ARIZONA SCIENCE CENTER
Never stop wondering.
Never stop imagining.

Cloudy with a Chance of Science! Week 3: Grades 3-5

Day	Topics	Related Standards
1	What's the Weather Like Outside?	**Collect**, **analyze**, and **interpret** data to explain weather and climate patterns.
2	Weather vs. Climate	**Collect**, **analyze**, and **interpret** data to explain weather and climate patterns.
3	Proceed with Caution: Severe Weather Challenge!	**Collect**, **analyze**, and **interpret** data to explain weather and climate patterns. **Define problem(s)** and **design solution(s)** to minimize the effects of natural hazards.
4	Gotta Plan?	
5	Improvements Ahead!	

Cloudy with a Chance of Science!

Week 3

Day 1: What's the Weather Like Outside?

Teacher/Parent Background:

Breezy, warm, cloudy, wet! What is the weather like outside your house today? In science, weather is described as the condition of an environment at a given time and involves factors such as cloud coverage/sun exposure, wind, temperature and precipitation. Tracking the weather over time by collecting data can tell us more about the environment we live in and can help us better prepare for upcoming weather.

Overview:

In this activity, students will engage in an outdoor exploration in order to describe the weather conditions of their environment.

Related Standards:

- Collect, analyze, and interpret data to explain weather and climate patterns.

Key Terms:

- Weather: the condition of an environment at a given time.
- Temperature: the measurement of heat in a place.
- Precipitation: water (liquid or solid) that falls from clouds.
- Thermometer: a tool used to measure temperature.
- Meteorologist: a scientist who studies weather.

Materials List:

- Internet access
- Parental/adult supervision
- Safe, outdoor areas
    - Frontyard, backyard, neighborhood sidewalks, nearby field or park, etc.
- Thermometer
- Timer
- Pen/pencil
- *Student Resources - Pages 6-8*

- *Weather Cards*
- *Weather Data Table - Part 1*
- *Weather Data Table - Part 2*

Activity Description:

- Temperature is a weather condition and is the measurement of the heat in a place. Before starting the lesson, place a thermometer on an outdoor surface that is not covered by shade and is not directly on the ground (ex: resting on lawn furniture).
  - Record the initial temperature to give to students at a later time.
  - You and your students will revisit this thermometer later in the lesson to record a final temperature. Use a timer to keep track of the time between temperature readings.
- Ask students to observe and describe what they see in each of the *Weather Cards*. Engage students in a discussion of key ideas:
  - What do you see in each card?
    - Trees, skies, clouds, water, sunshine, playground equipment, etc.
  - What kinds of words would you use to describe each card?
    - Card 1: Windy
    - Card 2: Cloudy
    - Card 3: Sunny
    - Card 4: Rainy
    - Card 5: Hot
  - How would you need to dress/bring with you in order to go outdoors in each of the scenarios?
    - Card 1 and 2: Sometimes when it is windy or cloudy, I get cold so I would need to bring a jacket.
    - Card 3: When it is sunny, I wear sunglasses and sunscreen to protect me from the Sun.
    - Card 4: When it rains, I use an umbrella and I wear rain boots.
    - Card 5: When it is hot, I wear lighter clothes and bring lots of water to drink!
  - What are some differences between the cards? What is similar between the cards?
    - One card shows the Sun shining brightly while other cards show cloudy skies and rain, one card shows a hot place, etc.
    - All of the cards show things that happen to/affect us outside.
- Although all of these cards are different from one another, they have something in common: each card shows a weather condition! In the science community, we describe *weather* as the condition of an environment at a given time. Just like you saw in each card, there are certain weather conditions or factors, such as:
  - Cloud coverage/Sun exposure - as seen in Card 2 and 3

    - Wind - as seen in Card 1
    - Temperature - as seen in Card 5
        - *Temperature* is defined as the measurement of heat in a place. Like a hot, summer day in Phoenix!
    - Precipitation - as seen in Card 4
        - *Precipitation* is defined as water, either in liquid (rain) or solid (snow) form, falling from clouds.
- All of these conditions can be studied by using tools and making observations.
    - Prompt students to access the *Scholastic Study Jams: Weather Instruments Slideshow*. As applicable/wanted, prompt students to engage in the *Test Yourself* option.
- Explain to students that the conditions outside tell us a lot about the weather in our environments and since we live in our environments, we want to know the weather to plan for the day/week!
    - We can track the weather over time by collecting data. This data can tell us more about the environment we live in and can help us better predict and prepare for upcoming weather!
    - In fact, scientists who study weather are called *meteorologists*. Today, we are going to become meteorologists and collect data about the weather outside our homes!
- Engage students in the following activity:
    - With adult/parental supervision, explore the weather of the safe, easily accessible outdoor areas of your neighborhood. This may include:
        - Your front and backyard, sidewalks around your neighborhood, a nearby field or park, etc.
    - Prompt students to collect and record data to explain the weather conditions of their environment:
        - Briefly review the *Weather Data Table - Part 1* details and prompt students to circle the appropriate rating, depending on the current weather conditions.
        - Briefly review the *Weather Data Table - Part 2* details.
            - **Note:** Provide students with the starting temperature from the beginning of the lesson and then guide students to read and record the final temperature.
            - Reading and recording temperature in degrees Fahrenheit may be the most familiar measurement to students at this time.

Closure:

- After the activity has concluded, return home and engage in a discussion with students:

- What is the weather like outside your house? Describe the weather using observations from your investigation.
- Why do you think it is important to know the weather conditions of your environment?
- Based on the weather observed today, what do you predict tomorrow's weather will be like? Will it be similar? Why do you think so?

Extensions:

Continue the Investigation!

- Engage students in collecting specific information about the wind outside!
  - Explore this activity to make a *wind vane* with household materials!
    - How can you tell which direction the wind is blowing?
- Encourage students in collecting specific information about rainfall!
  - Explore this activity to make a *rain gauge* with household materials!
    - How can you tell how much rainfall we had?
- Assist students in downloading the free *Google Science Journal* app. to collect and record real-time conditions about their environments!
  - Barometer
  - Brightness

- Call or video-chat with a family member/friend that lives in a different city. What is their weather like today?
  - Encourage students to share the weather data they collected and listen to the data from a different environment.
    - What is similar about the weather data?
    - What is different about the weather data?

Student Resources

Weather Cards

Card 1	Card 2
	
Card 3	**Card 4**
	
Card 5	
	

Weather Data Table - Part 1

Sunshine/Cloud Scale

1 Low	2 Medium	3 High
The sky is completely covered by clouds. Little/no sunshine is seen.	The sky is somewhat cloudy. The Sun can be seen.	The sky has no/few clouds. The Sun can be seen shining full, brightly.

Wind Scale

1 Low	2 Medium	3 High
There is little/no wind. The leaves of trees are completely still.	There is moderate wind. The leaves of trees move/sway back and forth.	There is a strong wind. The leaves/branches of trees shake violently and make loud noises.

Precipitation Scale

1 Low	2 Medium	3 High
There is no precipitation. There is no falling rain or snow.	There is light precipitation. Some rain or snow is falling.	There is strong precipitation. Rain or snow is falling heavily.

Weather Data Table - Part 2

Temperature Over Time

Starting Temperature	Final Temperature

Cloudy with a Chance of Science!

Week 3

Day 2: Weather vs. Climate

Teacher/Parent Background:

Although the words *weather* and *climate* are sometimes used interchangeably, weather and climate represent different things about our environments! In science, weather is described as the condition of an environment at a given time and involves factors such as cloud coverage/sun exposure, wind, temperature and precipitation. Climate, however, is described as the average pattern of the weather conditions taken over a period of time. Tracking the weather over time by collecting data can tell us more about the environment we live in and can help us better predict and prepare for upcoming weather.

Overview:

In this activity, students will describe the climate of their environment by interpreting weather patterns over time.

Related Standards:

- Collect, analyze, and interpret data to explain weather and climate patterns.

Key Terms:

- Weather: the condition of an environment at a given time.
- Climate: the average pattern of the weather conditions taken over a period of time.
- UV Index: measurement of the strength of the Sun's radiation at a given place and time.

Materials List:

- Pen/pencil
- *Student Resources - Pages 5-8*
    - *Phoenix Weather Forecast*
    - *Phoenix Data - Part 1*
    - *Phoenix Data - Part 2*
    - *Phoenix Data - Part 3*

- Computer/phone with audio - *optional for Extensions*

Activity Description:

- Ask students to review what they learned about weather during *Day 1: What's the Weather Like Outside?*. Briefly discuss with students:
    - What was the weather like outside your house? Describe the weather using observations from your investigation.
    - Why do you think it is important to know the weather conditions of your environment?
- We have learned that weather tells us about the conditions of our environment at a given time! But, is the weather the same each and every day? Have you ever experienced a change in the weather from day-to-day?
    - Prompt students to discuss and share their experiences.
- Looking at *Phoenix's Weather Forecast* for the week of 4/6-4/12, or the prediction of the week's weather, describe the weather conditions:
    - What changes in temperature were predicted?
        - Temperatures were predicted to start in the 80's, drop to the 70's and then rise back up to mid-80's.
    - What changes in sun exposure/cloud coverage were predicted?
        - The week was predicted to start out mostly sunny, become cloudier with storms/showers and then return to mostly sunny.
    - What changes in precipitation were predicted?
        - The week was predicted to begin with a 0% chance of precipitation, which then rose to a 65% chance of precipitation and ended with a 6% chance of precipitation.
            - **Note:** Although wind is a weather condition, wind is not a condition represented in this particular weather forecast but can be researched as wanted/applicable.
- As we can see, weather can change day-to-day! Since changes in weather happen daily, how do we best predict and prepare for upcoming weather?
    - Just as we observed and collected data about the weather outdoors, meteorologists use tools and their observations to study an environment's *climate*, the average pattern of the weather conditions taken over a period of time...usually over many years!
    - Meteorologists interpret weather patterns over time and make predictions about the upcoming weather of a large area or environment.
- Let's take a look at the average weather patterns of the month of April in Phoenix to learn more about what we can expect and prepare for!
    - Prompt students to observe and interpret the data in the *Phoenix Data Part 1-3*.

        - **Note:** Although wind is a weather condition, wind is not a condition represented in this data set but can be researched as wanted/applicable.
    - Facilitate a discussion of key ideas:
        - What can we expect in the month of April for high and low temperatures?
            - We can expect a high of about 85 degrees and a low of about 60 degrees Fahrenheit.
        - What can we expect in the month of April for precipitation?
            - We can expect about 2 days of rainfall.
        - What can we expect in the month of April for direct sunlight?
            - We can expect a mid-UV index/direct sunlight.
                - **Note:** In regards to *Phoenix Data Part 3* data, *UV index* is defined as a measurement of the strength of the Sun's radiation at a given place and time. Assist students in interpreting the graph by equating a high UV index number to the strength of sunlight. As appropriate, discuss measures to protect ourselves from the Sun's radiation.
        - Although it is still early in the month, how do the average weather conditions compare to what you have observed/experienced about April's weather so far?
            - The high/low temperatures seem spot on, as last week's weather forecast predicted on the hottest day a high of 84 degrees and a low of 61 degrees Fahrenheit.
            - So far, we have only had one day of rain, similar to the average weather conditions.
        - Looking at the data for the whole year, how would you describe your climate overall? What weather conditions do you experience throughout the year, mostly every year?
            - In my climate, I experience hot summers and cool but not freezing winters, lots of sunlight and little rain.

Closure:

- How do you think knowing more about our environment's climate helps us? How can you use this information in your life?

Extensions:

Continue the Investigation!

- Video-chat or email with a family member/friend that lives in a different city. What is their climate like?

- Encourage students to share their climate data and obtain data from a different environment.
  - What is similar about the climates?
  - What is different about the climates?

Watch!

- Crash Course Kids: *Weather vs. Climate*

Student Resources

Phoenix Weather Forecast

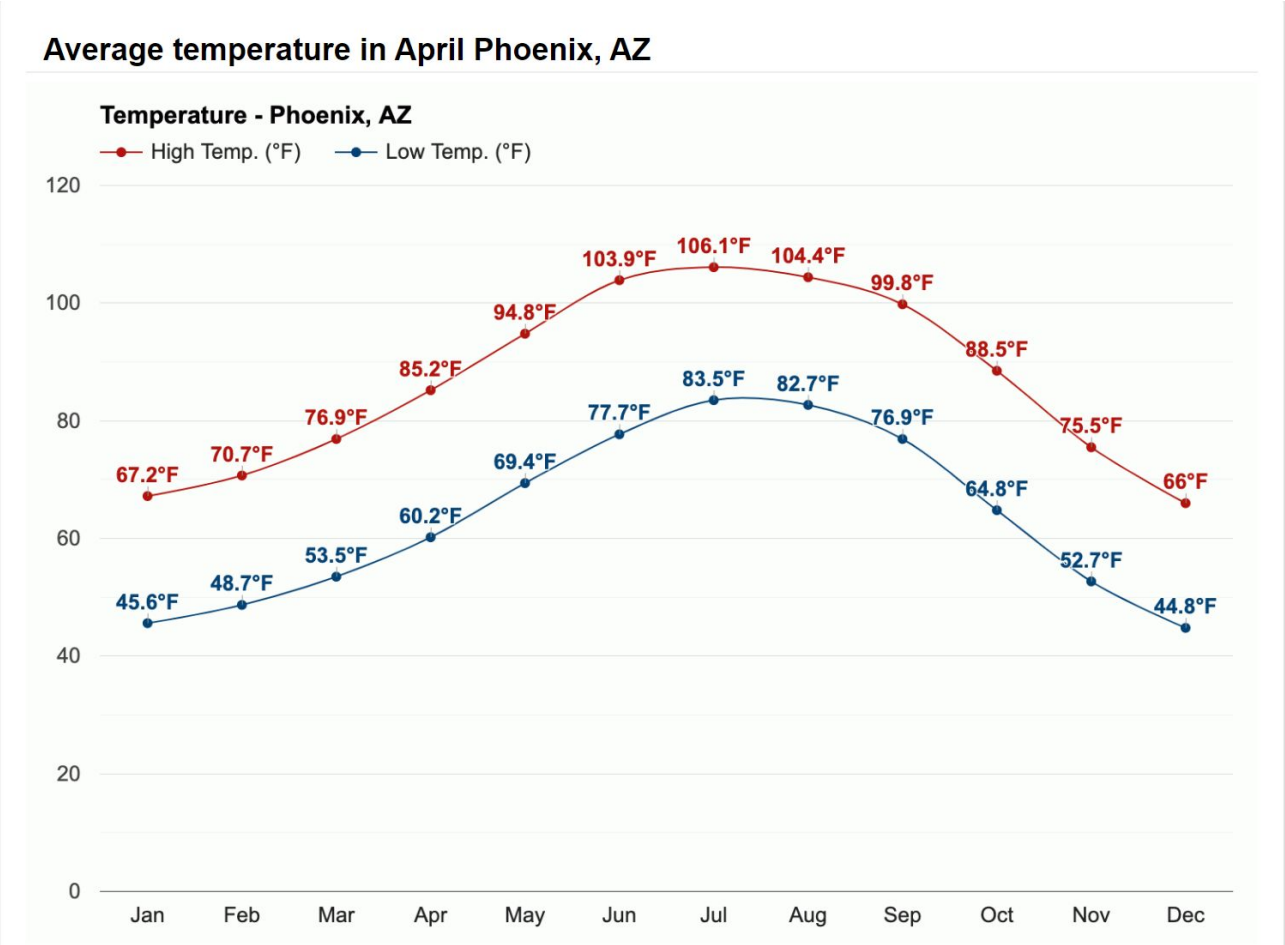
Week of 4/6 - 4/12

Mon 4/6	81° / 55°	Mostly sunny	Precip 0%
Tue 4/7	83° / 56°	Mostly sunny and nice	Precip 1%
Wed 4/8	74° / 49°	A t-storm in the afternoon	Precip 60%
Thu 4/9	70° / 51°	A couple of showers	Precip 65%
Fri 4/10	74° / 54°	Partly sunny, a shower; cool	Precip 40%
Sat 4/11	79° / 61°	Mostly sunny and warmer	Precip 6%
Sun 4/12	84° / 61°	Mostly sunny	Precip 6%

AccuWeather: Phoenix, AZ, Daily - Forecast.

Phoenix Data - Part 1

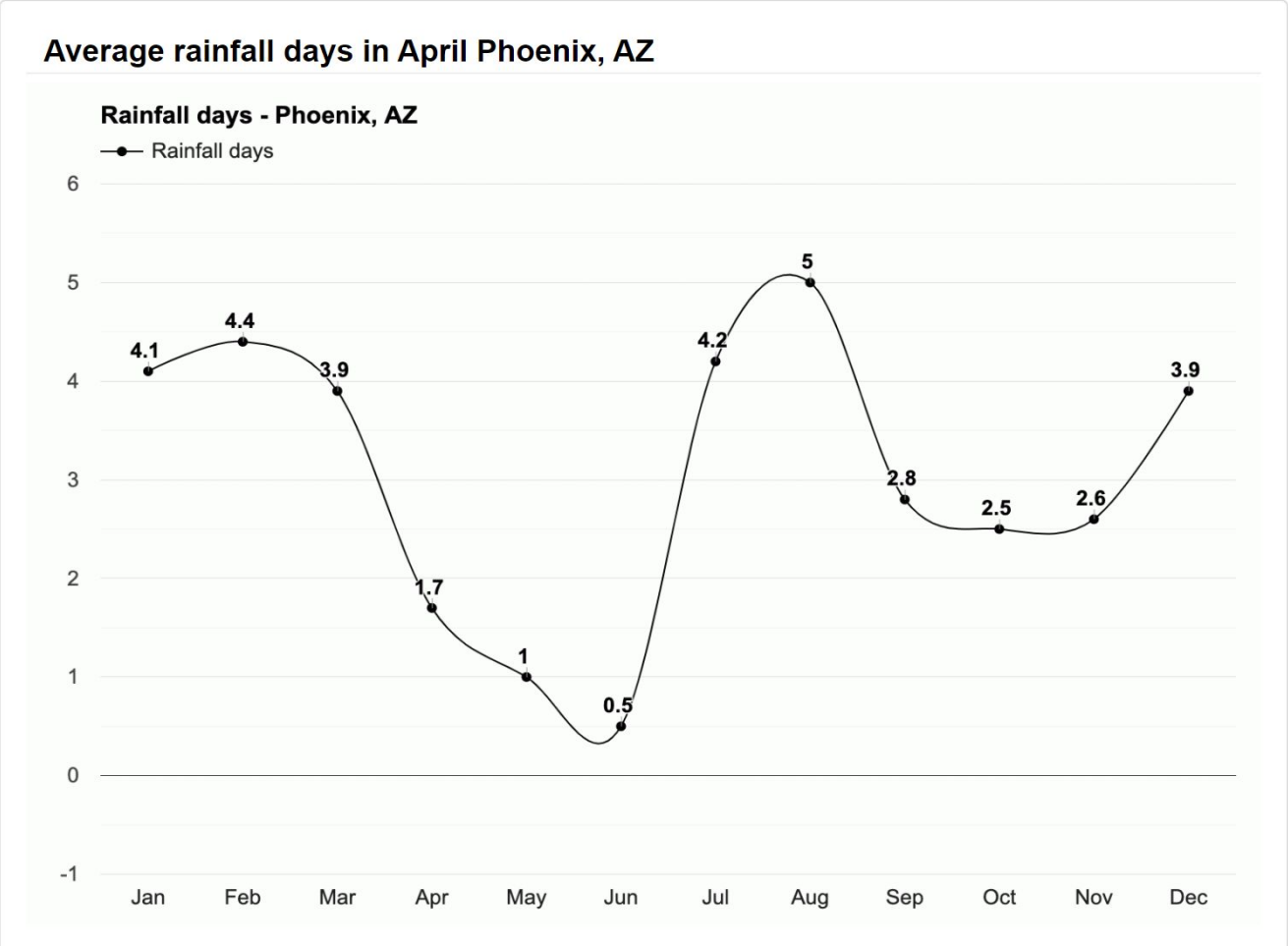
Average Temperature



Weather Atlas: April weather forecast and climate, Phoenix, AZ - Average temperature.

Phoenix Data - Part 2

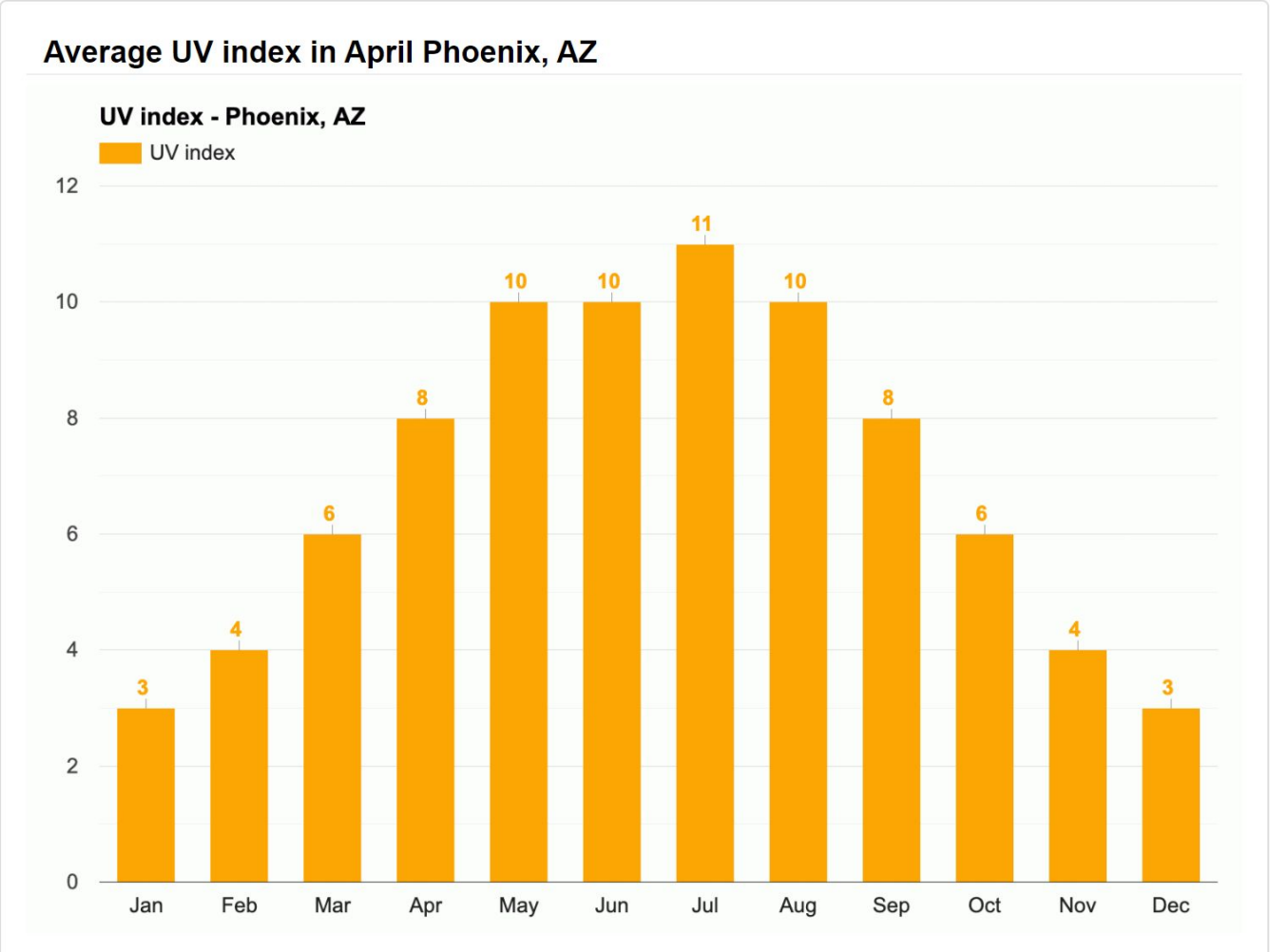
Average Precipitation



Weather Atlas: April weather forecast and climate, Phoenix, AZ - Average rainfall.

Phoenix Data - Part 3

Average UV Index/Strength of Sunlight



Weather Atlas: April weather forecast and climate, Phoenix, AZ - Average UV index.

Cloudy with a Chance of Science!

Week 3

Day 3: Proceed with Caution: Severe Weather Challenge!

Teacher/Parent Background:

Boom! Clap! Crack! Rumble! Proceed with caution...severe weather ahead! Although we experience changes in weather conditions every day, severe weather is on a whole different level. In science, severe weather is described as a dangerous weather event that puts people, animals and buildings at risk. Depending on the locations and conditions of various environments, people may experience severe weather such as tornadoes, blizzards, hurricanes, floods, droughts, etc. Parts of Arizona are known to also experience severe weather, including monsoons. Since severe weather poses risks to people, animals and buildings, scientists and engineers work together to propose solutions to minimize the negative effects. Through the Engineering Design Process, engineers follow a set of steps to propose solutions to problems in order to make the world a better place.

Overview:

In this activity, students will learn about the risks of an example of severe weather they face in their environment: monsoons. By using the Engineering Design Process, students will begin to address their severe weather challenge: *How can we design a house that can withstand the effects of a monsoon?*

Related Standards:

- Collect, analyze, and interpret data to explain weather and climate patterns.
- Define problem(s) and design solution(s) to minimize the effects of natural hazards.

Key Terms:

- Severe weather: a dangerous weather event that puts people, animals and buildings at risk.
- Engineering Design Process: a set of steps engineers use to propose solutions to problems

- Constraints: limitations or restrictions

Materials List:

- Internet access
- Computer/phone with audio
- Pen/pencil
- *Student Resources - Pages 5-6*
    - *Engineering Design Process Graphic*
    - *Step 1: Ask Table*

Activity Description:

- Ask students to review what they learned about weather and climate during *Day 2: Weather vs Climate*. Briefly discuss with students:
    - How would you describe your climate overall? What weather conditions do you experience throughout the year, mostly every year?
    - How does knowing more about our environment's climate help us? How can you use this information in your life?
- We have learned that tracking weather over time can tell us more about our climate, which in turns helps us better predict and prepare for upcoming weather. But, we experience small changes in weather conditions every day, so what do we need to be prepared for? What kind of big weather events have you experienced in your environment that you needed to be prepared for?
    - Prompt students to discuss and share their experiences. Possible student responses may include:
        - I needed to wear sunscreen and drink lots of water during hot, summer days. I could only go outside for a short time.
        - I needed to stay inside during big, summer rainstorms.
        - My family has used flashlights and candles when the power has gone out, due to a big storm.
- It sounds like we have all experienced some sort of big, weather event! We each needed to be prepared for this event because if we were not, we could be harmed in some way. In the science community, we describe this type of weather as *severe weather*, or a dangerous weather event that puts people, animals and buildings at risk.
    - Depending on the locations and conditions of various environments, people may experience severe weather such as tornadoes, blizzards, hurricanes, floods, droughts, etc.
- In Arizona, we also face severe weather. One severe weather we face every summer is the monsoon! But, how do monsoons form and what risks do they pose?
    - Play the Arizona Emergency Information Network video: *Monsoon Awareness Week*.

- Engage students in a discussion of main ideas:
  - What kinds of risks do monsoons pose to people, animals and buildings?
    - Flooding, strong winds, dust storms, extreme heat.
  - How does a monsoon form?
    - Winds push moisture towards the desert areas. The combination of moisture and the summer heat produces monsoons over the desert mountains.
  - What risks can we expect during the monsoon season?
    - During the first part of the season, it is drier and hotter. We can expect lightning without rain and strong winds, which can lead to fires.
    - In the middle part of the season, it is less dry and we can expect thunderstorms that bring rain, strong winds, dust storms, and sudden flash floods.
    - As the season nears its end, more flooding can be expected.

- Now that we know how monsoons are formed and what risks they pose, what can we do about it to help lessen the negative effects?
  - Since severe weather poses risks to people, animals and buildings, scientists and engineers work together to propose solutions to minimize the negative effects. As we have seen before, through the *Engineering Design Process*, engineers follow a set of steps to propose solutions to problems in order to make the world a better place.
    - Show students the *Engineering Design Process Graphic* as a reminder of each step.
      - **Note:** Students have previously learned about and experienced the Engineering Design Process through the lessons: *A Wild Ride!*. Please reference *Day 1's: Are You Up For a Challenge?* as needed.
  - By using the Engineering Design Process, you too will propose solutions to weather-related problems to help us all remain safe! Your severe weather challenge is: *How can we design a house that can withstand the effects of a monsoon?*
  - As we have learned before, engineers begin addressing a problem by asking questions.
    - Guide students through the "Ask" step of the Engineering Design Process:
      - **Step 1: Ask** -
        - Ask questions about the problem.
        - Consider what you need to know to solve the problem.
        - Ask about what others have done to solve the problem/similar problems.

- Consider the *constraints* or limits you have to stay within while solving the problem.
  - Example: time, materials, etc.
- Prompt students to record ideas/questions in the *Step 1: Ask Table*.
  - Possible student responses may include:
    - I need to know...
      - Which monsoon conditions are we testing?
      - What materials do we have to build the house?
      - How should the house be built?
      - How much time will we have to build the house?
    - Others have...
      - Used brick, wood, stone, metal, etc. to build strong houses.
      - Used slanted roofs or gutters to move rain off of the top of houses.
      - Experienced and fixed leaks inside houses if the roof wasn't built strong enough.
- Tell students that although we may not have the answers to these questions or "need to knows" at this time, we will know more tomorrow in order to accomplish our goal!

Closure:

- Engage in a discussion with students:
  - Thinking about what engineers do, what are your next steps to move forward in the challenge?
  - What are you most looking forward to as we begin the severe weather challenge?

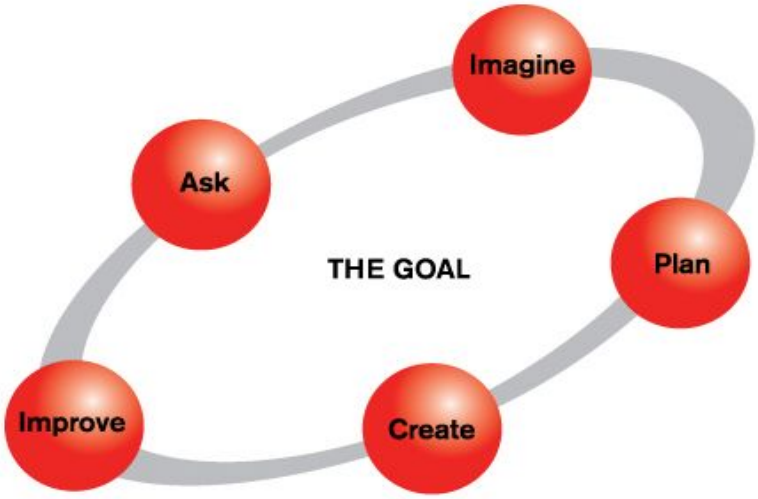
Extensions:

Watch!

- Crash Course Kids: *Severe Weather*

Student Resources

Engineering Design Process Graphic



The Engineering Design Process, EiE, Museum of Science, Boston.

Step 1: Ask Table

What is the problem?	What do you need to know to solve the problem?	What have others done when solving a similar problem?

Cloudy with a Chance of Science!

Week 3

Day 4: Gotta Plan?

Teacher/Parent Background:

When scientists and engineers are faced with a challenging question or problem, they follow steps to best address their task. In engineering fields, engineers use the Engineering Design Process to propose solutions to problems in order to make the world a better place. Engineers start by clearly defining the problem, imagining possible solutions and designing a plan before they create their solutions.

Overview:

In this activity, students will utilize the steps of the Engineering Design Process in order to design a plan for their challenge: *How can we design a house that can withstand the effects of a monsoon?*

Related Standards:

- Collect, analyze, and interpret data to explain weather and climate patterns.
- Define problem(s) and design solution(s) to minimize the effects of natural hazards.

Key Terms:

- Severe weather: a dangerous weather event that puts people, animals and buildings at risk.
- Engineering Design Process: a set of steps engineers use to propose solutions to problems
- Constraints: limitations or restrictions

Materials List:

- Parental/adult supervision
- Possible house/roof building materials:
    - Cardboard pieces
    - Aluminum foil
    - Construction paper
    - Popscile sticks

    - Foam
    - Fabric
    - Clay/Playdough
    - Notecards
- Pen/pencil
- *Student Resources - Pages 5-7*
    - *Challenge Details*
    - *Step 2: Imagine*
    - *Step 3: Plan*

Activity Description:

- Ask students to revisit the "Ask" step and discuss other "need to knows". Possible student responses may include:
    - I need to know...
        - Which monsoon conditions are we testing?
        - What materials do we have to build the house?
        - How should the house be built?
        - How much time will we have to build the house?
    - Others have...
        - Used brick, wood, stone, metal, etc. to build strong houses.
        - Used slanted roofs or gutters to move rain off of the top of houses.
        - Experienced and fixed leaks inside houses if the roof wasn't built strong enough.
- To answer the remaining "need to knows", review the *Challenge Details* with students. Encourage students to ask clarifying questions about the challenge details.
- Provide time for students to become familiar with the possible house/roof materials.
    - Prompt them to feel and bend the possible house and roof building materials for flexibility/rigidity, structure/support, texture, absorbency considerations, and other various properties.
    - **Note:** The amounts/types of materials will depend on the availability of materials. Limit quantities as you see fit.
- Then, direct students to revisit their remaining "need to knows". Possible student responses/questions may include:
    - How much time will we have to build/test the house?
        - Now that the challenge has been clearly defined and we have accomplished the "Ask" step, you will have today to imagine and plan for your solution. Tomorrow, you will build, test and improve your solution.
- Guide and actively assist students through the "Imagine" step of the Engineering Design Process by reviewing *Step 2: Imagine*. Key details/directions include:

- Now that the problem has been clearly explained/defined…
  - brainstorm more than one possible solution to the problem.
  - keep in mind the materials/design requirements, as they should be incorporated into your designs.
  - draw and label diagrams of your designs, write-out words/phrases to help you brainstorm!
  - pick your best solution to share with others.
    - **Note:** Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a sounding board for the student, allowing him/her to share their best solution ideas.

- Next, guide and actively assist students through the "Plan" step of the Engineering Design Process by reviewing *Step 3: Plan*. Key details/directions include:
  - Work together to decide on one best solution to be built by the whole team. This solution should include ideas from the team; not just one member's ideas!
  - keep in mind the materials/design requirements, as they should be incorporated into your solution.
    - **Note:** Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a design team member by listening to their ideas and sharing additional thoughts/your ideas. You will both work as a team to design a plan.
  - Draw and label a design of your solution and create a materials list with types and amounts of materials needed.
    - **Note:** The types/amounts of materials will depend on the availability of materials. Limit quantities as you see fit.

Closure:

- Ask students to think about tomorrow's activities. Engage in a discussion:
  - Thinking about what engineers do, what steps will be taking tomorrow to propose your best solution to the challenge?
  - What are you most looking forward to?

Extensions:

Continue the Investigation!

- Prompt students to research steps/tips to best prepare for the upcoming monsoon season:
  - What can you do to prepare the inside of your house?
  - What can you do to prepare the outside of your house?

- Can you design a *Monsoon Emergency Checklist* to show others how to be safe before, during and after a monsoon?

Student Resources

Challenge Details

Dear Student,

As a local meteorologist, my team and I are interested in working with you to teach the public about how to stay safe during the upcoming monsoon season! You have been tasked with designing a model house that can withstand the effects of a monsoon. Please closely follow all details outlined below:

1. **Use the steps of the Engineering Design Process to design the best possible house. This includes:**
    a. Imagining possible solutions - there are many possible solutions to this one challenge; think big!
    b. Planning your chosen solution
    c. Creating and testing your solution
    d. Improving your solution to make it even better

2. **You may only use <u>two</u> of the following building materials - <u>one</u> to design the model house and <u>one</u> to design the roof:**
    a. Cardboard
    b. Aluminum foil
    c. Construction paper
    d. Popscile sticks
    e. Foam
    f. Fabric
    g. Clay/Playdough
    h. Notecards

3. **Your model house and roof must include/stay within the following design requirements:**
    a. Your model house must have four walls; similar to that of a box.
    b. Your roof must be peaked and placed on top of your house.
    c. Your design must be able to withstand monsoon rain and winds!
        i. Your roof must stay on top of the house without being blown away.
        ii. You must keep a paper towel dry inside the house.
        iii. Your roof cannot collapse under water and wind forces.

My team eagerly awaits your design proposal. Best of luck!

Sunnie McCloudster, Chief Meteorologist

Step 2: Imagine

Possible Solution #1 (include a diagram with labels)

Possible Solution #2 (include a diagram with labels)

Step 3: Plan

Team Solution (include a diagram with labels)	Materials List (include material types and amounts)

Cloudy with a Chance of Science!

Week 3

Day 5: Improvements Ahead!

Teacher/Parent Background:

When scientists and engineers are faced with a challenging question or problem, they follow steps to best address their task. In engineering fields, engineers use the Engineering Design Process to propose solutions to problems in order to make the world a better place. Once engineers have established a plan, they create/test their designs and make improvements in order to propose the best possible solution.

Overview:

In this activity, students will utilize the steps of the Engineering Design Process in order to create, test and improve designs to address their challenge: *How can we design a house that can withstand the effects of a monsoon?*

Related Standards:

- Collect, analyze, and interpret data to explain weather and climate patterns.
- Define problem(s) and design solution(s) to minimize the effects of natural hazards.

Key Terms:

- Engineering Design Process: a set of steps engineers use to propose solutions to problems

Materials List:

- Parental/adult supervision
- Possible house/roof building materials:
    - Cardboard pieces
    - Aluminum foil
    - Construction paper
    - Popscile sticks
    - Foam
    - Fabric
    - Clay/Playdough

- Notecards
- Testing materials:
  - Pasta strainer
  - Water - 0.5 quart of 2 cups
  - Hair dryer
  - Paper towel
  - Tray to catch water spills
- Tape/glue
- Scissors
- Timer
- Pen/pencil
- *Student Resources - Pages 6-7*
  - *Step 4: Create and Test*
  - *Step 5: Improve and Re-test*

Activity Description:

- Today is finally the big day...we get to build and test our model house designs! Before we jump right into building, let's first revisit our plans.
  - Ask students to review their design plans by referencing *Step 3: Plan*. Guide students through a "checklist" in order to evaluate their plans and move on to creating their designs:
    - Check your plans for the following:
      - Does your plan have a diagram with labels?
      - Does your plan have a materials list that includes both types and amounts?
      - Does your plan follow the materials and design requirements?
        - Review the *Challenge Details* with students.
    - If your plan is missing something, please take time with your team to address it.
      - **Note:** Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a design team member by listening to their ideas and sharing additional thoughts/your ideas, if the plan is missing any requirements.
- Now that we have reviewed our plans, let's begin the creating process!
  - Guide and actively assist students through the "Create/Test" step of the Engineering Design Process by reviewing *Step 4: Create and Test*. Key details/directions include:
    - Build your design with your team!
    - Stick to your plan, including only using the types and amounts of materials you asked for.
    - Test it out! How did your solution work; what did and did not work well? Record the testing results.

- Testing procedures are as follows:
    - 1. Build the four walls of your house, using your selected material. Use tape/glue to hold them together.
        - **Note:** Carefully monitor and assist students when using scissors to cut any materials throughout the activity. Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a design team member by sharing the building, testing and reflecting responsibilities.
    - 2. Place a paper towel on the "floor" of your house. This will help us determine if any water leaks through!
    - 3. Build the roof of your house, using your selected material by creasing/folding it in half to form a peak.
        - Once it is peaked, place it on top of the house.
    - 4. To test how the house withstands wind, work with a parent/adult to turn on a hair dryer and set it to a cool/medium setting.
        - Move the hair dryer above and around the roof for about 1.5 minutes.
        - When done, pass the hair dryer to the adult/parent.
            - **Note:** Carefully handle the plugging in/turning on and off/unplugging of the hair dryer. Allow students to hold the dryer over the roof for testing only. For electrical and water safety considerations, completely remove the hair dryer out of the testing area for the next step.
        - Make observations, did the roof stay intact and in place?
    - 5. To test how the house withstands rainfall, place your house inside a tray, to catch spilling water.
        - Then, pour 0.5 quart or 2 cups of water into a pasta strainer. Hold the strainer above the roof.
        - When all the water has strained through, make observations. Is the roof intact and in place?

        - Remove the house to observe the paper towel. Is it wet or dry?
    - After testing has concluded, review testing results using *Step 4: Create and Test*, including the *Success Criteria* section, to assist students in reflecting on what did/did not work well.
- Our time is up! How can we make your design even better?
    - Next, guide and actively assist students through the "Improve" step of the Engineering Design Process by reviewing *Step 5: Improve and Re-test*. Key details/directions include:
        - Based on your testing results, discuss and decide what your team can do to make your design even better. Remember to still stay within the material and design requirements!
            - Review the *Step 5: Improve and Re-test*, including the *Team Suggested Improvements*, to assist students in discussing and deciding what to improve and how they will do so.
                - **Note:** Depending on the status of the materials, some may be able to be re-used and some may not.
                - **Note:** Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a design team member by sharing the reflection/discussion responsibilities.
        - Begin to re-create and re-test your improved design!
            - **Note:** Depending on the learning environment, the adult/parent may be the only other person in the "class". Act as a design team member by sharing the rebuilding and retesting responsibilities.
    - Our time is up! How did your solution work this time?
        - Prompt students to discuss, once again referencing the *Success Criteria* to determine what worked/did not work well.

Closure:

- As we approach the end of our week-long challenge, let's reflect!
    - What was the most enjoyable part of this process? Why?
    - What was the most challenging part of this process? Why?
    - Overall, how successful would you rate your final design, on a scale of 1-5 (1 is unsuccessful)? Explain your rating.

Extensions:

Continue the Investigation!

- Prompt students to extend the challenge with the following prompts:
    - How can you make your design *even* better?

    - What improvements would you make now? Why?
    - What were the testing results of this version?
- Can you design a house with structures to guide falling water off of the roof and away from the house?
    - How does this design improve safety both inside and outside the house?

Student Resources

Step 4: Create and Test

What Worked Well?	What Didn't Work So Well?

Success Criteria…

- Did you only use the available material amounts and types you planned for?
- Did you use only one type of material for the house walls and one type for the roof?
- Did your house have four walls and a peaked roof?
- Did your design withstand the rainfall test?
- Did you design withstand the wind test?

Step 5: Improve and Re-test

Team Suggested Improvements
We have decided to improve… **To improve this, we will...**

Re-testing Results

What Worked Well?	What Didn't Work So Well?

Did your design withstand the rainfall test?

Did your design withstand the wind test?

Did you use only one type of material for the house walls and one type of material for the roof?

Did your house have four walls and a peaked roof?