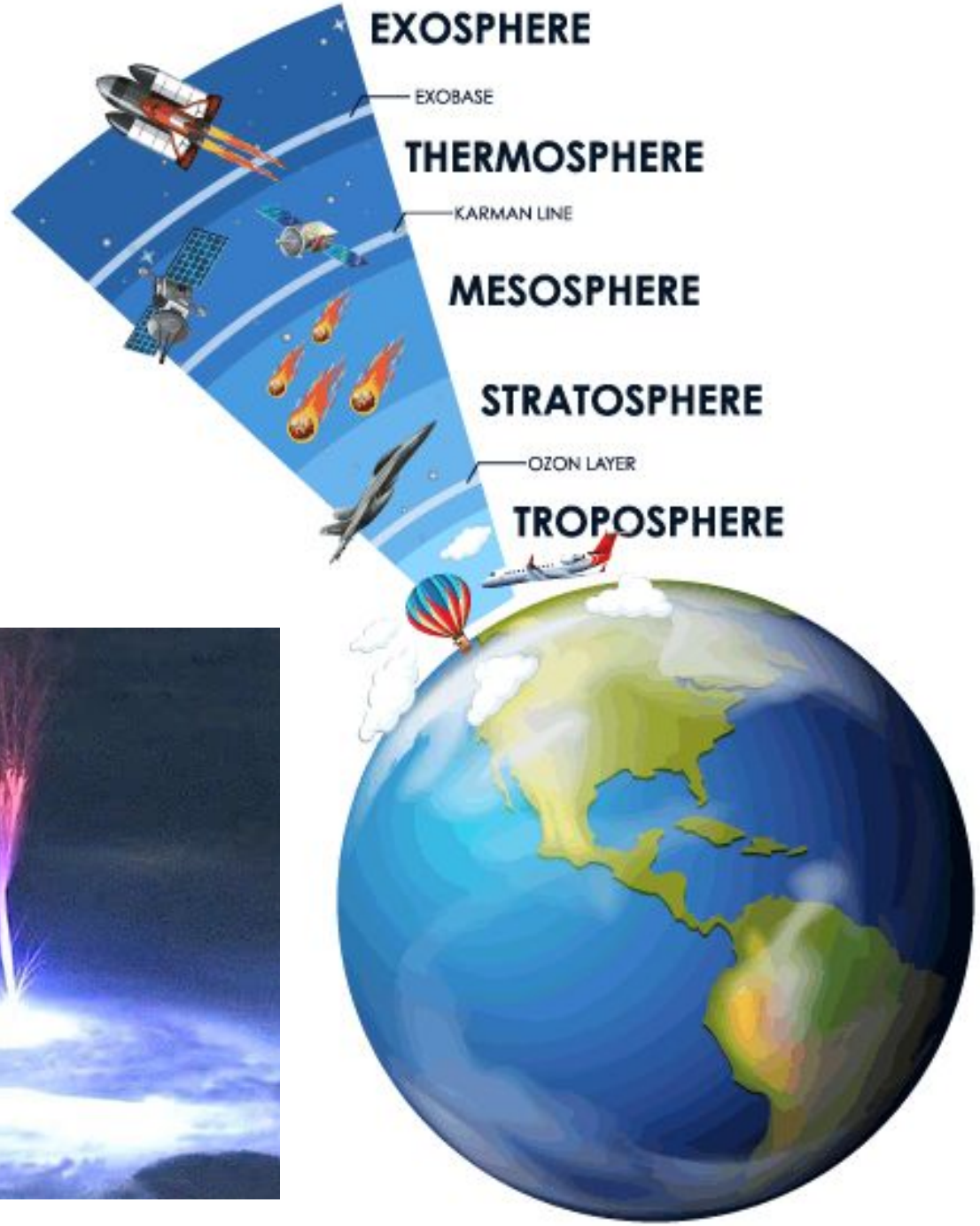
Climate



- Normal weather conditions in an area in general or over a long period
- Climate looks at weather conditions over time spans longer than a year.
- "The climate in Arizona is hot and dry." This doesn't mean that every single day in Arizona is hot and dry, or that every part of Arizona is hot in dry. But in general, compared to other places, the average climate of Arizona is hot and dry.

Atmosphere

- A layer of gases that envelop a planet and is held in place by the gravity of the planetary body.
- AKA "air" (78% NO_2 21% O_2 1% etc)
- Our atmosphere is divided into 5 different layers.
- Almost all weather occurs in the troposphere, the bottom layer.
- A rare counter-example: (photo from ISS)



Study of Weather and Climate

Meteorologists

- Scientists who study the processes and phenomena of the atmosphere and forecast the weather are called meteorologists.
- This week you will do several simulations to predict weather, just like meteorologists do.
- In the next few slides, we'll learn about the tools they use to do this.

Climatologists

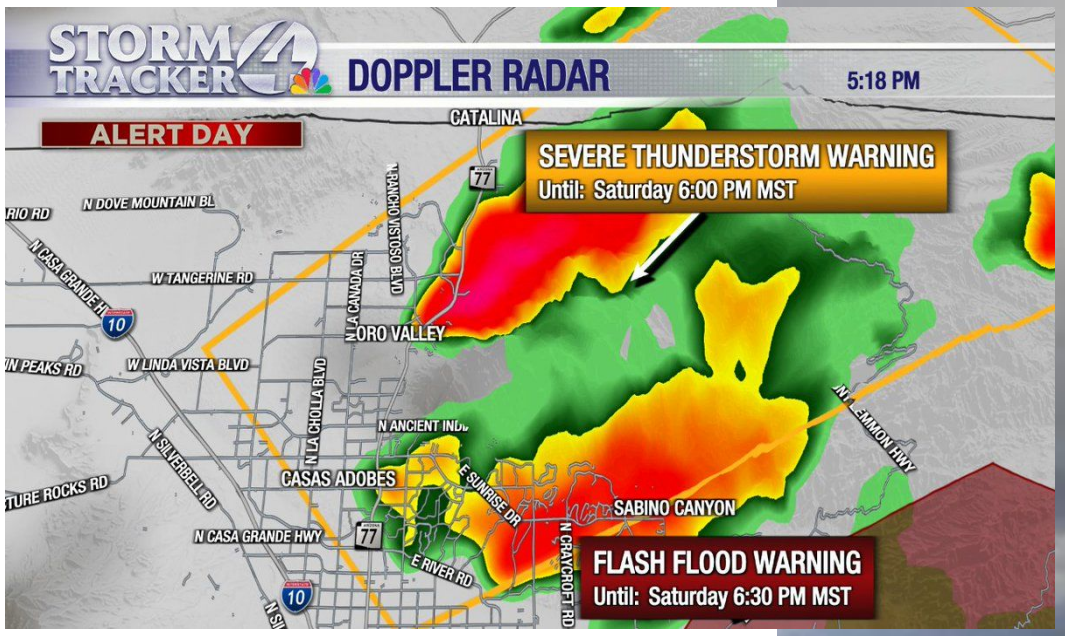
- Scientists who study climate are called climatologists.
- We will learn more about climate and climatology next week.
- Build models based on data collected by meteorologists

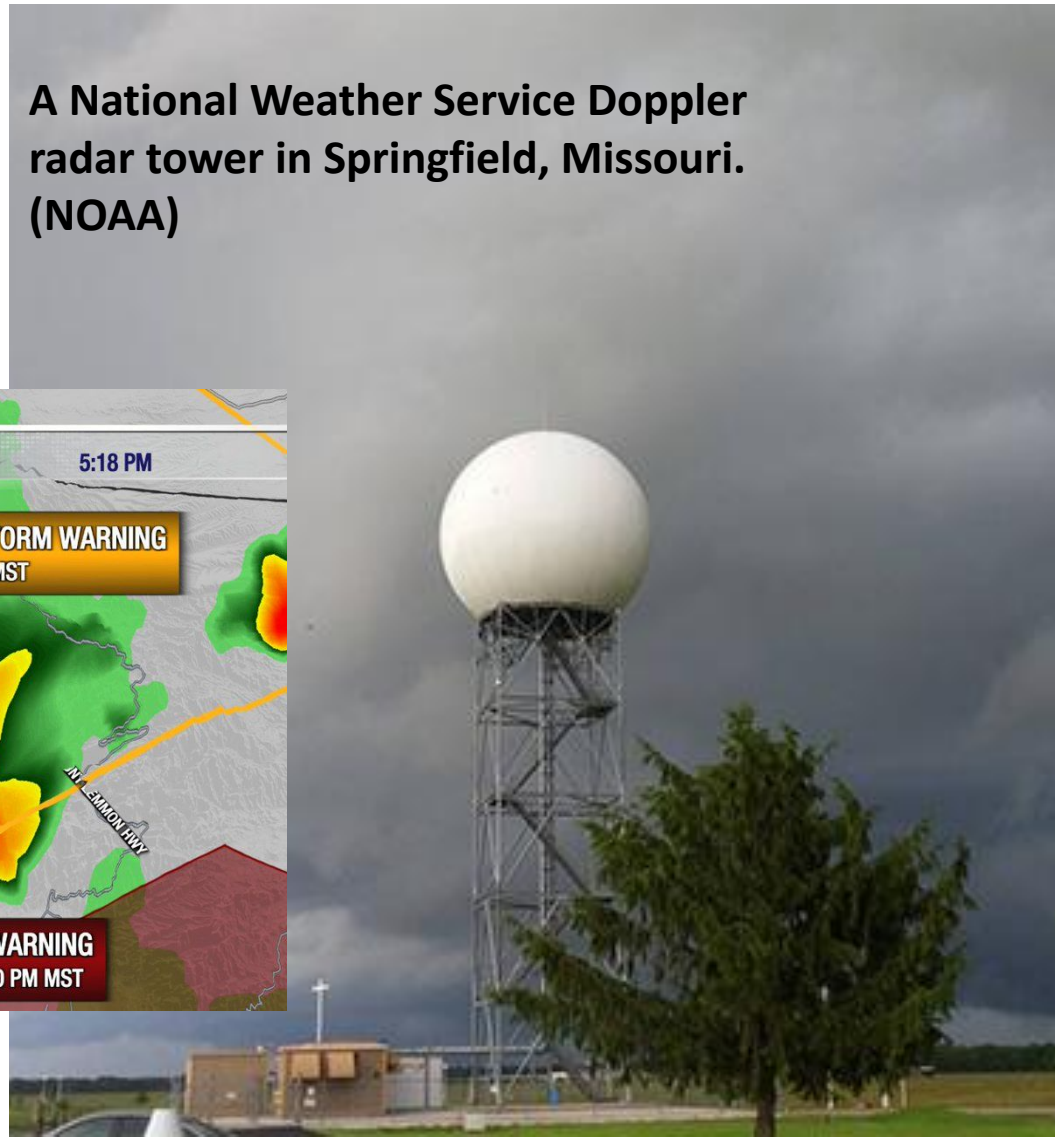
Tools Meteorologists Use—Doppler Radar

- How they observe severe storms
- There are more than 159 radar towers across the United States

It detects:

- all types of precipitation
- the rotation of thunderstorms
- airborne tornado debris
- wind strength and direction





A National Weather Service Doppler radar tower in Springfield, Missouri. (NOAA)

Satellites

They monitor Earth from space, collecting observational data for scientists to analyze. There are three main types of weather satellites:

- Polar orbiting satellites orbit the Earth close to the surface, taking six or seven detailed images a day.
- Geostationary satellites stay over the same location on Earth high above the surface taking images of the entire Earth as frequently as every 30 seconds.
- Deep space satellites face the sun to monitor powerful solar storms and space weather.

Radiosondes

Primary source of upper-atmosphere data

- At least twice per day, radiosondes are tied to weather balloons and are launched in 92 locations across the United States.
- In its two-hour trip, the radiosonde floats to the upper stratosphere where it collects and sends back data every second about air pressure, temperature, relative humidity, wind speed and wind direction.
- During severe weather, we usually launch weather balloons more frequently to collect additional data about the storm environment.

A NWS weather balloon fitted with a radiosonde launches in Bismarck, North Dakota. (NOAA)

Automated Surface Observing Systems

ASOS at the Childress Municipal Airport in Texas. (NOAA)

Constantly monitor weather conditions on the Earth's surface.

- More than 900 stations across the U.S. report data about sky conditions, surface visibility, precipitation, temperature and wind up to 12 times an hour.
- Nearly 10,000 volunteer NWS Cooperative Observers collect and provide us additional temperature, snowfall and rainfall data.
- The observational data our ASOS and volunteers collect are essential for improving forecasts and warnings.

Supercomputers

NOAA's Weather and Climate Operational Supercomputer System (WCOSS) is the backbone of modern forecasting.

- Observational data collected by doppler radar, radiosondes, weather satellites, buoys and other instruments are fed into computerized NWS numerical forecast models.
- The models use equations, along with new and past weather data, to provide forecast guidance to meteorologists.

Vocabulary Meteorologists Use-

Temperature

- Measure of the average kinetic energy of the particles (atoms or molecules) in a substance (e.g. air)
- In weather, we often talk about the "high" and "low" for the day. These refer to the highest temperature reached and the lowest temperature reached that day. Meteorologists forecast what they think the high and low will be, but this prediction is usually off by a few degrees. After the day is over, the exact high and low are recorded in the historical record.

Humidity

- Measure of the amount of water vapor in the air.
- Meteorologists often include the level of humidity in their weather forecasts. However, what they tell you on the weather report is relative humidity, or the amount of water vapor in the air "relative" to how much the air can hold. The warmer the air, the more moisture it can hold before it starts to rain.

Precipitation

- Rain, snow, sleet, or hail that falls to the ground.
- When most people say "precipitation," they are referring to rain. But in meteorology, precipitation is any form of condensation of atmospheric water vapor that falls under gravitational pull from clouds.
- Weather reports usually express precipitation as a percentage, meaning the chance that it will precipitate that day **in a particular location**.

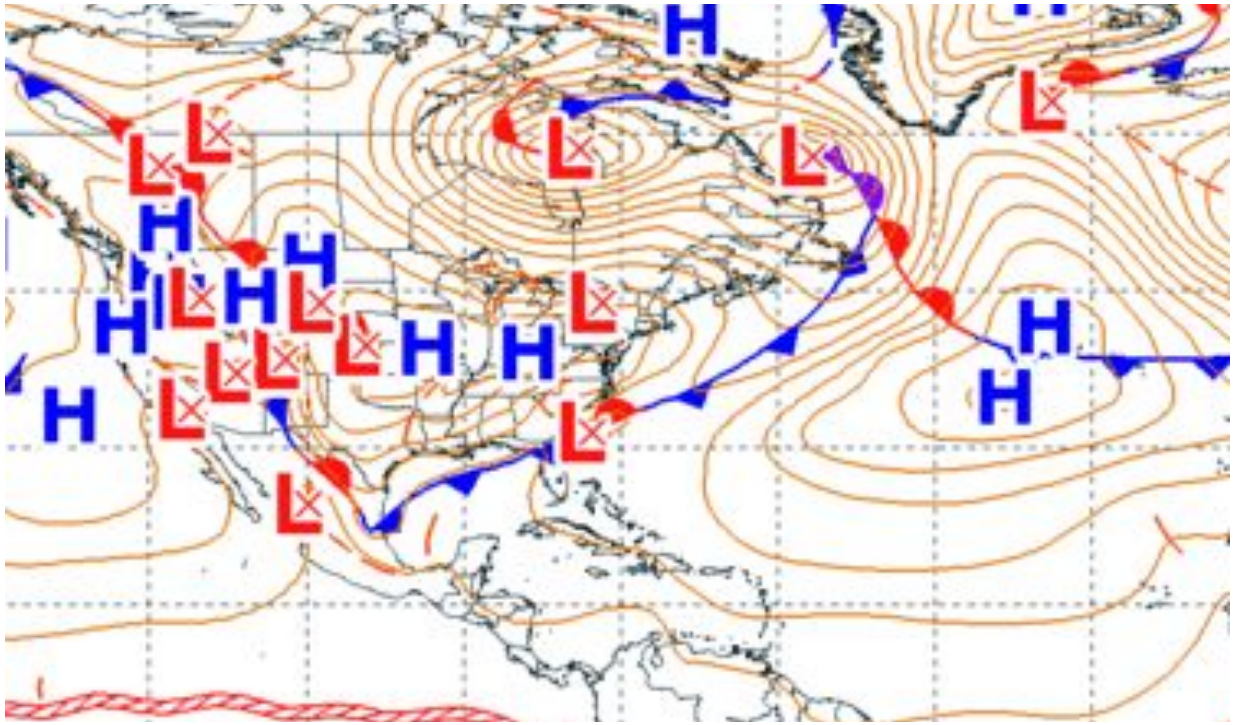
DATE	TEMP	DESCRIPTION	PRECIP	HMD	WND
FRIDAY 11/18	**73°**/40°	Mostly Sunny	**0%**	**23%**	SSW 9 MPH
SATURDAY 11/19	**70°**/44°	Sunny	**0%**	**27%**	E 10 MPH
SUNDAY 11/20	**67°**/41°	Sunny	**0%**	**38%**	E 14 MPH

Atmospheric Pressure

The force on a surface by the air above it as gravity pulls it to Earth.

- We often just call this "air pressure" because it is the pressure exerted by the weight of the air. How hot or cold the air is affects its pressure. You will learn more about this in group work. When meteorologists refer to "pressure systems" they are talking about areas that are experiencing higher or lower pressure than normal.

- A barometer:



Guiding Question 1: How do changes in weather and the climate affect our lives?

_____ 1. **Lesson** Weather & Meteorology
Markup overview then participate in lesson on the difference between weather and climate. Take notes on GO.

_____ 2. **IW** Vocabulary
Words: ***atmosphere, climate, meteorologist, mitigate, weather***
Find appropriate definitions & add them to the vocab list in your notebook.

_____ 3. **GW** Weather (& all that it affects) Observation Project
Small groups will pick a spot near a tree and revisit it daily, creating a Journal of the Senses & Minds.

_____ 4. **GW** Weather Activities
With your small group, complete ***each*** *of the following activities. Follow the steps on the Weather Activity Sheet and answer all questions along the way.*

_____ a. Why does the wind blow?
_____ b. Make a Thunderstorm
_____ c. Weather Lab
_____ d. The Cloud Lab