Science Learning Packet
Grade 6:
Weather Patterns, Lesson 8

science learning activities for SPS students during the COVID-19 school closure.

Seattle Public Schools is committed to making its online information accessible and usable to all people, regardless of ability or technology. Meeting web accessibility guidelines and standards is an ongoing process that we are consistently working to improve.

While Seattle Public Schools endeavors to only post documents optimized for accessibility, due to the nature and complexity of some documents, an accessible version of the document may not be available. In these limited circumstances, the District will provide equally effective alternate access.

Due to the COVID-19 closure, teachers were asked to provide packets of home activities. This is not intended to take the place of regular classroom instruction but will help supplement student learning and provide opportunities for student learning while they are absent from school. Assignments are not required or graded. Because of the unprecedented nature of this health crisis and the District’s swift closure, some home activities may not be accessible.

If you have difficulty accessing the material or have any questions, please contact your student’s teacher.
Weather Patterns

Chapter 1: Understanding Rainfall
Chapter 2: Investigating Temperature

Student Name:______________________________________________________________

School:__________________________________________ Grade:________________________

Science Teacher:____________________________________________________________________

Date:______________________________________________________________________________
Hello Families,

We hope you and your family are well and safe during this time. During this unprecedented out-of-school time, the SPS middle school science team will be offering instructional opportunities for students that align with the district’s adopted middle school science instructional materials.

This investigation packet is part of a series of district-aligned lessons about Weather Patterns, a 6th grade life science unit developed by AmplifyScience and adopted by SPS in 2019. While Amplify Science lessons are designed to be done in the classroom with peers, there are some activities that students can complete at home. In this packet you will find activities to accompany lessons in the unit. Accompanying lesson videos are posted on the SPS Science webpage under Grade 6. These lesson videos, developed in collaboration between SPS teachers, Denver Public Schools teachers, and Amplify Science, feature teachers going through the information in the lessons. The work in this packet is intended to be completed alongside the viewing of the video of the corresponding videos.

To find the correct lesson videos:

- Go to SPS Science webpage
- Scroll to “6th Grade”
- Find the “Weather Patterns” videos section
- Select the video that matches the lesson you are completing that day.

For students who have access to the internet and the following devices and browsers may wish to log-in to their AmplifyScience account from home are welcome to do so. Chrome and Safari are the recommended browsers to use for full functionality of the Amplify digital tools and features.

Sincerely,

The Jane Addams Grade 6 Science Team & Seattle Public Schools Science Department
This packet continues Chapter 2, Investigating Temperature

-Day 1: Chapter 2, Lesson 2.2  Reading “Disaster In California”

-Day 2: Chapter 2, Lesson 2.3 Simulating a Large Storm

-Day 3:  Chapter 2, Lesson 2.4  Analyzing New Data About Galetown

-Day 4: “Check your Understanding” quiz on Schoology
Lesson 2.2 Reading “Disaster in California”

WARM-UP: In our last lesson learned about a specific layer in the atmosphere.

Which end of the arrow is warmer and which end is colder? What happens in between the two ends of the arrow?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

Vocabulary So Far:

AIR PARCEL: An amount of air that moves as a unit
CLOUD: Liquid water droplets suspended in the air
CONDENSATION: The process by which a gas changes into a liquid
ENERGY: The ability to make things move or change
EVAPORATION: to move from one object to another or one place to another
TEMPERATURE: A measure of how hot or cold something is; a measure of the average kinetic energy of the molecules of a thing
TRANSFER: To move from one object to another or one place to another
TROPOSPHERE: the layer of the atmosphere closest to Earth, where weather happens
WATER VAPOR: Water as a gas
WEATHER: Conditions such as rain, clouds, wind at a particular time and place

Goal: Investigate a historic weather event and analyze what caused it to happen. We will do this by reading an article and applying our new knowledge of how rainstorms form.

The article you will read today is about a particularly dangerous series of rainstorms that happened over 100 years ago. To understand why these storms happened you will need to understand factors that can cause severe storms that produce a lot of rain.
So far, we understand that when an air parcel cools it loses energy, and the more energy it loses the more rain can be produced. But we still do not know everything about what causes an air parcel to cool. Learning about these storms in California will give us some insight into that question.
Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.

2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.

3. Examine all visual representations carefully. Consider how they go together with the text.

4. After you read, discuss what you have read with others to help you better understand the text.
This photograph, taken during the Great Flood of 1862, shows people rowing boats in the flooded streets of Sacramento. Sacramento is the capital of California.

Disaster in California!

In 1862, a natural disaster in California caused thousands of deaths and destroyed the state’s economy. This disaster wasn’t an earthquake or a fire—it was an enormous flood that hit huge sections of the state. The Great Flood of 1862 was caused by a series of storms that brought more than double the normal amount of rain to California in a very short period of time.

Scientists and historians call the Great Flood of 1862 a “megaflood” because of the devastation it caused. Before the flood, there was an extensive period of time with little rain, and California farmers were struggling because there wasn’t enough rain to water their crops. However, they probably weren’t expecting what came next! During December 1861 and January 1862, so much rain fell that many of the dry, flat farms in the center of California were completely covered in water—the whole valley looked like a large inland sea. Rivers and streams all over the state swelled up and over their banks, causing dangerous water flow that destroyed homes and killed animals and people in its path.

Using sources such as newspaper reports, data collected by scientists, and diaries and letters from people living in California at the time, people have reconstructed the kinds of damage done in this two-month period. Because of the massive rainfall and flooding, entire towns were destroyed. In some places, the water from the flood was 30 feet deep, covering the telephone poles that had just been put in place. Farmers and ranchers all across the state reported that they lost their homes, barns, farm equipment, and most of their animals. The devastation was so great and affected so many people that the state of California went bankrupt trying to support the people who were affected by the flood.
What Caused the Great Flood of 1862?

The Great Flood of 1862 was caused by a series of powerful storms that began over the Pacific Ocean. These storms were so strong because local temperatures were higher than normal—the winter of 1862 was unusually warm in California. Out in the ocean, both the ocean surface water and the air above it were also warmer than usual. The higher temperatures caused more ocean water to evaporate into the air. These warm air parcels full of water vapor rose high into the troposphere above California. In fact, because they were warmer than usual, they rose higher in the troposphere than the cooler air parcels that cause normal rain storms. As they traveled up through the colder parts of the troposphere, energy transferred from the parcels to the surrounding air, lowering the temperature of the air in the parcels. The parcels cooled until they had the same temperature as the surrounding air, causing the water vapor inside to condense into liquid water. The higher they rose, the more energy the parcels lost and the more water vapor condensed. The clouds that formed from these air parcels were full of liquid water that would soon fall as rain.

The same pattern of high temperatures leading to more water vapor in the air continued through the winter, causing multiple storms and record rainfall in many parts of California. Los Angeles received over 167 centimeters (66 inches) of rain in just two months—four times the amount of rain that normally falls there each winter. Rivers and streams were already full of water, so there was no place for the extra water from the rainfall to go. The water stayed above ground for weeks and caused flooding all across the state.

Could the conditions that caused the Great Flood of 1862 happen today? Meteorologists say that the perfect conditions for these kinds of storms—surface air temperatures that stay warm for several months and a constant source of water for evaporation—happen once every 100–200 years, so it’s possible that California will see this kind of rainfall again. However, we now have a better understanding of the pattern that leads to these storm clusters and can predict when and where they might happen. We can’t avoid storms, but we can figure out when they might happen and help people prepare when they do occur.
Let’s look specifically at the first paragraph in the section “What Caused the Great Flood of 1862?” What evidence can you find to help answer the question why were these storms so strong?

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

What conditions are necessary for these kinds of storms to happen?

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

Lesson 2.2 Wrap-Up

- Air parcels cool as a result of energy transfer
- Temperature affects how much rainfall can happen
- The amount of surface water available affects the amount of water vapor

No new key concepts this lesson.

Bonus Challenge activity:

Use the internet to research the rainfall in our state. Fill in the table below.

1. What is the average annual rainfall in your state? ______________________
2. What is the average annual rainfall in your city? ______________________
3. What day had the highest rainfall? ______________________
4. How many inches of rain fell on that day? ______________________
Lesson 2.3 Simulating a Large Storm

Goal: Investigate what determines how much an air parcel will cool and how this cooling effect impacts the amount of rain. We will do this by reviewing the article and building different storms in the SIM.

**Vocabulary So Far:**

AIR PARCEL: An amount of air that moves as a unit

CLOUD: Liquid water droplets suspended in the air

CONDENSATION: The process by which a gas changes into a liquid

ENERGY: The ability to make things move or change

EVAPORATION: to move from one object to another or one place to another

TEMPERATURE: A measure of how hot or cold something is; a measure of the average kinetic energy of the molecules of a thing

TRANSFER: To move from one object to another or one place to another

TROPOSPHERE: the layer of the atmosphere closest to Earth, where weather happens

WATER VAPOR: Water as a gas
WEATHER: Conditions such as rain, clouds, wind at a particular time and place

WARM-UP: In the last lesson, you read about a megaflood that happened in California in 1862. The flood happened because of a series of huge rainstorms that occurred.

Below is a set of weather events that caused the Great Flood of 1862. The list of weather events is not in the correct order. Put the events in the order of what happened, using numbers 1 – 6.

- The warm air parcel rose into the troposphere and lost energy, forming clouds as it rose.
- Severe flooding happened.
- Energy transferred from Earth’s surface to the air parcel, warming the air.
- The sun heated the surface of Earth.
- A lot of rain fell.
- The air parcel stopped when it reached the same temperature as the surrounding air high in the troposphere.

Let’s take a minute to review the important points from the article we read yesterday about the floods in California.

Why did warmer temperatures lead to more rainfall?
_________________________________________________________________
_________________________________________________________________

What happens when an air parcel rises higher in the troposphere?
_________________________________________________________________
_________________________________________________________________

When does an air parcel stop losing energy?

Gr 6 Weather Patterns Lesson 8, JAMS Science Team - Gr 6 team, SPS, 4-2020
Exploring the SIM
If you have access to Amplify, you can go into the Weather Patterns SIM and explore now. If you are watching the videos, you can choose to just watch her run the SIM.

In the previous chapter, you created different rainstorms by controlling both the temperature of the air parcel and the surrounding air while keeping the amount of water vapor constant. This time try to make the rainstorms by controlling one factor: the amount of sunlight.

Functions in the SIM
- You can move between Build, Run, and Analyze
- Sunlight and surface water sliders on the Build screen.
- Water vapor and temperature readout in the air parcel in Run.
- Yellow arrows that indicate energy
- Pause, Play, and Reset options in Run.
- Time slider in Analyze.

Model creating a cloud with severe rain. We are going to make a cloud with severe rain as a class, and then you will use its data as a reference to modify the sunlight to surface level and create the other weather events.
- In Build, set the surface water level to 5.
If I want a cloud with severe rain, I would need a large amount of energy transferred out of the parcel when it condenses so we should use a high level of sunlight.
- Set the sunlight to surface level to 4.
- Go to Run and observe. What is the water vapor level? Temperature of the air parcel? The starting temperature of the air parcel is the temperature after it gets heated (shown in red in the Sim) and before it rises. What is the final height of the air parcel and the temperature of the troposphere at that height?
- Record the air parcel height [6.5 km] and the temperature of the troposphere at that height [-30°C].
- Go to Analyze. What is the rainfall level?
- Record the following information in your data tables:
  “Temperature of Troposphere Where the Parcel Stops: -30°C”
  “Starting Air Parcel Temperature: 35°C”
  “Final Air Parcel Temperature: -30°C”
Simulating Rainstorms
Make three weather events: cloud with severe rain, cloud with moderate rain, and cloud with very severe rain.
Launch the Weather Patterns Simulation.
1. We did the first weather event ‘cloud with severe rain’ together.
2. For the second weather event, return to Build. Leave the surface water level at 5.
3. Refer to the first weather event and decide how to change the amount of sunlight to make a cloud with moderate rain.
4. Run the Simulation.
5. Go to Analyze and check if you have the desired Rainfall Level. If you do, fill out the information in the data table. If you do not, go back to Build and change the conditions.
6. Repeat steps 2–5 for a cloud with very severe rain.

<table>
<thead>
<tr>
<th>Weather event</th>
<th>Temperature of troposphere where the parcel stops</th>
<th>Parcel height</th>
<th>Starting air parcel temperature</th>
<th>Final air parcel temperature</th>
<th>Air parcel temperature difference</th>
<th>Energy transferred out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1: Cloud with severe rain (Rainfall Level 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test 2: Cloud with moderate rain (Rainfall Level 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test 3: Cloud with very severe rain (Rainfall Level 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What patterns do you notice?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

What happened when you changed the sunlight?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Use your new knowledge to fill in the blanks for the key concepts.

Key Concept

As an air parcel rises, energy transfers from the __________ air parcel to the __________ surrounding air until their temperatures become __________. (warm, cold, equal)

Key Concept

When an air parcel starts with a _________ temperature, it will rise higher and lose more energy, causing _________ rainfall. (higher, more)

Did I get it?

Can I answer the investigation question: What determines how much an air parcel will cool? (word bank: energy, temperature, air parcel, troposphere)
Lesson 2.3 Wrap-Up

- Air parcels cool as a result of energy transfer
- The warmer the air parcel, the higher it will rise
- The higher an air parcel rises, the more rain it will produce

Key Concept-As an air parcel rises, energy transfers from the warm air parcel to the cold surrounding air until their temperatures become equal.

Key Concept-When an air parcel starts with a higher temperature, it will rise higher and lose more energy, causing more rainfall.
Up Next: Lesson 2.4
- Analyzing temperature data
- Modeling effects of temperature
- New key concepts

Lesson 2.4 – Analyzing new data about Galetown

WARM-UP:
One of the claims used to explain the severe rainstorms in Galetown is this: Warmer weather caused Galetown to have more severe storms. **Do you think that a higher temperature is affecting the amount of rain?** (Pick one)

Yes    No    Not sure

Explain your answer giving evidence from the table above.

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

---

From: Dr. Kenji Emerson  
To: Student Meteorologists  
Subject: Temperature Data for Galetown

We’ve gathered data about the air temperature before the storms started in Galetown and added it to this data table. Look carefully at the data for Storms 2 and 3 below. We think the temperature differences could be an important factor that can help explain the severe storms Galetown has been experiencing.

<table>
<thead>
<tr>
<th>Weather Event</th>
<th>Local Surface Water</th>
<th>Amount of Rain</th>
<th>High Temperature Before the Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm 1 (before lake)</td>
<td>low</td>
<td>mild, 6 cm (2.4 in)</td>
<td>very high, 39°C (102°F)</td>
</tr>
<tr>
<td>Storm 2 (after lake)</td>
<td>high</td>
<td>moderate, 12.7 cm (5 in)</td>
<td>high, 27°C (81°F)</td>
</tr>
<tr>
<td>Storm 3 (after lake)</td>
<td>high</td>
<td>severe, 20.3 cm (8 in)</td>
<td>very high, 40°C (104°F)</td>
</tr>
<tr>
<td>Storm 4 (after lake, July of this year)</td>
<td>high</td>
<td>very severe, 30.5 cm (12 in)</td>
<td>high, 39°C (102°F)</td>
</tr>
</tbody>
</table>

How does this increase in temperature affect rainfall?
For this next activity we are going to focus on Storm 2 and Storm 3 to try and answer the Chapter 2 Question of: **Why is the amount of rain in Galetown different from storm to storm?**

Why did Storm 2 have moderate amounts of rain, while Storm 3 had severe rainfall?

<table>
<thead>
<tr>
<th>Weather Event</th>
<th>Local Surface Water</th>
<th>Amount of Rain</th>
<th>High Temperature Before the Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm 2 (after lake)</td>
<td>high</td>
<td>moderate, 12.7 cm (5 in)</td>
<td>warm, 27°C (81°F)</td>
</tr>
<tr>
<td>Storm 3 (after lake)</td>
<td>high</td>
<td>severe, 20.3 cm (8 in)</td>
<td>hot, 40°C (104°F)</td>
</tr>
</tbody>
</table>

**Your Task:**
Come up with at least two different sentences that answer the question “Why is the amount of rain in Galetown different from Storm 2 to Storm 3?”

- Your sentences should include at least 2 vocabulary words each
- You may use the same word in multiple sentences
- There are many different ways to answer this question, you will probably need to use multiple sentences together to answer it completely.

**Word Bank:**

- **AIR PARCEL**: An amount of air that moves as a unit
- **ENERGY**: The ability to make things move or change
- **TEMPERATURE**: A measure of how hot or cold something is; a measure of the average kinetic energy of the molecules of a thing
- **TRANSFER**: To move from one object to another or one place to another
- **TROPOSPHERE**: The layer of the atmosphere closest to Earth, where weather happens
- **WATER VAPOR**: Water as a gas

1. EXAMPLE: The air parcel for Storm 3 probably rose higher into the troposphere.  
2. __________________________________________________________________________  
   __________________________________________________________________________  
   __________________________________________________________________________  
3. __________________________________________________________________________  
   __________________________________________________________________________  
   __________________________________________________________________________  

*Gr 6 Weather Patterns Lesson 8, JAMS Science Team - Gr 6 team, SPS, 4-2020*
Modeling Storm 2 and Storm 3
Below is a pre-made model for Storm 2 explaining its moderate amount rainfall, use the table and the key to complete the model for storm 3 to help explain its large amount of rainfall.

<table>
<thead>
<tr>
<th>Weather Event</th>
<th>Local Surface Water</th>
<th>Amount of Rain</th>
<th>High Temperature Before the Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm 2 (after lake)</td>
<td>high</td>
<td>moderate, 12.7 cm (5 in)</td>
<td>warm, 27ºC (81ºF)</td>
</tr>
<tr>
<td>Storm 3 (after lake)</td>
<td>high</td>
<td>severe, 20.3 cm (8 in)</td>
<td>hot, 40ºC (104ºF)</td>
</tr>
</tbody>
</table>

**Effect of Temperature**

Goal: Show how temperature caused different amounts of rain in Galetown.

Before  Storm 2  After

Modeling Tool Key
- temperature: very low, low, medium, high, very high
- water: low, medium, high
- energy transfer: low, medium, high
- amount of cloud and rain:
Hopefully your model for “Storm 3” includes that it started at a high temperature which caused it to travel higher up into the troposphere where it was colder. This would cause the air parcel to lose more energy and result in more condensation and rain!

**Which storm had a greater change in temperature?** (Circle one)
- Storm 2
- Storm 3
- They were the same

**What explains the greater temperature change?** (Select one)
- [ ] There was more surface water
- [ ] Surrounding air temperature at the surface was different
- [ ] The air parcel lost more energy

Now let’s look back at our claims for this unit!
We gathered evidence in Chapter 1 to prove Claim 1 is true because there was more surface water to evaporate into the air.

Now, do you think Claim 2 is also correct? **Do you think warmer weather caused Galetown to have more severe rainstorms? Explain why you think so:**

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

**Lesson 2.4 Wrap-Up**

- Temperature has an impact on the severity of rainstorms
- The warmer the air parcel, the higher it will rise
- The higher in the troposphere you travel, the colder it gets
- The higher an air parcel rises, the more energy it loses
- The more energy an air parcel loses, the more rain it will produce

Key concepts (from the previous lesson)
Key Concept-As an air parcel rises, energy transfers from the warm air parcel to the cold surrounding air until their temperatures become equal.

Key Concept-When an air parcel starts with a higher temperature, it will rise higher and lose more energy, causing more rainfall.

Up Next: Check for understanding on Schoology
- Check what you know
- Answer the short answer question as fully and completely as you can!

Chapter Two: Check for Understanding

If you have Schoology, please take the “Chapter Two: Check for Understanding” on Schoology. This allows your teacher to give you feedback. If you do not have Schoology access, try out the questions below!
Question 1

The Troposphere is the layer of the atmosphere closest to Earth. This is where weather happens. Where is the Troposphere the warmest?

- The temperature is all cold throughout the Troposphere.
- It is warmest the higher up in the Troposphere, and colder the closer to Earth's surface.
- It is warmest at the surface, and colder as you go up in the Troposphere.
- The temperature is all warm throughout the Troposphere.
Question 2

Which air parcel can **rise higher** in the Troposphere, if both have the same surrounding air temperature of -2 degree Celsius?

- They both would rise the same amount.
- Air Parcel B will rise higher.
- Air Parcel A will rise higher.
- They both would not rise.

Question 3

As a warm air parcel rises, how does energy transfer?

- Energy transfers from the warm air parcel to the warm surrounding air of the Troposphere.
- Energy transfers from the cold surrounding air of the Troposphere, to the warmer air parcel.
- Energy transfers from the warm air parcel to the cold surrounding air of the Troposphere, until temperatures are equal.
- No energy transfer happens.
Question 4

Storm 1 had a lot of rain. Storm 2 had a little rain. What could explain why Storm 1 had more rainfall than Storm 2?

Before Storm 1, the air parcel at the surface could have been:

- warmer, so when the air parcel moved higher, it lost more energy.
- warmer, so when cooler air from above moved down, it lost more energy.
- cooler, so when the air parcel moved higher, it gained more energy.
- cooler, so the air parcel had low energy and remained near the surface.

Question 5

There were two rainstorms in Seattle recently. Before Storm 1, Seattle's temperature at the surface was 26 degrees C. Before Storm 2, the air temperature at the surface was 14 degrees C.

The surrounding air temperatures were the same before both storms.

Which storm is likely to have had more rainfall? Why? Don't forget to include energy transfer in your explanation.

- 
- 
- 
- 
- 
- 
- 
- 
-