

“Fold and Forecast” Outline

Overview

The students will learn about forecasting and the role of forecasting in climate scientists' research. Students will learn how to convey information when we aren't certain an outcome will happen. The paper airplanes allow the students to create their own forecast about weather events that the teacher picks like rainfall or snow. The students will build a probabilistic forecast, see how one is made, and what the forecast means.

Subject

Science

Suggested Levels

Elementary

Learning Objectives:

- Students will learn to understand how to use fractions to issue a precipitation forecast
- Students will learn to recognize that weather is hard to predict
- Students will learn to explain why a precipitation forecast should be a fraction/percentage

NGSS

- [K-ESS3-2 Earth and Human Activity](#)

Materials Needed

- At least three pieces of paper for each student
- A sign for the forecast
 - Example: sign with one half indicating rain and the other half indicating no rain
- Tape or any type of object to place on the floor to indicate where the students should throw the airplane from

Background Information

Forecasting weather and climate change is critical for predicting not only common weather events like a rainstorm, but also for more severe weather and climate events like hurricanes or El Niño. This activity uses paper airplanes as an analogy for running models multiple times to get a sense of predicting the uncertainty in weather/climate prediction. The phrase “23 percent chance of rain” or a probability is used to communicate this uncertainty. The reason students are throwing the airplanes more than once is to simulate running a model more than once.

Additionally, the students recreate their throw as similarly as possible to their initial throw because this reduces small errors that create large uncertainties over time also known as the butterfly effect. Even with a perfect understanding of a climate system or specific weather pattern, the outcome is uncertain and that uncertainty grows over time. A microscopic change in

a system has a large impact on it over time. The instructor should encourage the students to think about the very tiny things that could influence the student's throw and how that could become magnified. For example, huge gusts of wind or another student bumping into you causes this uncertainty. We use forecasts to help us predict if and when we expect a particular event to occur, especially ENSO events.

ENSO stands for El Niño Southern Oscillation which is the interaction between the ocean and atmosphere of the tropical Pacific Ocean that impacts the temperature of the waters in the central and eastern Pacific. We care about ENSO due to its ability to influence temperature and precipitation around the world since these ENSO events will impact food security, how people respond to that through agricultural adaptation and drought and flood patterns with extreme weather events like tropical cyclone activity. We can predict ENSO through observational data and seasonal forecast models. One model is run multiple times through a supercomputer and tiny adjustments are made to see the impact of small adjustments in the atmosphere. Models are run multiple times to get an accurate prediction which is simulated in our activity by throwing the paper airplane several times.

Additional Reading/Resources

- How to Create a Paper Airplane:
 - <https://www.hgtv.com/design/make-and-celebrate/handmade/how-to-make-a-paper-airplane>
- Explaining Forecasting to Kids
 - http://www.weatherwizkids.com/?page_id=80
- Ensemble Forecasts
 - <https://www.metoffice.gov.uk/research/weather/ensemble-forecasting/what-is-an-ensemble-forecast>
 - <https://www.e-education.psu.edu/meteo3/node/2284>
 - <https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/>

Activity 1 - "Making a Forecast"

Time Required: 25-30 Minutes

Initial Discussion Questions

1. How do you use weather forecasts in your everyday life?
2. Why are forecasts important? Why do they help in disaster situations like a tornado or hurricane?
3. *What does a forecast that says "50% chance of rain" mean?

Making Paper Airplanes

Each student will throw an airplane at least three times to replicate a forecast. It will be beneficial to the educator to have each student keep track of their throws either on a worksheet, white board, or chalkboard. The students will need to construct their own paper airplanes. The

steps for creating a paper airplane are to first fold the paper in half vertically also known as hotdog style.

Then the students should open the paper up with the crease down, fold the top corners of the paper down to meet the middle crease into a point, and repeat folding to fold the point in again so that it becomes sharper. Next, the students should fold it in half and press the airplane down so the edges are smooth and then the student needs to fold the wing by taking the wing and folding it across. Lastly, open the wings up a bit more so that the paper airplane is ready to fly.

Issuing Forecasts

The instructor should put a sign on the floor that is divided in with the top half indicating one weather event like rainfall and the bottom half indicating that weather event not happening, so no rainfall. Each student should throw the airplane from a place on the floor that is marked by the instructor. The instructor should emphasize the importance of trying to have the same type of throw each time so that the student is properly replicating their experiment. If the student's airplane is past the half of the piece of paper that states the weather event is occurring then the student should mark that as one throw for the weather event happening and if the paper airplane does not reach the half of the paper stating that weather event is happening, it is counted as a throw for the weather event not occurring.

Using rainfall as an example, after each student throws at least three paper airplanes they can determine the forecast of rainfall occurring using fractions. For example, if a student threw 4 paper airplanes and three went past the sign indicating rainfall and one did not, then there is a $\frac{3}{4}$ chance that it rains or a forecast stating there is a 75 percent chance of rain.

Discussion/Wrap Up

1. Now that you've done the activity, what do you think a forecast that says "50% chance of rain" mean?
2. What was the point of throwing it the same way every time? What would happen if you hadn't thrown the same way?

Connections with Other Subjects

Math → This activity can help teach fractions to younger students. Based on the amount of thrown paper airplanes, the students will need to find a percentage or fraction of the forecast of the climate event.