Living Coast Discovery Center
Field Trip Resource Packet

Watershed Chemistry

In this packet you will find lessons and resources related to your Living Coast field trip. The first two activities are intended to bookend before and after your trip, followed by additional resources.

Table of Contents

Other Resources

Water Pollution Experiment

Lesson Objectives:

- Students will be able to follow experimental protocol to compare different "pollutants" effect on water over time
- Students will be able to explain how different types of pollutants affect a body of water

Standards:

- **HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **HS-ESS3-5** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Materials:

- 6 small dishes (like petri dishes)
- Water
- Dirt
- Vegetable oil
- Baking soda
- Food coloring
- Eye dropper or small spoon
- Vinegar
- Pen
- Measuring spoons
- Masking tape

Outline:

- Mark the 5 of the dishes for the experimental objects: vegetable oil, food coloring, dirt, vinegar, control. The sixth dish is for testing on days two and three
- Add one tablespoon of water to all the dishes except the vinegar. Add 1 ½ teaspoons water to the vinegar dish
- Add 3 drops vegetable oil, 1 drop food coloring, 1 teaspoon dirt and 1 ½ teaspoon vinegar to the appropriate dishes. This should bring the total amount of liquid in each dish to 1 tablespoon
- Complete the day 1 observation sheet and set the dishes in a safe location
- Next day, complete the day 2 observation sheet.
- Vinegar is not visible, so we are going to test its presence with a chemical reaction. Add 5 drops water to the unused dish and add a pinch of baking soda. Observe. Empty and rinse out dish. Add 5 drops from the vinegar test dish

and add a pinch of baking soda. Observe and complete day 2 observation sheet
- Next day, check to see if the water in the control dish should have completely evaporated. If it has not, leave experiment for an additional 24 hours. Complete the following steps **only** when all water from the control has evaporated
- Complete day 3 observation sheet. Add one tablespoon of water to each dish and compare results to their day 1 observations.
- Add a pinch of baking soda to the vinegar test to check for vinegar.

Expected Observations:

- Vegetable oil – represents motor oil. Forms a thin coating on the water; reduces the rate of evaporation since the water does not come into contact with the air
    - Harmful effects: oil can coat bird feathers, kill insects that live on water surface, reduce air supply for aquatic animals
- Food coloring – represents persistent pollutants such as pesticides. Disperses evenly in the water. As water evaporates, the color deepens. The "pollutant doesn't go away – even when the water has evaporated, the pollutant remains on the bottom. Adding more water will re-disperse the pollutant.
    - Harmful effects: the concentration at which a pollutant is harmful varies, but is often measured in parts per million (ppm). Pollutants that are persistent in the environment tend to bioaccumulate in living organisms.
- Dirt – represents dirt and other particulates such as rubber worn off tires. When the dirt is first added and stirred, the water becomes murky. After two days, the particulate matter has settled to the bottom
    - Harmful effects: particulates in the water can clog fish gills and filter feeders' tentacles, and reduce the ability of light rays to penetrate the water, thereby reducing photosynthesis. Excessive sediment can suffocate organisms that live on the bottom of the water.
- Vinegar – represents acids such as those in driveway cleaners and pool chemicals. The addition of vinegar causes no apparent visual change, but a simple test of adding baking soda will indicate its presence. Once the vinegar has evaporated, adding water will not return the acidity.
    - Harmful effects: marine organisms can only live in water within a fairly narrow pH range. When water becomes too acidic or basic, survival rates decline.

See worksheets on following pages.

Name:_____ Date: _____

Water Pollution Experiment – Day One

Instructions:

1. Label 5 dishes: oil, food coloring, dirt, vinegar, control
2. Add 1 ½ teaspoons of water to the vinegar dish. Add 1 tablespoons water to all other dishes.
3. Predict what will happen to each dish when you add: (if you don't have a dropper, 5 drops = ¼ teaspoon) a. 5 drops of vegetable oil to the "oil" dish b. 1drop food coloring to the "food coloring" dish c. 1teaspoon dirt to the "dirt" dish d. 1 ½ teaspoons vinegar to the "vinegar" dish.
4. Observe what happens. How did your predictions compare to your observations?
5. Place your dishes in a safe place. Predict how each dish will look tomorrow.

	Vegetable Oil	Food Coloring	Dirt	Vinegar	Control
Prediction (Step 3)					
Observation (Step 4)					
Prediction (Step 5)					

Name:_____ Date: _____

Water Pollution Experiment – Day Two

Instructions:

1. Observe each dish. Has the color or amount of liquid changed? Is the water more or less clear? How did your predictions from yesterday compare?
2. Vinegar is not visible, so test for vinegar using a chemical reaction.
    a. Add 5 drops of water to a clean dish; then add a pinch of baking soda
    b. Rinse out the dish. Remove 5 drops from the "vinegar" dish and place in the clean dish. Add a pinch of baking soda. What happens?
3. Predict what will happen to each dish after another 24 hours.

	Vegetable Oil	Food Coloring	Dirt	Vinegar	Control
Observation (Step 1)					
Observation (Step 2)					
Prediction (Step 3)					

Name:_____ Date: _____

Water Pollution Experiment – Day Three

Instructions:

1. Observe each dish. Has the color or amount of liquid changed? Is the water more or less clear? How did your predictions from yesterday compare?
2. Add 1 tablespoon of water to each dish. Do the dishes look the same as day one?
3. Vinegar is not visible, so test for vinegar using a chemical reaction.
    a. Remove 5 drops from the "vinegar" dish and place in a clean dish. Add a pinch of baking soda. What happens?

	Vegetable Oil	Food Coloring	Dirt	Vinegar	Control
Observation (Step 1)					
Observation (Step 2)					
Observation (Step 3)					

Conclusions:

1. Do all pollutants act the same way?

2. Name something that can pollute water that is similar to each contaminant:

a. Oil

b. Food coloring

c. Dirt

d. Vinegar

3. How can these pollutants get into San Diego Bay?

4. How can these pollutants harm organisms that live in San Diego Bay?

California Changes Over Time

Lesson Objectives:

- Students will be able to analyze multiple data sources (graphs, charts, maps and images)
- Students will be able to compare multiple data sources to draw conclusions about California's climate over time

Standards:

- **HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **HS-ESS3-5** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Materials:

- Data Source Images and questions
- Chart paper (or digital equivalent)

Outline:
We're going to be looking at several different data sources to try and figure that out. Each group will be analyzing one data source, and then we'll get a chance to see what everyone has done. When you look at your data, you need to work with your group to answer the questions on the paper. Write the answers on the big chart paper. We're going to do a gallery walk around the room – you won't be there to explain, so make sure you write complete answers.

Have students walk around the room to see all the data sets. Your group will get a pack of post-it notes. As you walk around, you need to write how that data is related to your data source. Do they support or conflict with each other? Your post it needs to include: what data source is yours and which source you're looking at, along with your answer of how the data is related to your data source. You should be able to find this information where you answered the question "what is this data measuring"

What did we learn from this data? What are the effects we are seeing in SD? Would we expect the same results everywhere? No – other places in the world might see more tropical storms/flooding/snow storms and other issues.

Distance Learning Adaptations: Assign students data sources as individuals or small groups to work on as "homework." They should post their analysis somewhere other students can access (like google classroom). Students will leave a comment on other's submissions as the "gallery walk" of each other's work.

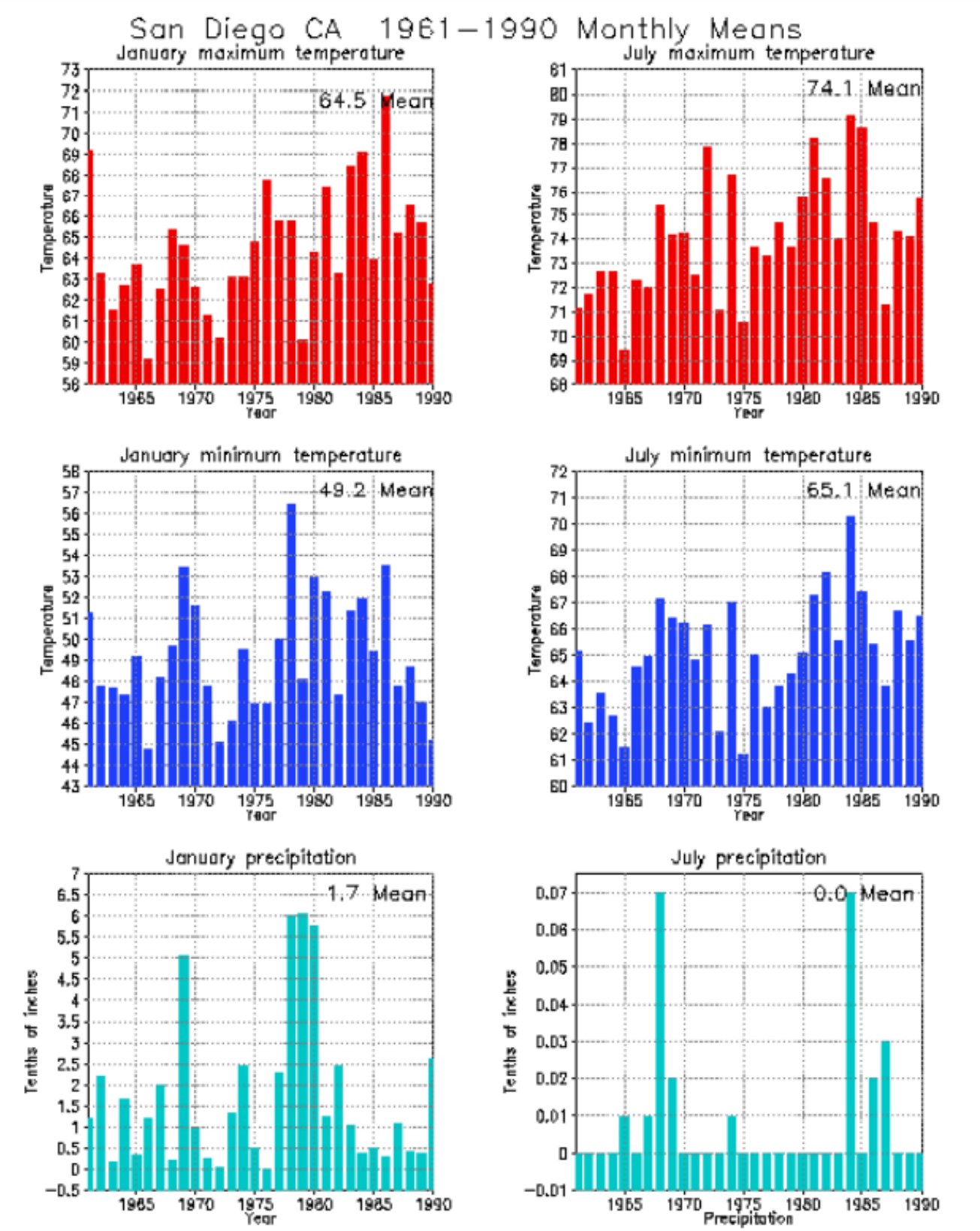
See Data Sources questions and data on following pages.

Data Source #1

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)
- What does the "mean" measure?

Data Source #1



Data Source #2

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)

Are these images a good source of data? Why or why not?

Data Source #2

2017

2014

Data Source #2

2014

2017

Data Source #2

2017

2014

Data Source #2

2014

2017

Data Source #2

2017

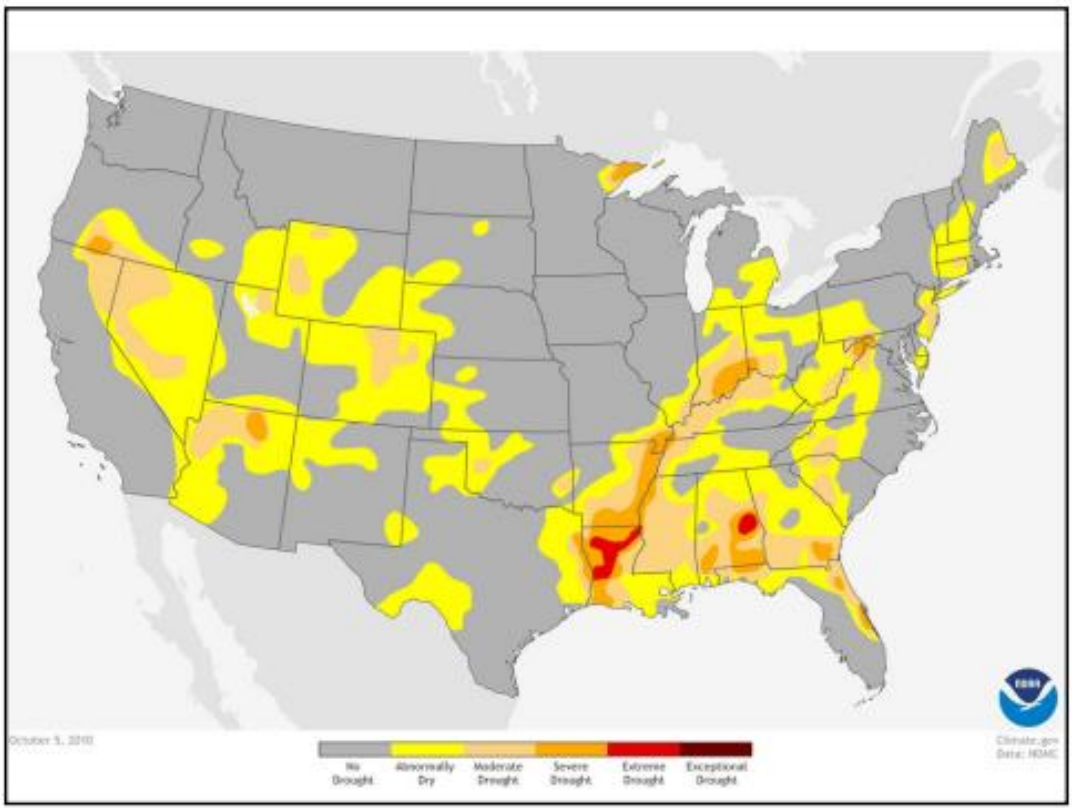
2014

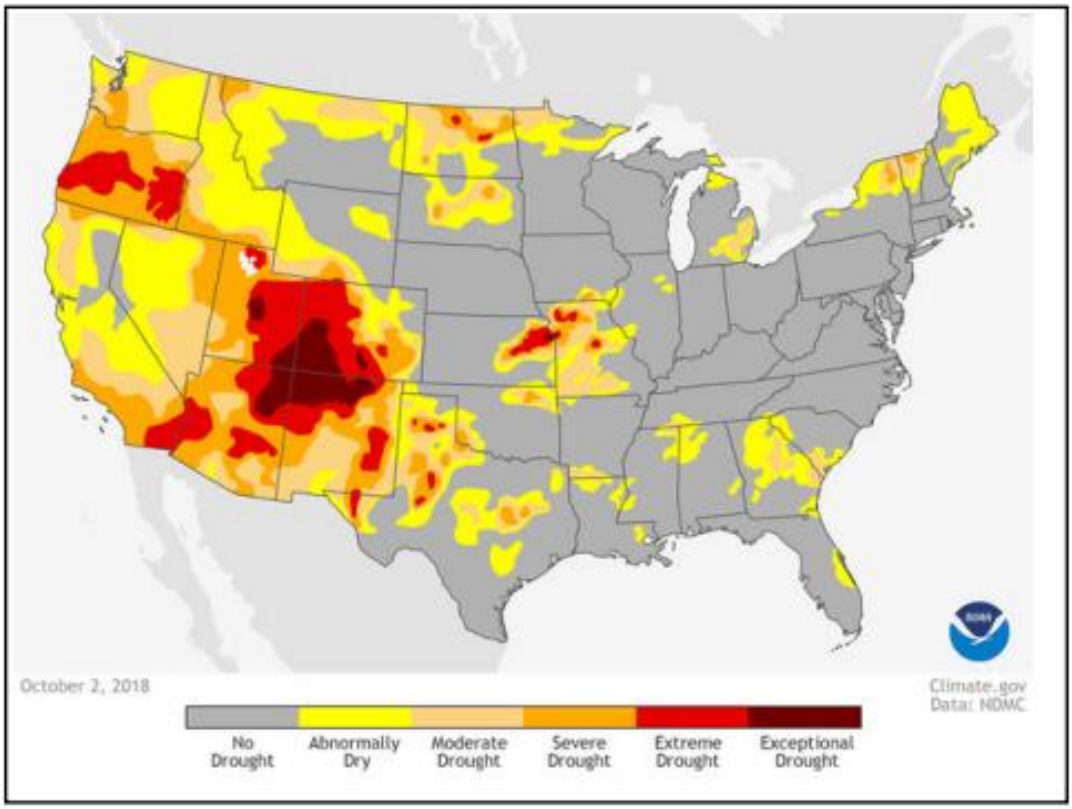
Data Source #3

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)
- What does "exceptional drought" indicate?
- Over the last decade, how many years did CA experience exceptional drought?
- Were there any years where CA didn't experience any drought?

Data Source #3.1





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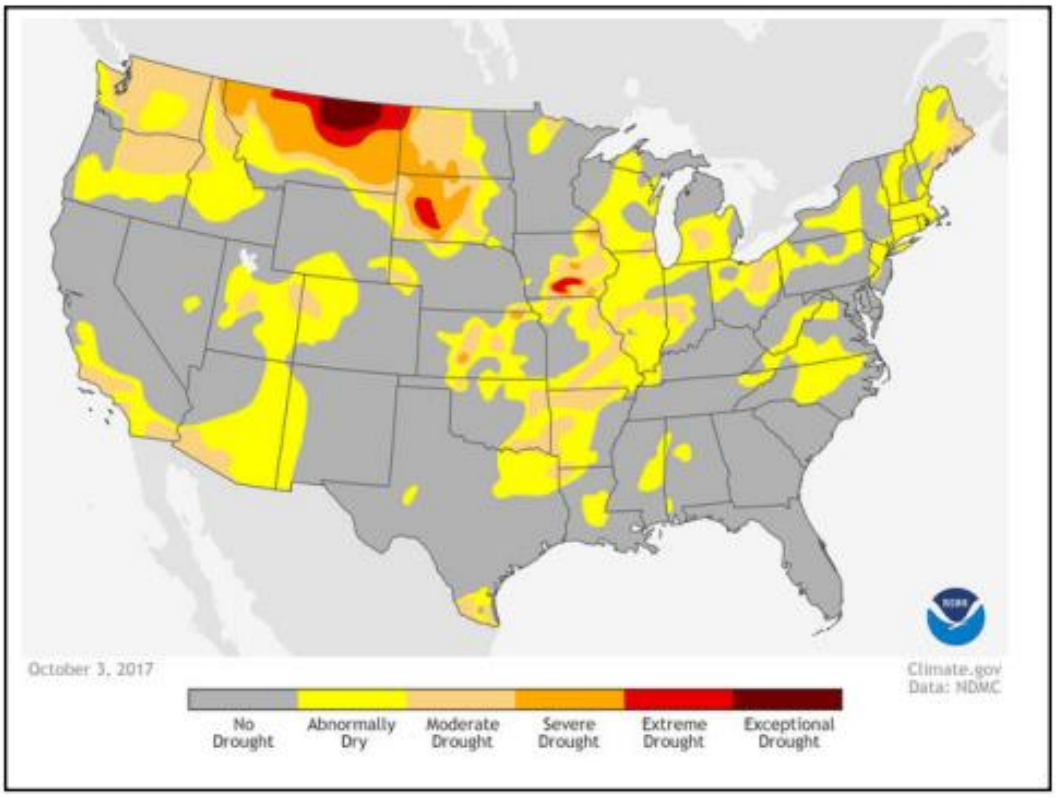

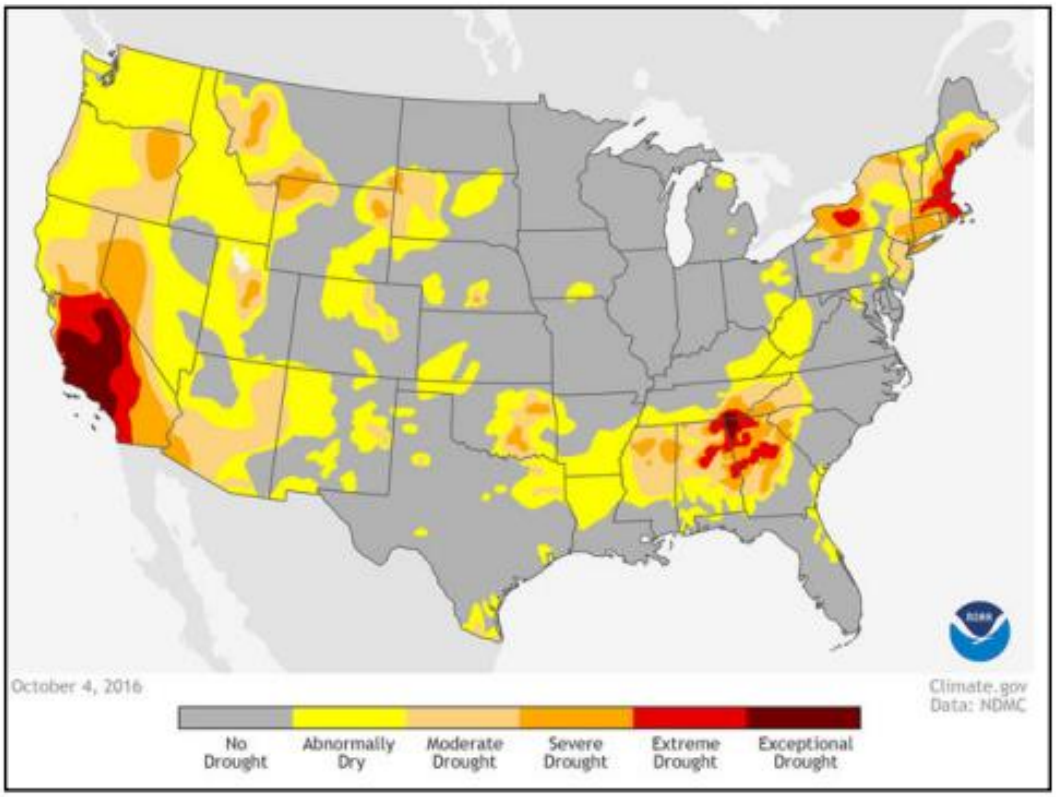

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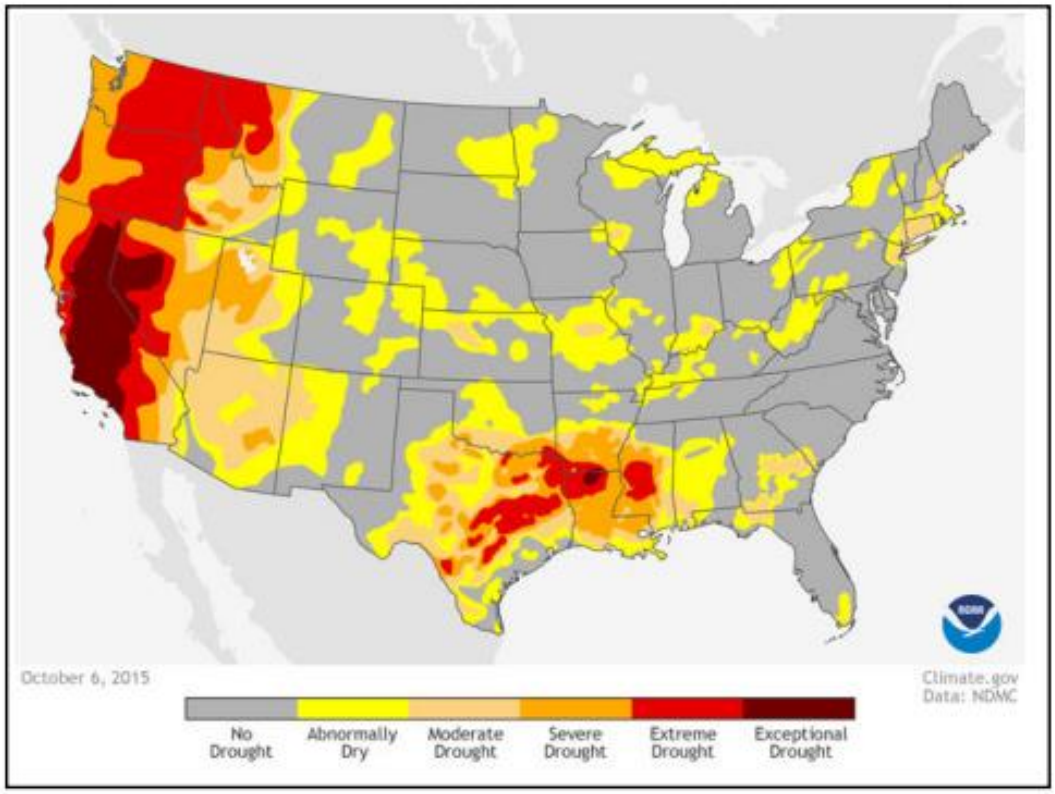

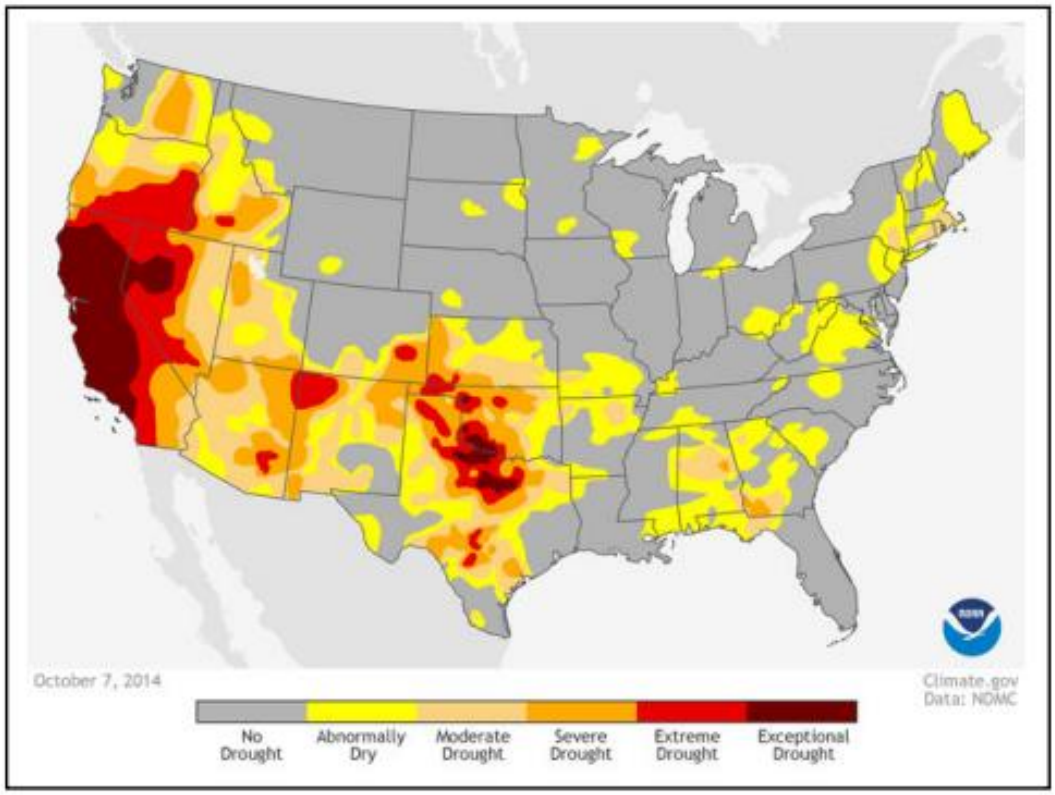

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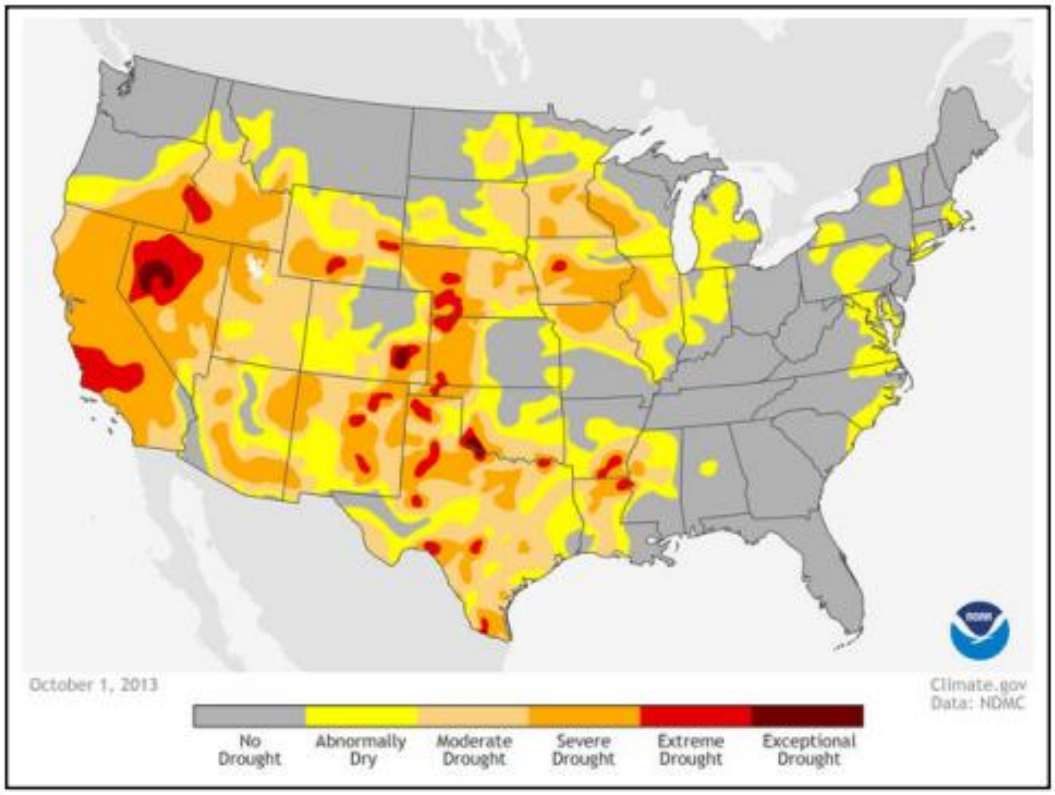

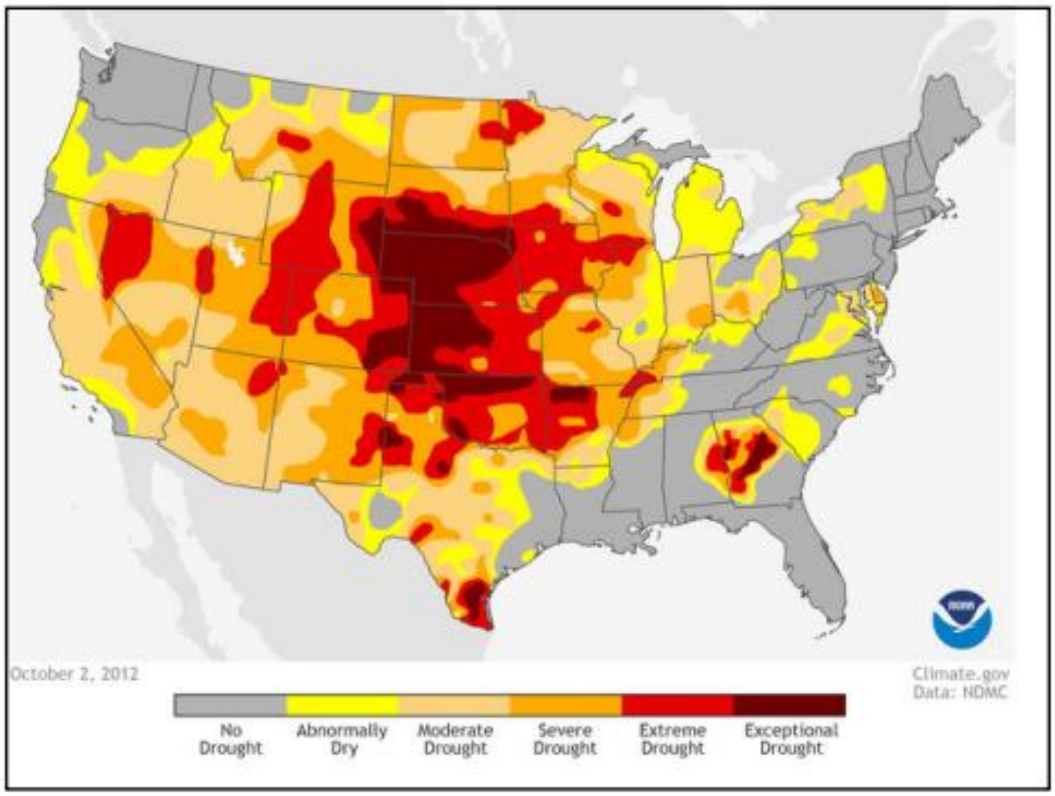

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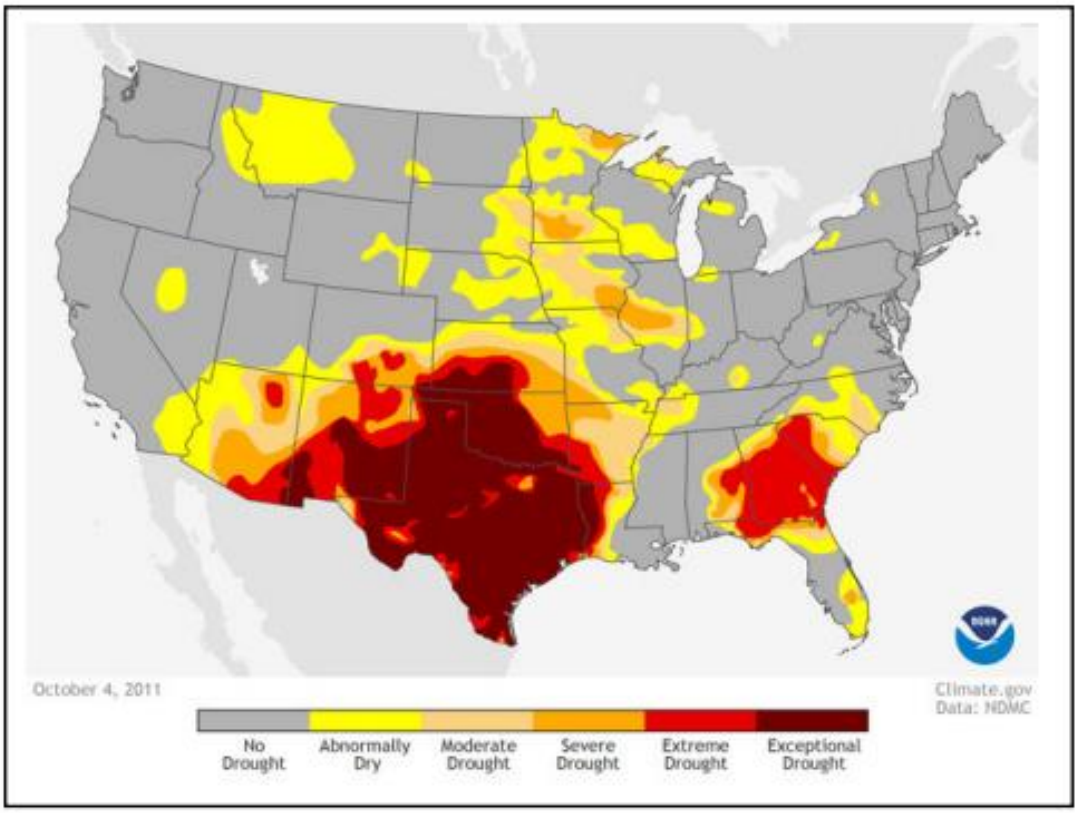
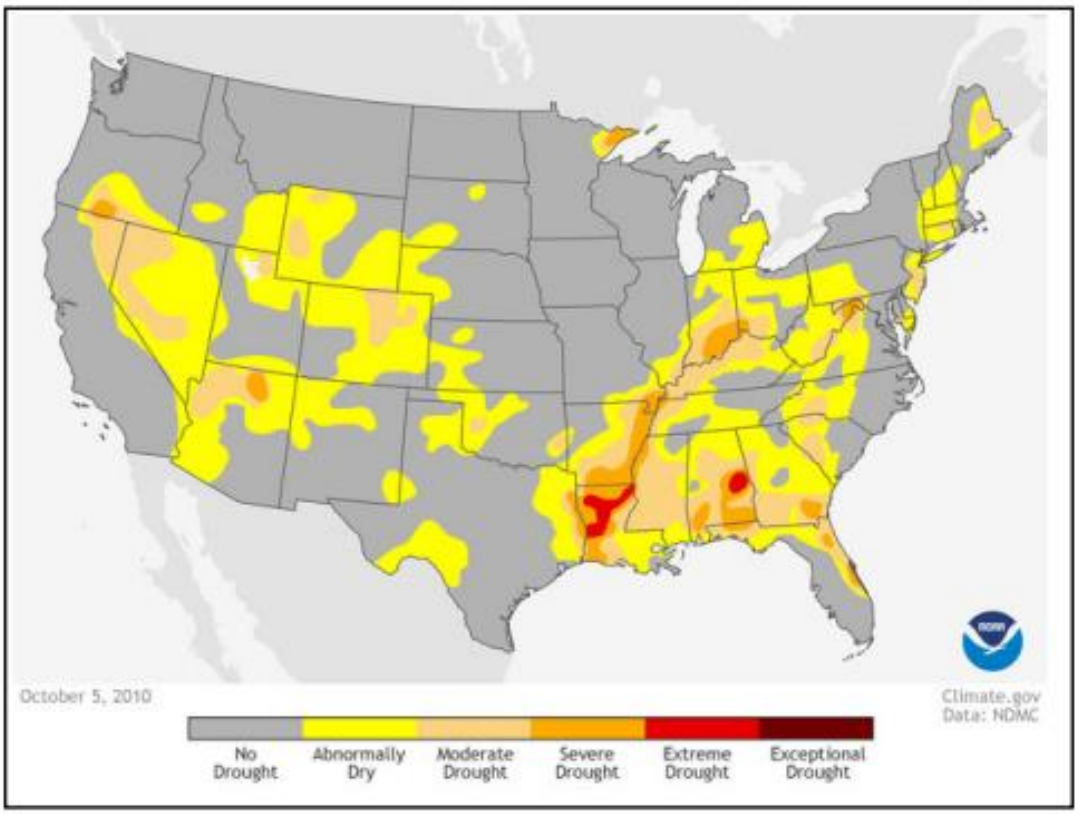


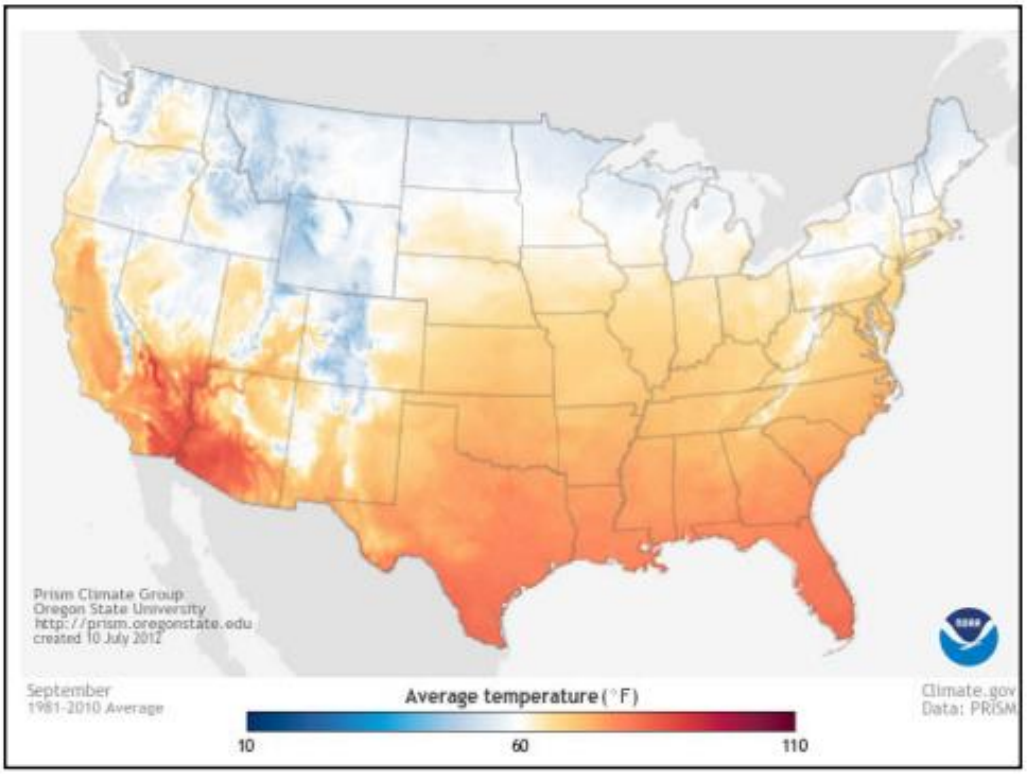


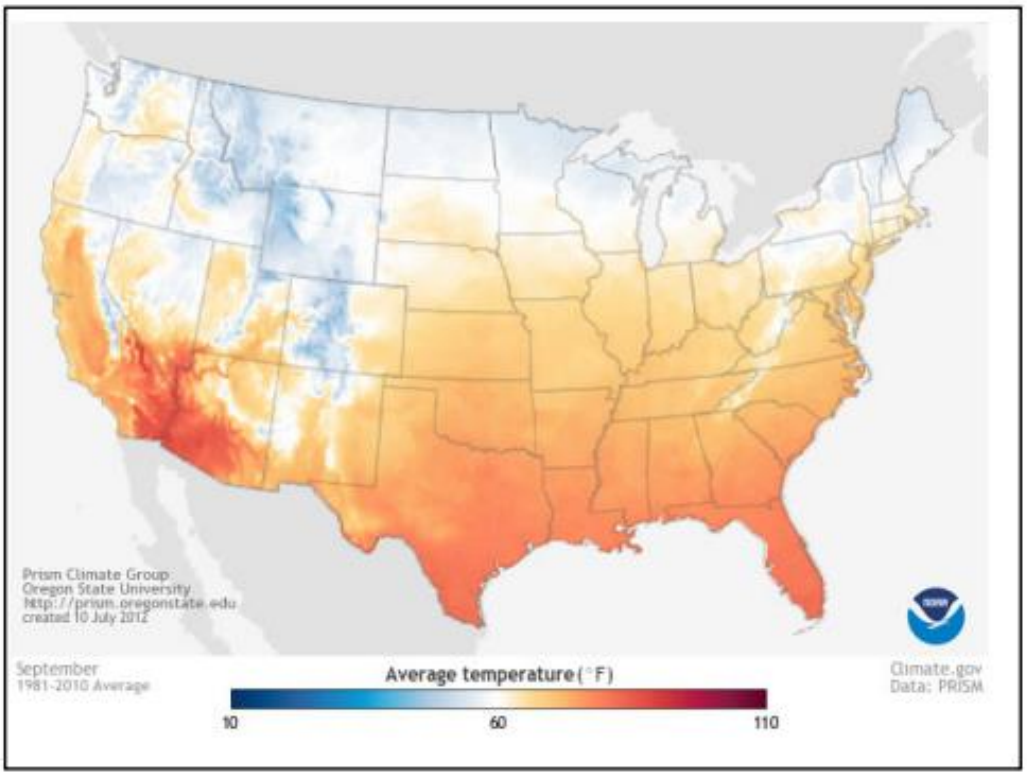
Data Source #4

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)
- What does "high emissions" mean?
- What does "stabilized emissions" mean?

Data Source #4.1





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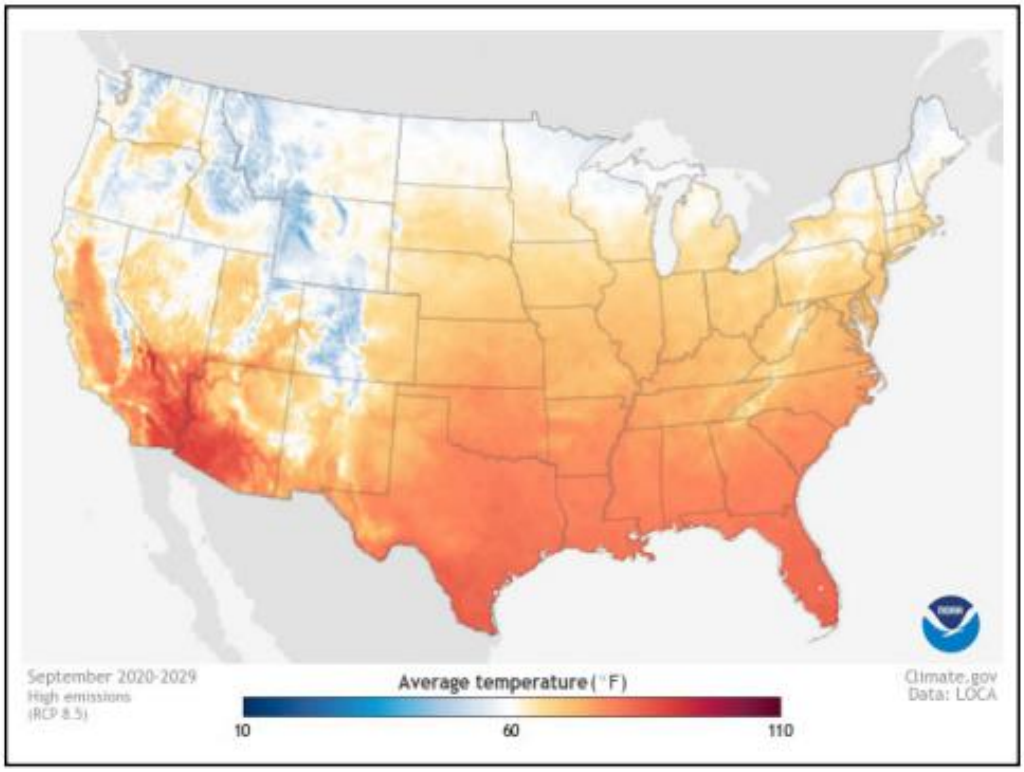

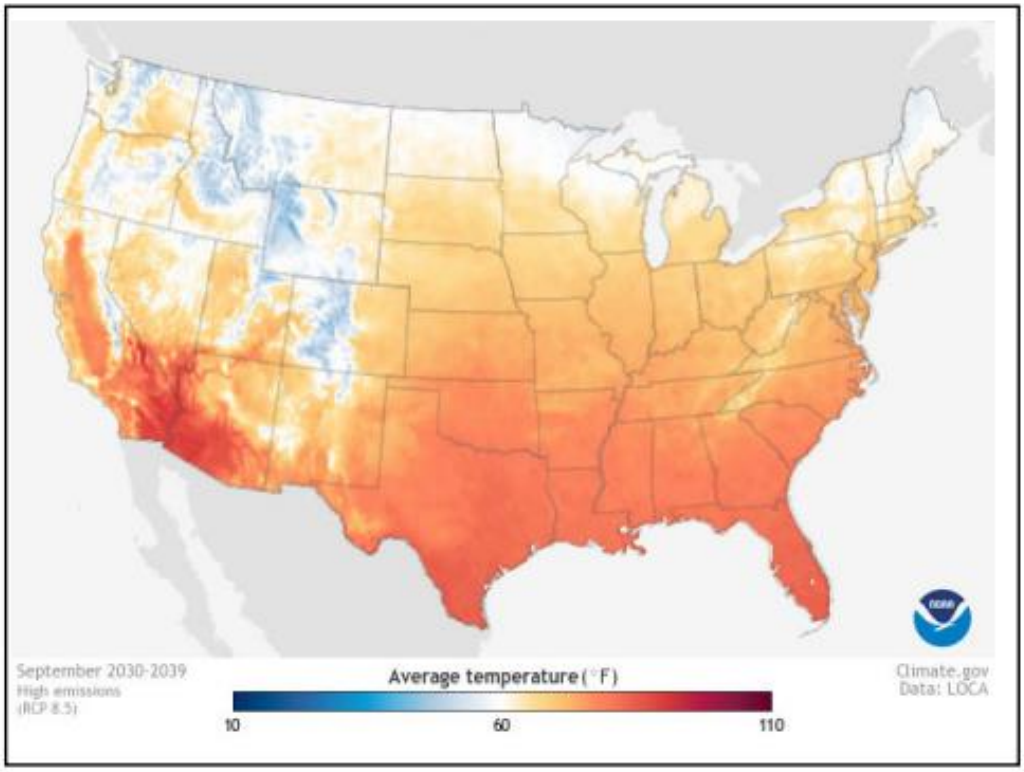

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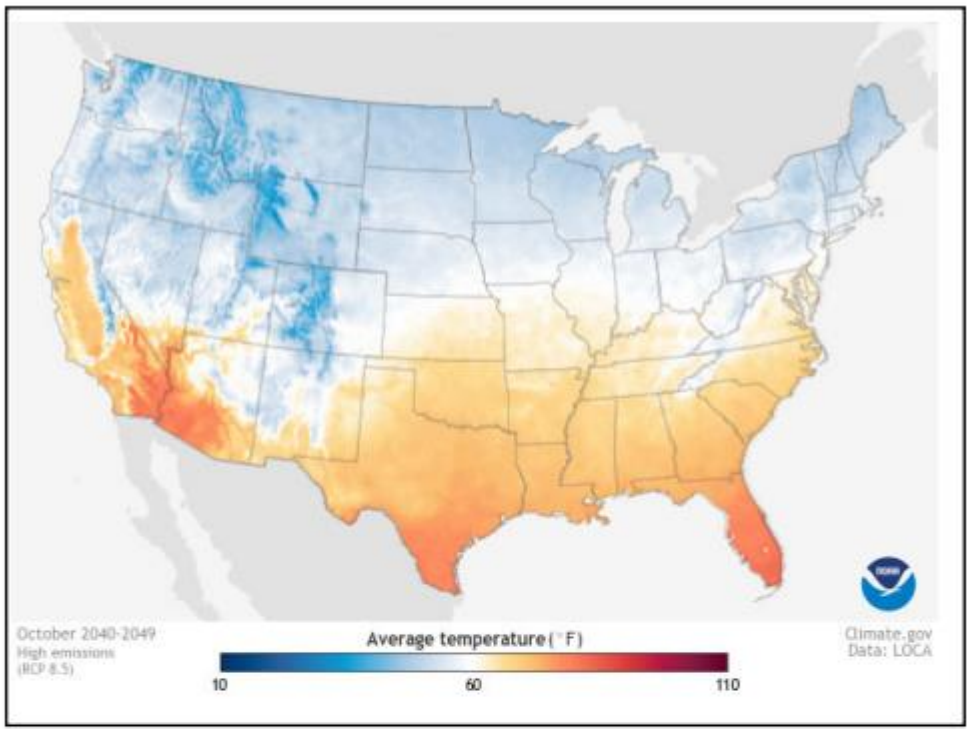

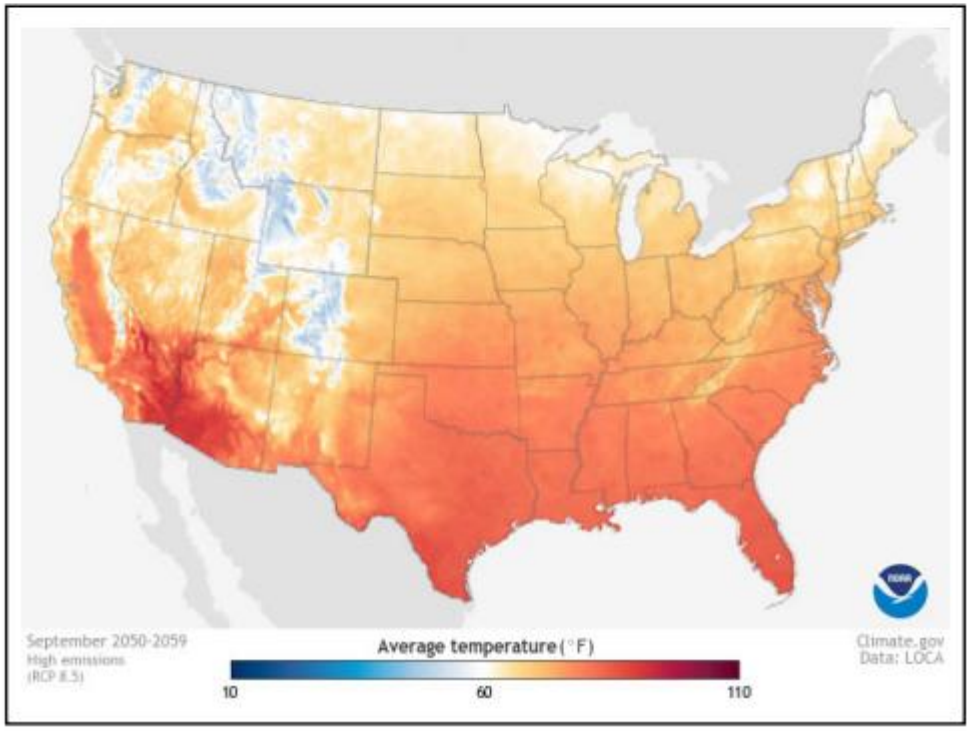

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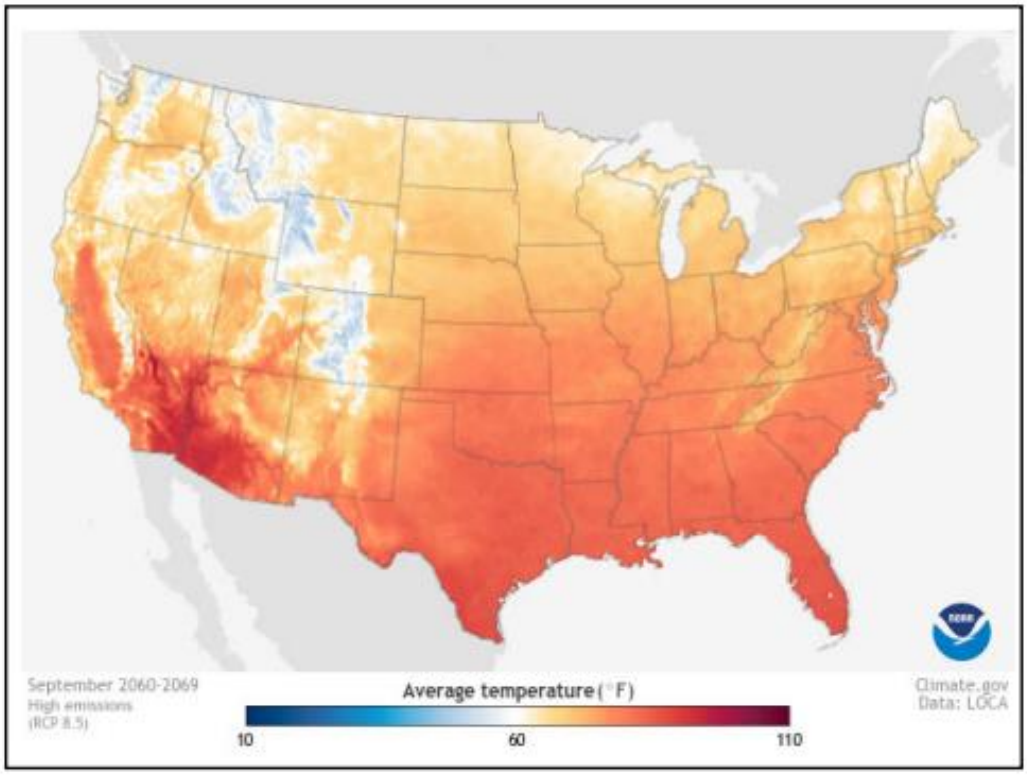

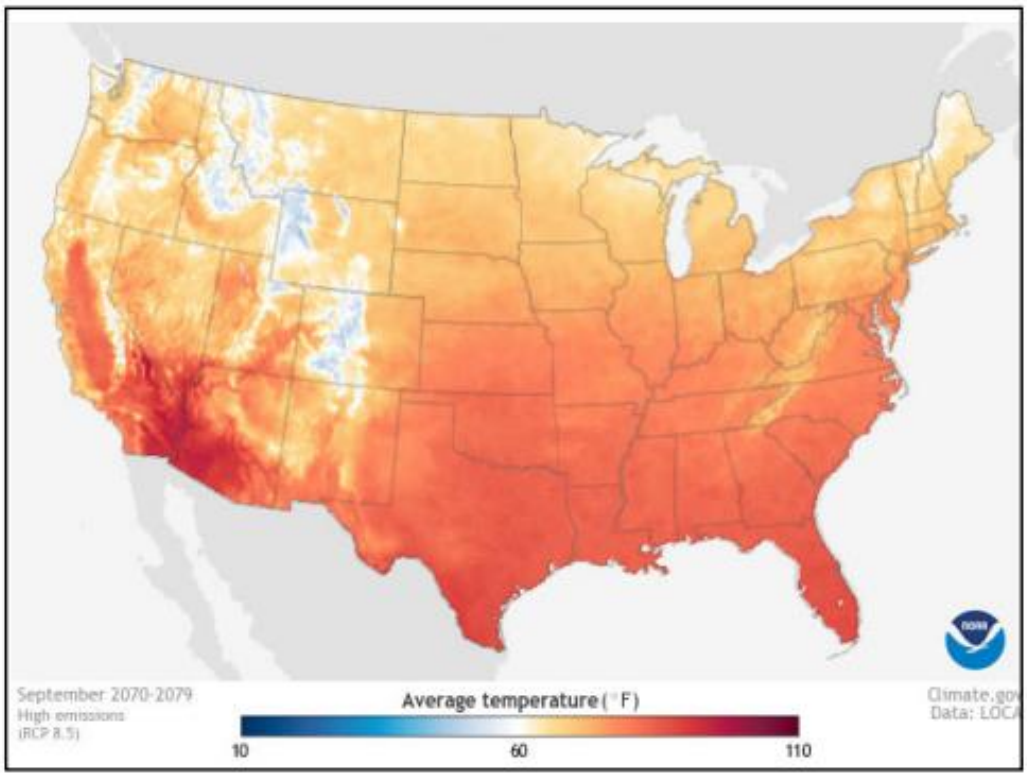

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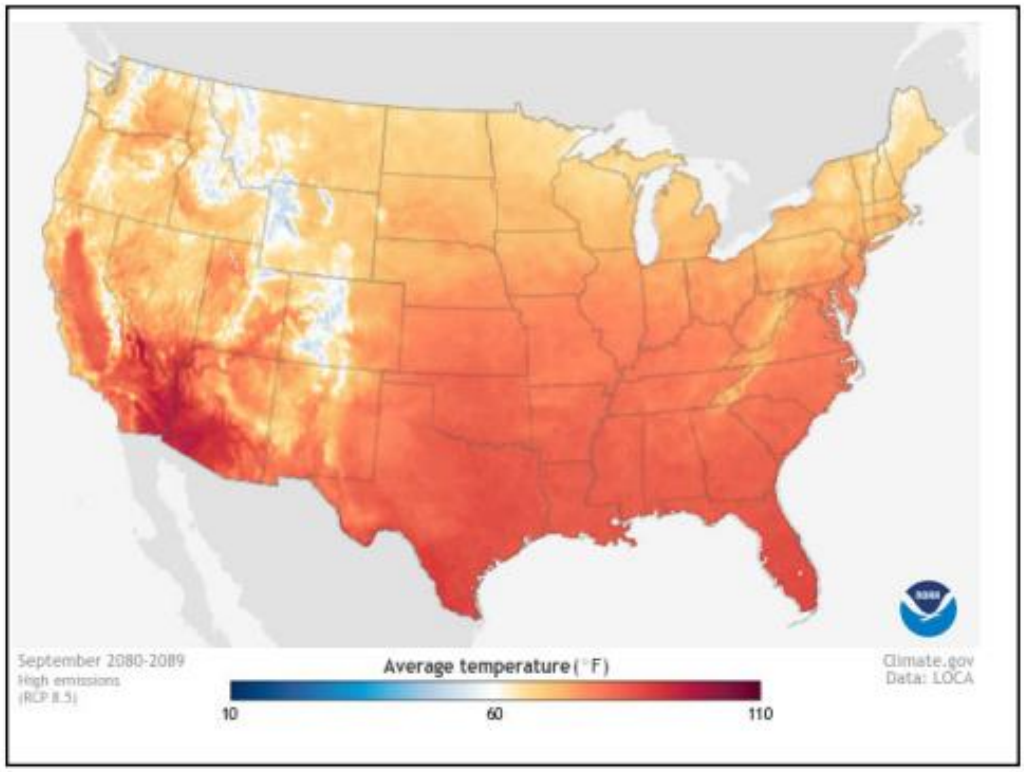
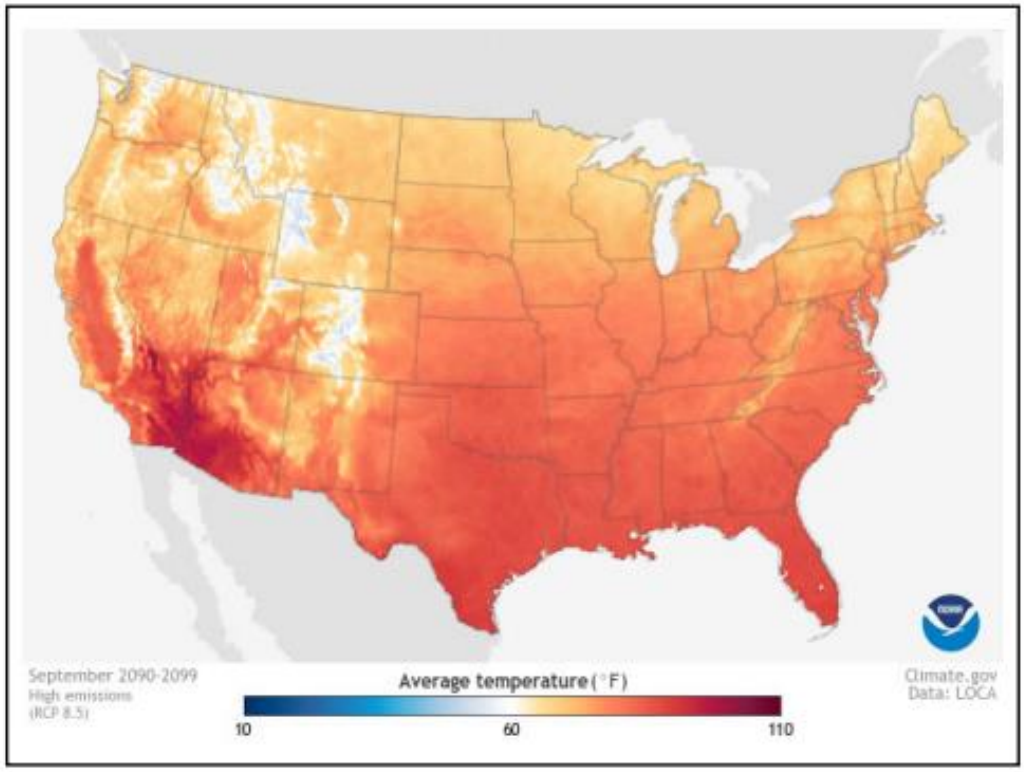


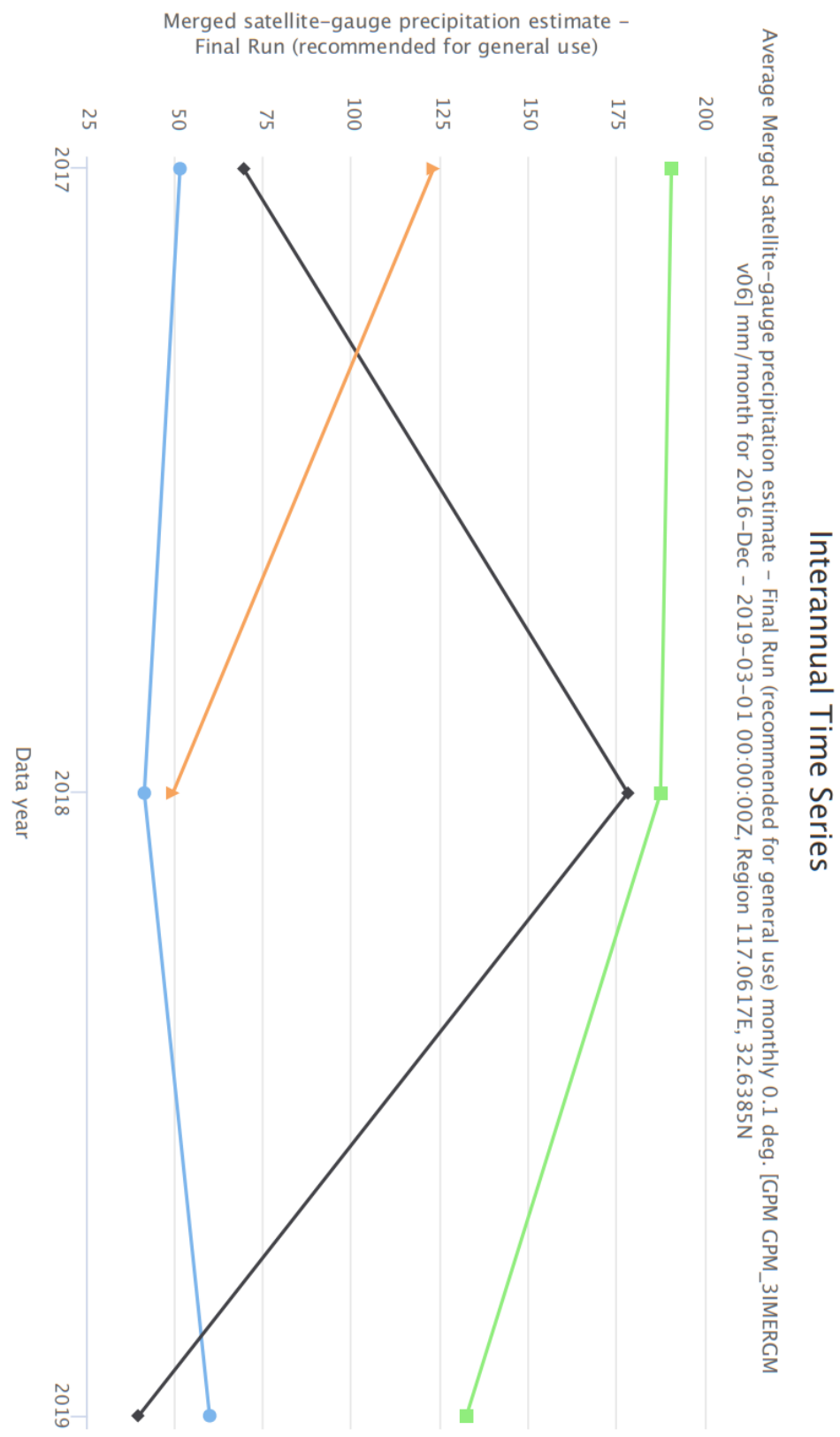


Data Source #5

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)
- The codes at the bottom of the graph indicate the seasons. Which code correlates with what season?

Data Source #5

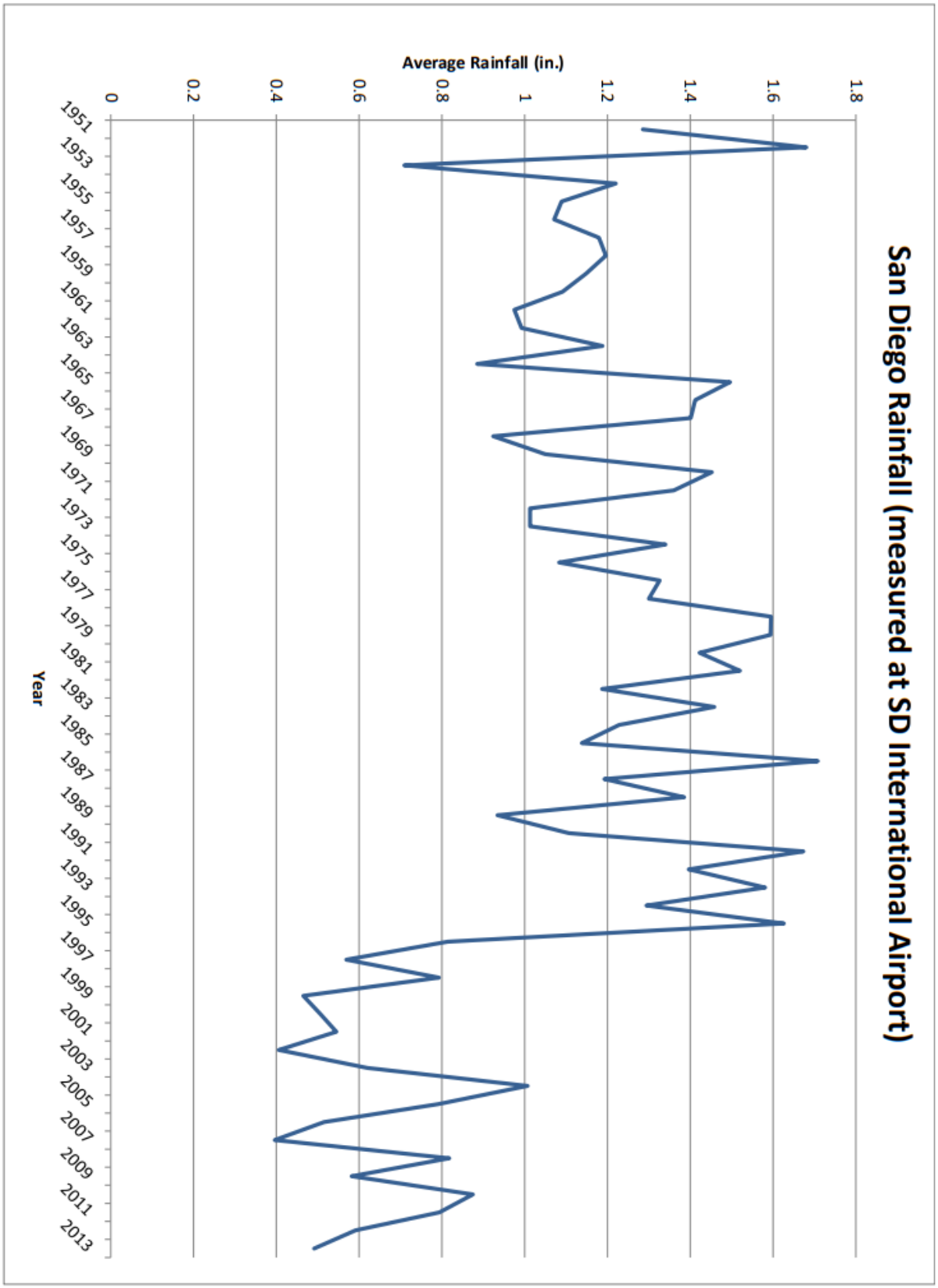


Data Source #6

Write the answers to these questions on chart paper. Make sure everyone in your group participates!

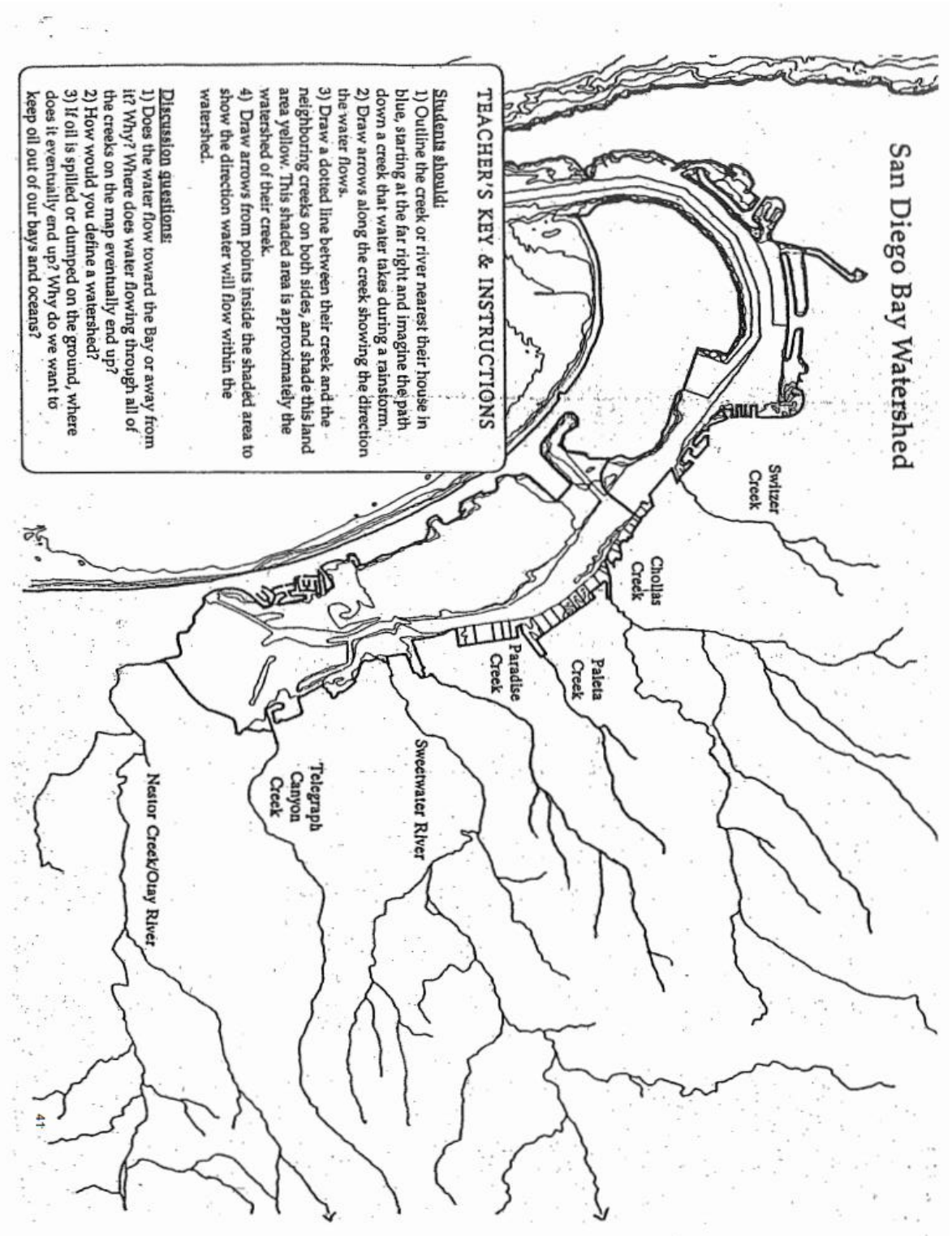
- What does this data measure?
- What time period does it cover?
- Is there an overall trend in this data? (Is it increasing, decreasing, or staying the same?)
- What year has the lowest value? The highest?
- If you were to make a prediction, what would be the rainfall for last year (2019)?

Data Source #6

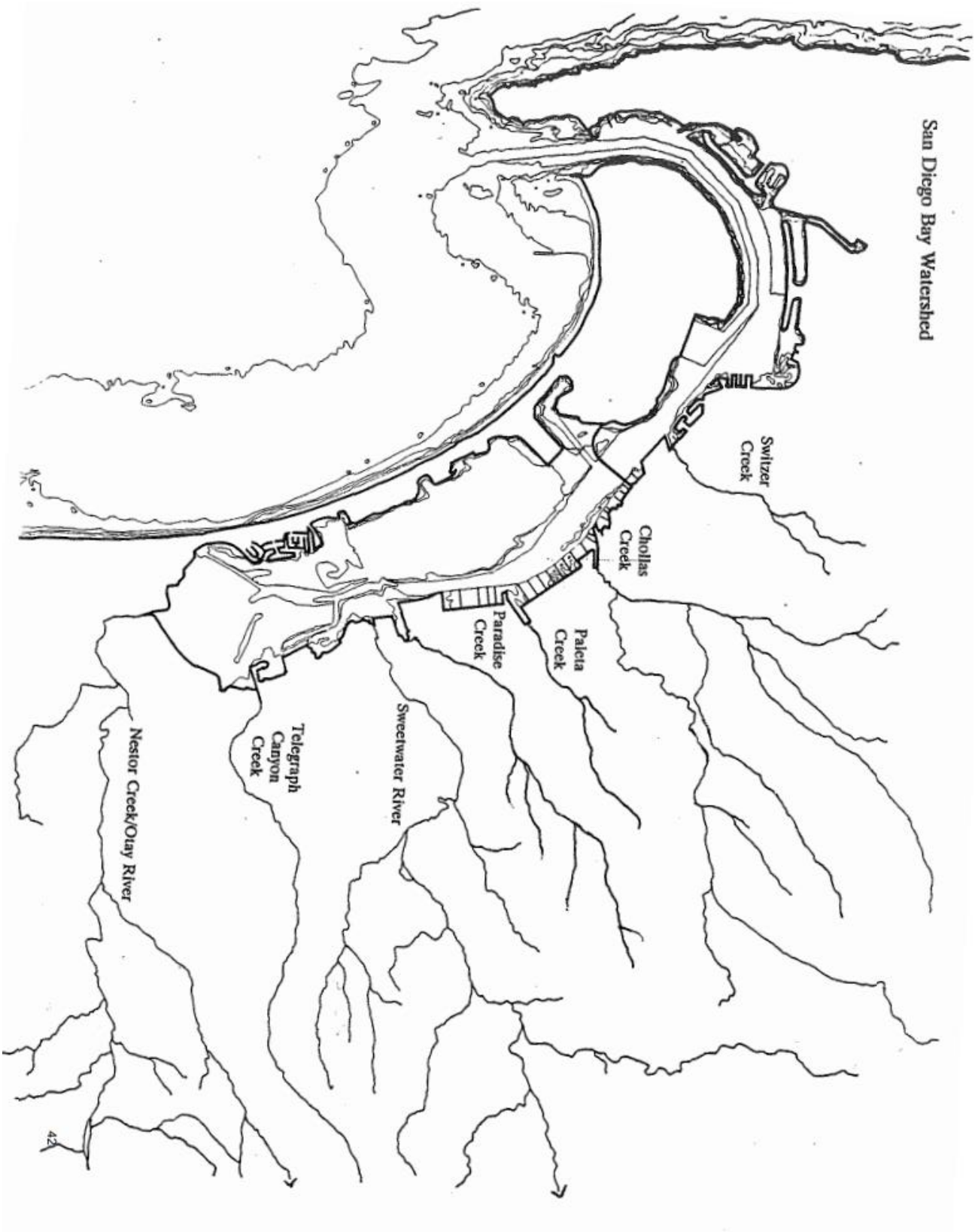


San Diego Watersheds

Map of San Diego Bay, with instructions for students to find out what watershed their home is located on and how their neighborhood is connected to the Bay. See teacher copy with instructions below. Student map on following page.



San Diego Watersheds Map



Water Conservation

Read the passage with students about water conservation and tracking personal water usage. Then, have students complete the Average Daily Water Use Tally survey. Reading passage and survey on following pages.

How do you think people got by with so little water? For one thing, they never dumped out water until it was too dirty to be used for anything else. A person might save their laundry water to clean their floor, for example. Sometimes whole families would take turns using the same bathwater. Be glad we don't still have to do that!

Activity 1

Average Water Use Tally

You can learn a lot about your own water use by doing the "Average Water Use Tally" activity. You'll learn where you use the most water at home. You'll find out whether your water use is above or below average. Then, in Section 2, you'll see how water is often wasted. In Section 3, you'll learn some ways you and your family can become water wise. Your leader or other adult can go over the directions for this exercise if you need help.

Directions:
Use the sheets provided to keep track of your own water use for three 24-hour periods. One of the three days should be a weekend day. You should include all water use for the three days, even water use at school, at a friend's house, or in a restaurant. You probably won't perform every task on the charts every day, or even once, during the three-day tally. When you're done, answer the reflection questions after the daily charts. Ask an adult for help with your observations if you need it.

Follow these steps:

1. Each time you use water in a way listed on the chart, mark a "1" next to the activity in column B.

2. At the end of the day, add up all the 1's for "flush toilet" and write the total in column C.

3. Now multiply the number in column C by the number given in column D. This answer tells you the number of gallons per day you used to flush the toilet. Write this answer in column E.

4. Repeat steps 2 and 3 for the other activities in column A of the chart.

5. Add up all the numbers in column E to get the total number of gallons of water you used on your first tally day.

6. Repeat these steps on days 2 and 3 of your water use tally.

7. After you finish the three-day tally, answer the reflection questions on page 13.

Average Daily Water Use Tally

Day 1:_____(Day of the Week)

A	B	C	D	E
Water Use Task	Times on Day 1	Total Times on Day 1 (add all your marks in column B)	Gallons Used per Time	Gallons per Day (column C x column D)
Flush toilet			6	
Run faucet for 1 minute (waiting for water to get hot or cold)			4	
Fill a bathtub (about 5 inches of water)			40	
Shower (5 minutes)			35	
Run dishwasher			15	
Wash a load of dishes by hand (in a basin or plugged sink without water running)			4	
Wash a load of dishes by hand (with water running)			30	
Wash a car (water off while soaping)			40	
Wash a car (water on while soaping)			180	
Wash 1 large load of clothing			45	
Wash 1 small load of clothing			30	
Brush teeth with water running			2	
Brush teeth with water off			1	
Wash hands			1	
Drink water			0.25	
Water lawn (20 minutes)			150	

Total Day 1 _____

Average Daily Water Use Tally

Day 2:_____(Day of the Week)

A	B	C	D	E
Water Use Task	Times on Day 2	Total Times on Day 2 (add all your marks in column B)	Gallons Used per Time	Gallons per Day (column C x column D)
Flush toilet			6	
Run faucet for 1 minute (waiting for water to get hot or cold)			4	
Fill a bathtub (about 5 inches of water)			40	
Shower (5 minutes)			35	
Run dishwasher			15	
Wash a load of dishes by hand (in a basin or plugged sink without water running)			4	
Wash a load of dishes by hand (with water running)			30	
Wash a car (water off while soaping)			40	
Wash a car (water on while soaping)			180	
Wash 1 large load of clothing			45	
Wash 1 small load of clothing			30	
Brush teeth with water running			2	
Brush teeth with water off			1	
Wash hands			1	
Drink water			0.25	
Water lawn (20 minutes)			150	

Total Day 2_____

Average Daily Water Use Tally

Day 3:_____(Day of the Week)

A	B	C	D	E
Water Use Task	Times on Day 3	Total Times on Day 3 (add all your marks in column B)	Gallons Used per Time	Gallons per Day (column C x column D)
Flush toilet			6	
Run faucet for 1 minute (waiting for water to get hot or cold)			4	
Fill a bathtub (about 5 inches of water)			40	
Shower (5 minutes)			35	
Run dishwasher			15	
Wash a load of dishes by hand (in a basin or plugged sink without water running)			4	
Wash a load of dishes by hand (with water running)			30	
Wash a car (water off while soaping)			40	
Wash a car (water on while soaping)			180	
Wash 1 large load of clothing			45	
Wash 1 small load of clothing			30	
Brush teeth with water running			2	
Brush teeth with water off			1	
Wash hands			1	
Drink water			0.25	
Water lawn (20 minutes)			150	

Total Day 3_____

Average Daily Water Use Tally—Reflection Questions

1. Calculate your average daily water use for the three days. (Add the three daily totals together and divide by 3.)

_____gallons/day

2. Which activity required the most water?

3. In which room of the house was the most water used?

4. What water uses in your house were not included in *your* water use tally?

5. How much does the water you use every day weigh? (A gallon of water weighs 8 pounds, so multiply the answer from question 1 by 8.)

_____pounds/day

How would you like to have to carry that much water into the house every day?

6. Was your average water use more or less than the national average of 50 gallons per person per day?

❑ More ❑ Less

If it was lower, congratulations! You already practice some water-wise ways. If it was higher, you'll learn some simple ways to start conserving water in the third section of this booklet. But first we're going to learn more about some ways that people waste water.

Adapted from "Water Wise: Lessons in Water Resources," by E. C. Moran and M. E. Krasny, published by Cornell Cooperative Extension, 1989.

Useful Links

Online simulator where students have to solve an ecological problem
http://www.biomanbio.com/GamesandLabs/EcoGames/ecodetectives%20peril%20river.html

Info about the Sweetwater Wildlife Refuge (where the Living Coast is!)
https://www.fws.gov/refuge/San_Diego_Bay/about.html

Why are Wetlands Important? Video
https://www.youtube.com/watch?v=h3dMkhO6jAw

Explanation of a Watershed Video
https://www.youtube.com/watch?v=LJ63xGJY4pM

Lesson plan with power point about water quality and water treatment
https://www.teachengineering.org/lessons/view/wst_environmental_lesson02

Online pH simulation
https://phet.colorado.edu/sims/html/ph-scale/latest/ph-scale_en.html