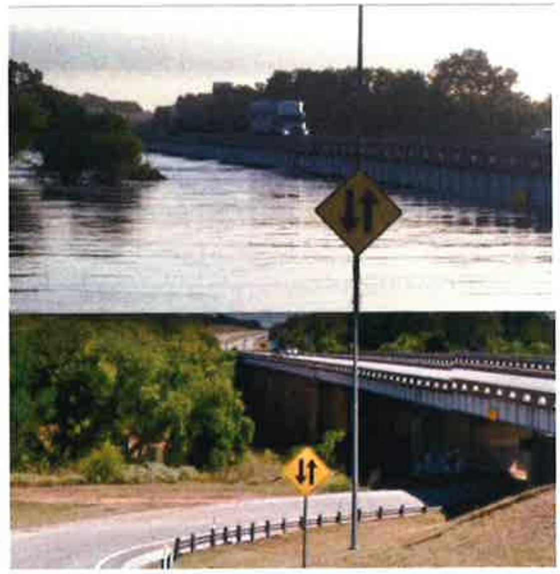
Climate vs. Weather

This text is from the U.S. National Oceanic and Atmospheric Administration: National Weather Service.

Time is the basic difference between climate and weather. When one averages the weather (maximum temperature, minimum temperature, wind speed and direction, rainfall, etc.) for any place, for any day, over a fixed number of years, that determines the average weather experienced, for that day, at that location.



2015 was an extraordinary year for rainfall in North Texas. This view is looking north into Oklahoma, from Texas, across the Red River in a "normal" year (bottom) and after very heavy rains that was part of the phenomenally wet year weather-wise.

Those averaged weather values then become to represent the *climatic normal* weather for that day. From the National Centers for Environmental Information (NCEI, formally NCDC), "the *climatic normal* is simply the arithmetic average of the values over a 30-year period (generally, three consecutive decades)."

The current set of climate normals is based upon observed weather in the years of 1981 to 2010. [I]n 2021, a new set of climate normals will be generated based upon the observed weather between 1991 and 2020.

Climatic normals (or averages) are most commonly seen on local weather broadcasts. The daily observed maximum and minimum temperatures is often compared to the "normal" temperatures based upon the 30-year average.

Also, these climatic normals help provide context if you hear something like "this winter will be wetter (or drier, or colder, or warmer, etc.) than normal." Other phrases such as "unseasonably warm (or cool)" weather is a comparison of the current weather conditions as related to the "climatic normal" for that time.

It has been said, "Climate is what you expect. Weather is what you get." In part, that is true, but for the vast majority of time, the observed weather [is] rarely "normal."

A good example is the all-time record rainfall for the Dallas/Fort Worth Airport in 2015. Climate normal for rainfall is 36.14" (918 mm). The actual rainfall for the year was 62.61" (1,590 mm). In only three months (May, October, and November) nearly a "normal" year's worth of rain fell.

The annual rainfall for 2015 broke the old all-time record by over 9" (229 mm). This was truly an extraordinary rain record that will stand for tens of decades, if not centuries.

2015 was a "roller coaster" year for the *occurrence* of rainfall in the DFW area as well. That same year, there was a stretch of 41 consecutive days with **NO** precipitation, which was the third-longest number of rain-free days on record.

Even individual days can have a wide variety of weather yet appear to be near climatologically normal. Again at the Dallas/Fort Worth Airport on November 27, 2015, the average of the maximum and minimum temperature was 55°F (13°C). The normal for that day is 52°F (11°C). So at first glance it would have appeared to be a "near normal" day temperature-wise.

The maximum temperature was 70°F (21°C), but [it] occurred around 3 AM in the morning. . . . [A] strong cold front moved past Fort Worth and Dallas early that morning, and the temperature began to fall.

The minimum temperature . . . was 39°F (4°C), and [it] occurred just prior to midnight. So the average temperature was near normal *climate*-wise, when that day was quite different weather-wise.

So large swings in day-to-day, month-to month, and even year-to year weather does not necessarily imply large, rapid changes in climate. Weather, over time, will become part of the 30-year normal.

After reading the article, explain how time impacts climate and weather.

Wind, Swell, and Rogue Waves

This text is from the U.S. National Oceanic and Atmospheric Administration.

The wind not only produces currents, it creates waves. As wind blows across the smooth water surface, the friction or drag between the air and the water tends to stretch the surface. As waves form, the surface becomes rougher, and it is easier for the wind to grip the water surface and intensify the waves.

Wind Waves

Storms of equal size can generate much larger waves in the open Pacific Ocean as compared to the other oceans due to the long open distance of water. How big wind waves get depends on three things:

- **Wind strength**. The wind must be moving faster than the wave crests for energy to be transferred.
- **Wind duration**. Strong wind that does not blow for a long period will not generate large waves.
- **Fetch**. This is the uninterrupted distance over which the wind blows without significant change in direction.

[. . .]

After the wind begins to blow for a while, the waves get higher from trough to crest, and both the wave length and period become longer. As the wind continues or strengthens, the water first forms whitecaps and eventually the waves start to break. This is referred to as a fully developed sea.

In the book *Oceanography and Seamanship*, William G. Van Dorn provided an example of what the wave heights would be if a steady 30 knots (33 mph/53 km/h) wind blew for 24 hours over a fetch of 340 miles.

- 10% of all waves will be less than 3.6 ft (1 m).
- The most frequent wave height will be 8½ ft (2½ m).
- The average wave height will be 11 ft (3 m).
- The significant wave height will be 17 ft (5 m).
- 10% of all waves will be higher than 18 ft (5 m).
- The average wave height of the highest 10% of all waves will be 22 ft (7 m).
- A 5% chance of encountering a single wave higher than 35 ft (11 m) among every 200 waves that pass in about 30 minutes.
- A 5% chance of encountering a single wave higher than 40 ft (12 m) among every 2,600 waves that pass in about five hours.

Swell

The waves in a fully developed sea outrun the storm that creates them, lengthening and reducing in height in the process. [These] are called swell waves. Swells organize into groups smooth and regular in appearance. They are able to travel thousands of miles unchanged in height and period.

The longer the wave, the faster it travels. As waves leave a storm area, they tend to sort themselves out with the long ones ahead of the short ones, and the energy is simultaneously spread out over an increasingly larger area.

As the waves close in on the coast, they begin to feel the bottom and their direction of travel might change due to the contour of the land. Eventually, the waves run ashore, increasing in height up to 1.5 times their height in deep water, finally breaking up as surf.

It is the swell waves . . . that are responsible for big wave surfing in Hawaii from November through March. [The swell waves are generated from large winter Pacific Ocean storms.]

Rogue Waves

There are many sailor tales of "rogue waves," "freak waves," "three sisters" and other "killer waves." Properly called "extreme storm waves" these tales were ridiculed, and mariners were accused of using them as an excuse to cover their own mistakes in wrecks. Rogue waves are simply unusually large waves appearing in a set of smaller waves.

Some of the characteristics of rogue waves are:

- their height is greater than twice the size of surrounding waves,
- they often come unexpectedly from directions other than prevailing wind and waves, and
- they are unpredictable.

Most reports of extreme storm waves say they look like "walls of water," and are seen as steep-sided with unusually deep troughs. The USS Ramapo reported one such wave with a height of 112 feet in the Pacific in 1933. Another report of a freak wave occurred with it [striking] the Queen Mary amidships, south of Newfoundland, at the end of World War II, rolling her to within a degree or two of capsizing.

In April 2005, a 70-foot wave crashed down on the Norwegian Dawn cruise ship. The average waves that day were 25 to 30 feet high before this monster wave struck. The wave even damaged the ship's hull.

What causes these enormous waves? Generally they form because of swells [travel across the ocean at] different speeds and directions. As these swells pass through one another, their crests, troughs, and lengths happen to coincide and reinforce each other, combining to form unusually large waves that tower then disappear. If the swells are traveling close to the same direction, these mountainous waves may last for several minutes before subsiding.

It is very seldom that huge waves over 65 feet (20 meters) are developed, and normally sailors do not even see them, because ships nowadays will try to avoid such conditions by altering course before the storm hits. But they do occur.

After reading the article, describe how wind, swells, and rogue waves are similar and how they are different.

Mapping Out the Future

Article

Mapping Out the Future

PART 1

WASHINGTON, D.C.. Last summer, my parents and I took a drive to another state. Before we set out on our road trip, we packed up the car with snacks, bottled water, and music. Thankfully, we also packed our GPS. A few hours into the trip, we took a wrong exit off the interstate. But our trusty GPS pulled up a map of the area and got us back on track in no time. It made me wonder: Who creates maps in the first place? After some research online, I learned that the people responsible for mapping out roads, mountains, oceans, and other places around the world are called *cartographers*. I did some reading about the career. Here's what I found:

Credit for photo and all related images: Bureau of Labor Statistics

Cartographers create maps of roads, mountains, oceans, and other places around the world.

What does a cartographer do?

Cartographers, also called mapmakers, interpret and analyze geographic data. They use this data to make detailed maps of sites around the globe. Some of these maps are digital, and are often used in GPS systems. Other maps are printed in books. These include road atlases and textbooks. Usually, cartographers prepare specific maps for specific customers. For example, a cartographer might be hired to create a special map for a government agency. Some cartographers also map things such as the populations of different places.

To do their work, cartographers put together data from a variety of sources. These sources include aerial photographs and satellite images. Cartographers also use ground surveys. Some cartographers conduct ground surveys themselves. They measure altitudes, angles, and distances on a piece of land. Most cartographers, however, rely on surveyors for this important information. Surveyors measure land, air space, and water areas to collect data for the mapmaking process.

Many cartographers are employed at firms that provide architectural and engineering services. Others work at local and federal government agencies.

What does it take to be a cartographer?

Most cartographers have a bachelor's degree in something related to the field, such as cartography or geography. Students who are interested in becoming cartographers should learn as much as they can about geography. It also helps to take courses in math and computer science. Some states require that cartographers be licensed as surveyors.

Mapmaking can be a long, difficult process. Because of this, cartographers need to have excellent critical-thinking skills. Cartographers work with existing maps, surveys, and other records. So they also need to be organized.

With the rise of new technologies such as GPS systems, cartographers need stronger computer skills than they did in the past.

How much do cartographers make?

The median annual wage for cartographers is $54,000. The lowest 10 percent earns less than $32,000. The top 10 percent earns more than $92,000.

Will more cartographers be needed?

In the U.S., employment opportunities for cartographers are expected to grow about 20 percent by 2020. This is faster than the average growth of all occupations combined. Fueling most of this growth is the increasing use of maps for national security. Also, digital maps have increasingly become a main feature of many GPS systems and Web sites. Therefore, more cartographers will be needed to make sure that newly produced and updated maps are accurate.

Based on what I've read about cartographers, I'd say that their work is extremely important to a lot of people. Next time a map keeps me from getting lost, I'll be sure to thank a cartographer!

PART 2

Dig Deeper

People have been making maps for hundreds of years. Have you ever seen a really old map? Some of them look funny. That's because the cartographers got them wrong!

Long ago, mapmakers did not have the tools we have today. To make maps, they sailed to faraway lands. Then, they tried to figure out the shape and placement of these lands. Sometimes, they didn't actually sail to the lands—they just read other people's stories about these places. This sometimes led to mistakes. For example, people used to think that California was an island because old maps show it that way.

Image credit: Public Domain

This map from 1650 shows California as an island. But California is not an island!

Maps have gotten a lot better since then. That's because people created new tools, such as satellites, to figure out where lands are. Satellites are spacecraft that circle Earth to take pictures and measurements. Satellites can tell exactly where something is on our planet. This helps us make maps.

Dictionary

aerial *(adjective)* having to do with or achieved through the use of aircraft

analyze *(verb)* to examine something in great detail in order to understand it better

atlas *(noun)* a book of maps; may also include tables, charts, and other information about land

GPS *(noun)* a tool that can be used to find people or things anywhere on Earth

specific *(adjective)* relating to something or someone in particular

Thought Question

Describe how the job of a mapmaker, or cartographer, has changed since 1650. Be sure to use facts from the lesson in your answer.

Type your answer in the text box below.

8.EE Cell Phone Plans

Task

You are a representative for a cell phone company and it is your job to promote different cell phone plans.

a. Your boss asks you to visually display three plans and compare them so you can point out the advantages of each plan to your customers.

- Plan A costs a basic fee of $29.95 per month and 10 cents per text message
- Plan B costs a basic fee of $90.20 per month and has unlimited text messages
- Plan C costs a basic fee of $49.95 per month and 5 cents per text message
- All plans offer unlimited calling
- Calling on nights and weekends are free
- Long distance calls are included

b. A customer wants to know how to decide which plan will save her the most money. Determine which plan has the lowest cost given the number of text messages a customer is likely to send.

Illustrative Mathematics

8.EE Solving Equations

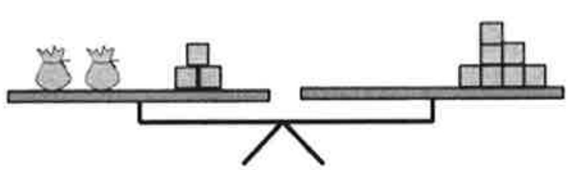
Task

In elementary school, students often draw pictures of the arithmetic they do. For instance, they might draw the following picture for the problem $2+3$:

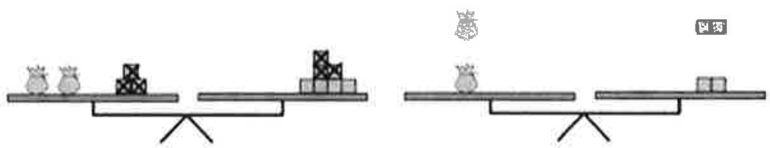
In this picture, each square represents a tile.

We can do the same thing for algebraic expressions, but we need to be careful about how we represent the unknown. If we assume that an unknown number of tiles x are contained in a bag, we could draw the following picture for $2x+3$:

When we have an equation to solve, we assume that the two sides of the equation are equal. We can represent this by showing them level on a balance. For example, we the equation $2x+3=7$ could be shown as:



When we solve equations, we can add, subtract, multiply or divide both sides of the equation by the same thing in order to maintain the equality. This can be shown in pictures by keeping the balance level. For example, we could solve the equation $2x + 3 = 7$ using pictures by first removing (subtracting) 3 from each side, and then splitting (dividing) the remaining blocks into two equal groups:



From this picture, we can see that, in order to keep the balance level, each bag must contain 2 tiles, which means that $x = 2$.

a. Solve $5x + 1 = 2x + 7$ in two ways: symbolically, the way you usually do with equations, and also with pictures of a balance. Show how each step you take symbolically is shown in the pictures.

b. Solve the equation $4x = x + 1$ using pictures and symbols. Discuss any issues that arise.

c. What issues arise when you try to solve the equation $2 = 2x - 4$ using pictures? Do the same issues arise when you solve this equation symbolically?

d. Make up a linear equation that has no solutions. What would happen if you solved this equation with pictures? How is this different than an equation that has infinitely many solutions?

Use pictures to show why the following solution to the equation $2x + 4 = 10$ is incorrect:

$$\frac{2x}{2} + 4 = \frac{10}{2}$$

$$x + 4 = 5$$

$$\underline{\quad -4 \quad -4}$$

$$x \quad = 1$$

Illustrative Mathematics

8.EE Coupon versus discount

Task

You have a coupon worth $18 off the purchase of a scientific calculator. At the same time the calculator is offered with a discount of 15%, but no further discounts may be applied. For what tag price on the calculator do you pay the same amount for each discount?

8.EE Summer Swimming

Task

The local swim center is making a special offer. They usually charge $7 per day to swim at the pool. This month swimmers can pay an enrollment fee of $30 and then the daily pass will only be $4 per day.

a. Suppose you do not take the special offer. Write an equation that represents the amount of money you would spend based on how many days you go to the pool if the passes were bought at full price.

b. Write a second equation that represents the amount of money you would spend if you decided to take the special offer.

c. Graph your two equations from part (a) and (b).

d. After how many days of visiting the pool will the special offer be a better deal? How can you tell algebraically? How can you see this graphically?

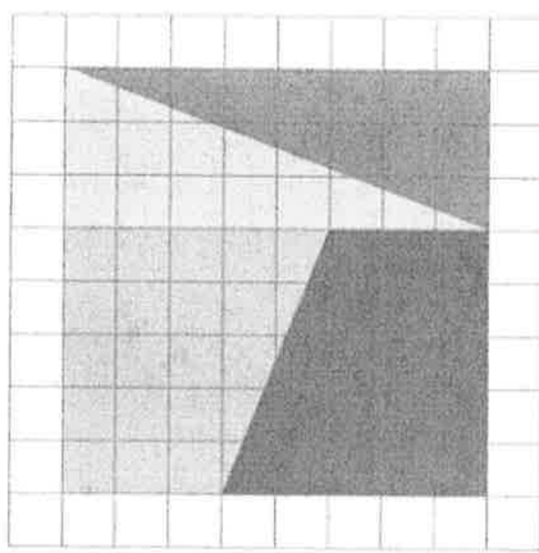
e. You only have $60 to spend for the summer on visiting this pool. Which offer would you take? Explain.

Illustrative Mathematics

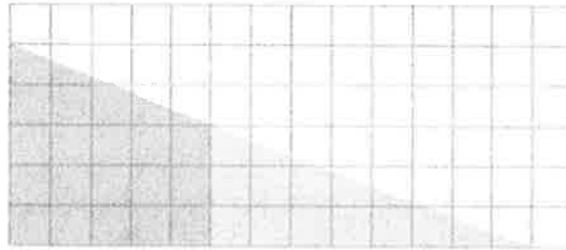
8.G, 8.EE Different Areas?

Task

Below is a picture of an 8 by 8 square divided into four polygons:



The green and yellow polygons can be combined along their 3 unit edges as shown below:



a. What is the area of the green and yellow shape above? What about the area of the blue quadrilateral and orange triangle?

b. What is the area of the original square?

c. Are the answers to (a) and (b) consistent? Explain.

Quick Set with Kids

50 crunches

25 jumping jacks

20 lunges

10 tricep dips

5 push-ups

50 bicycles

5 burpees

20 squats

25 high knees

(repeat if desired)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Drawing - Butterfly

Draw what you see.