

Forecasting & Preparing for Extreme Weather

5th Grade Guam STEM Design Challenge

Anchor Question: How can we forecast weather patterns around Guam that are changing as the climate changes, and how can we help people prepare for extreme weather events?

Overview

Guam Connection

The highest risk of damage from typhoons across Guam is from August through November each year, but they can occur all year round. From the 1600s to 1962, Guam experienced 11 typhoons. In comparison, from 1962 - 2008 Guam experienced 18 typhoons. Typhoons can result in damage or loss of homes and businesses, loss of electrical power, inoperable water supply system, and extreme flooding. Super Typhoon Mawar, in May 2023, was the strongest storm in decades. In 1962 Super Typhoon Karen, destroyed 95% of the homes on island.

Engineering Design Challenge

Guam is experiencing more extreme weather conditions due to changing climate. Residents and tourists need to know what to do to be safe in these situations. Different weather instruments are needed to gather the data that are used to create weather and climate models. To monitor short-term weather changes, build multiple weather instruments and collect class data for at least a week. Once you understand the different kinds of data, create a model that illustrates normal weather patterns and a second model illustrating severe weather events resulting from recent climate changes. Plan and design a project to help people prepare.

NGSS Performance Expectation

[No grade 5 engineering designs built into NGSS Performance Expectations]

5-ESS2-1. Develop a model using an example to describe ways the geosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, and climate; the influence of the atmosphere on ecosystems through weather and climate; and the influence of ocean on winds and clouds in the atmosphere.]

STEM Concepts (NGSS Disciplinary Core Ideas)

ESS2.A: The ocean supports a variety of ecosystems and organisms, and influences weather and climate. Winds and clouds in the atmosphere interact with the oceans' landforms to determine patterns of weather.

Time: Estimated Number of Classes

3-5 classes (45-minute class)

Materials for the Design Challenge

Weather Record

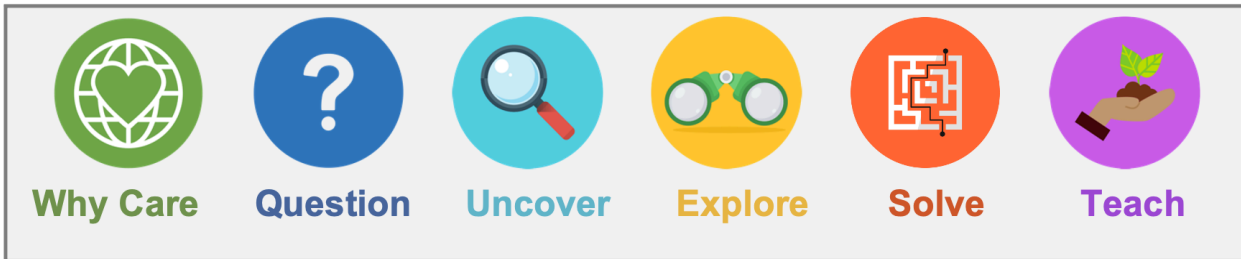
Materials for Thermometer: Empty Glass Soda Bottle, ½ c Rubbing Alcohol, Straw, Modeling Clay

Materials for Wind Vane: 5 small paper cups 3 oz, 2 straws, 1 pencil with eraser, Push Pin, Water Bottle, Small Rocks or sand for weight, craft glue or hot glue, scissors, ruler

Materials for Anemometer: 2 paper plates, Modeling clay, Small rocks or sand for weight, Cardboard, Plastic Straw, Push Pin, hole punch, scissors

Materials for Barometer: Wide mouth glass jar, Large balloon, 2 straws, Rubber band, Sheet of paper, Cardboard, Toothpick, Duct tape or glue

The Q-U-E-S-T Experience



Why Care? What is the problem, anchor question, and design challenge? How is this relevant and interesting to us and where we live?

Question Begin by asking QUESTIONS about the problem and ways to solve it. Figure out what you already know, and brainstorm what you could do.

Uncover Learn the science ideas needed to understand the problem and design a project to solve the problem.

Explore Apply what you've learned in Uncover to EXPLORE the problem in your community and consider project ideas to solve the problem.

Solve Use the engineering design process to design and do a project that helps SOLVE the problem.

Teach Share your project with others to help others understand the problem and how your project helped solve it.



Why Care?

What is the problem, anchor question, and design challenge? How is this relevant and interesting to us and where we live?

Introduce the Quest

1. **Post and read the anchor question:** How can we forecast weather patterns that are changing as the climate changes, and how can we help people prepare for extreme weather events?
2. **Read, describe, and post the design challenge:** Guam is experiencing more extreme weather conditions because of changing climate. Residents and tourists need to know what to do to be safe in these situations. Different weather instruments are needed to gather the data that are used to create weather and climate models. Build multiple weather instruments and collect data for a week and compare your results to those provided on Guam weather service sites. Once you have an understanding of the different kinds of data, create a model that illustrates normal weather events. Then create a second model to show conditions for severe weather events that result from recent climate change. Think about some ideas about how you get information warning of storms and typhoons. What information is needed to warn residents and tourists before the storm arrives, when it comes ashore on Guam and what to do after the extreme weather passes?

3. **Share and talk about the Driving Question for why we should care:** Why should I care about this anchor question and design challenge? How might it affect my island, my community, my family, and/or me? Example Driving Question: How does understanding weather forecasts and changes due to climate change, help us to prepare residents and tourists for extreme weather events?
4. **Do this:**
 - a. Students listen to a read aloud about a young girl who wants to be a meteorologist. [Kids book read aloud -The Meteorologist in me - Children's bedtime stories - Storytime Haven](#)
 - b. Students learn the conditions for weather (Video). [Measuring Weather](#)
 - c. Students learn the difference between weather and climate and the effects that temperature changes have on the ocean?
https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html

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Write or draw your “why I care” and why others on Guam care.



Question

Begin by asking QUESTIONS about the problem and ways to solve it. Figure out what you already know, and brainstorm what you could do.

Ask Questions

1. **Create a KND Chart (Know, Need to know, Do)** with the three driving questions below. You will want to save the questions and responses to look at during the QUEST; writing them on chart paper, butcher paper, in student design notebooks, or use a digital organization chart, like Jamboard. KND Questions:
 - a. What do we **KNOW** already about weather, climate and severe weather events?
 - b. What do we **NEED TO KNOW** to understand what conditions are needed to generate severe weather like typhoons and how we can find out what is being done now to help prepare residents and tourists?
 - c. What could we **DO** to learn about weather models and the data they contain? What are some ideas of what we could DO to use the weather data to predict severe weather events and use that information to prepare people for the weather extremes before, during and after they occur?
2. **Gather responses from students.** Have students think and write responses: 1.First, silently and individually, 2. Then, in small groups, 3. And finally, with the full class. The end result is a class KND chart to refer to, add to, and reorganize throughout the QUEST. Students could sort the responses that are similar. This information will help guide the UNCOVER and EXPLORE.

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Write KND lists. Organize the questions (Need to Know) from class. Record the categories, or themes, of the questions and ones you are most interested in.



Uncover

Learn the science ideas needed to understand the problem and design a project to solve the problem.

Uncover Key Ideas

1. **Share the Driving Question:** What data is needed to be collected to determine weather patterns on Guam?
 - a. Legends of Learning Simulation [Weather Prediction Science Games | Legends of Learning](#)
 - b. Students take data daily and compare it to Wunderground, Guam
 - i. [Weather Chart](#)
 - ii. [At-home mini weather station for meteorologists in the making](#)
 - iii. [Make a bottle thermometer](#)
 - iv. [Guam Weather Conditions](#)

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Write the driving question and summarize what you did and learned. (blank page)

Students will understand these NGSS Disciplinary Core Ideas:

ESS2.A: Earth Materials and Systems. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)



Explore

Apply what you've learned in Uncover to EXPLORE the problem in your community and consider project ideas to solve the problem.

Apply Your Learning

1. **Share the Driving Question with students:** How can we apply what we learned in UNCOVER to understand the problem in our community and to come up with project ideas to help solve the problem?
2. **Revisit the KND lists** you wrote at the beginning of your Quest. Add and edit them to include new understandings and experiences from UNCOVER.
 - a. KNOW - What have you confirmed as accurate? Correct any inaccurate information.
 - b. NEED to know - Mark any questions that you have answered, and ones you still need and want to answer. Add new questions.
 - c. DO - Add any new project ideas you could do to help solve the problem.
3. **Return to the anchor question:** How can we forecast weather patterns that are changing as the climate changes, and how can we help people prepare for extreme weather events?
4. **Read and talk about the design challenge:** Guam is experiencing more extreme weather conditions because of the changing climate. Residents and tourists need to know what to do to be safe in these situations. Different weather instruments are needed to gather the data that are used to create weather

and climate models. To monitor short-term weather changes, build multiple weather instruments and collect class data for at least a week. Once you understand the different kinds of data, create a model that illustrates normal weather patterns and a second model illustrating severe weather events resulting from recent climate changes. Plan and design a project to help people prepare.

- a. Investigate weather using your data collection tools that you made. Compare your results to those of your classmates. Determine how your class data compares to the weather forecasters? How can you use what you know to help people prepare for extreme weather conditions? Analyze and summarize and add to your project ideas to help you solve the problem.
- b. How do weather forecasters use these weather instruments to know when conditions are developing that could result in extreme weather events? Compare the purpose of four different instruments and the data they provide.
- c. How is weather information communicated and updated when severe weather is forecast? Before the storm? During the storm? After the storm passes? Summarize.
- d. Ideas for students sharing weather information:
 - i. Create a TV weather report. [Create your own TV weather report | Discovery Place Science](#)
 - ii. Create a pictorial model for the public (tourists, residents) that illustrates the causes (impacts of climate change) and conditions that occur which result in a severe weather event. Share strategies they should implement to be safe during this weather event. This could be in a digital or paper Weather Alert.

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- Design Challenge Map- Complete as much as you can. Then add to and edit it throughout SOLVE.
- Design Requirements and Limitations (criteria and constraints)



Solve

Use the engineering design process to design and do a project that helps SOLVE the problem.

Design Your Project

Your steps will follow the steps of the [Engineering design process](#) (Poster). Students build and test their models. Follow these steps to determine the most effective design to solve the problem.

1. Decide what you want you want your model to do and to look like.
2. Get the materials you need to build your model.
3. Build your model.
4. Test your model to see if it works to illustrate the weather features of extreme storms like typhoons and how people should prepare and respond before, during and after the storm.
5. Students can revise their model based on their test and their answer to the questions about their model.
 - a. What worked well to help people know about and prepare for extreme weather conditions?
 - b. What did not work well? Why do I think it did not work well?
 - c. How could I improve my model?

6. Students modify their models or make a new model. Then have them test their models and compare how well it worked compared to their first model. Encourage them to make 2-3 different models and be able to explain why one model works better than another.

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- Edit and complete the Design Challenge Map.
- Edit and complete the Design Requirements and Limitations (criteria and constraints)
- Action Plan: List steps to complete the project, and who will do what.
- Team Self-Review: Review your project design to make sure it is focused on the design challenge, anchor question, and Guam.
- Gathering Feedback from Others: Get input from others to help strengthen your project.
- Claim-Evidence-Reasoning (CER): Give evidence for the most effective project design.



Teach

Share your project with others to help others understand the problem and how your project helped solve it.

Share & Reflect on What You Learned

1. **Return to the anchor question:** How can we forecast weather patterns that are changing as the climate changes, and how can we help people prepare for extreme weather events?
2. **Students creatively share their project** and how it helped solve the problem.
 - a. Share this information in a Weather Alert report that informs the community about how to respond in an extreme weather condition.
 - i. Who's your audience? Who will benefit from hearing about and seeing your project?
 - ii. How will you share this information?
 - iii. What do you want them to know and understand about the problem, how you collected data, your project and its impact?
 - iv. When and where will you share?
 - b. Ask a local meteorologist to give feedback on their data and presentations. They will be given suggestions for creating their own weather station and forecasts.
3. **Student reflection:** Students can reflect on their experience with this design challenge while preparing their presentation or afterwards. Here is one reflection idea: 4-3-2-1: Looking back, planning forward. Respond to:
 - a. FOUR of the most important things I learned doing this design challenge.
 - b. THREE of the most important things I learned about myself doing this design challenge.
 - c. TWO things I will do differently in my next problem-solving experience.
 - d. ONE thing I now want to learn more about.

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- TEACH. Make a plan for sharing your project with others.
- Looking back, planning forward. Reflect on what you did and what you might do next time.



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