Temperature's Rising!
Materials:

- Rulers (one per student)
- String (8-inch length, dark colors preferred)
- Ping-pong ball (one per student)
- One or two-liter bottles (2 per student)
- Tornado tube coupler (1 per student)
- Cardstock paper cut into "pizza" wedges with approximately 6-inch edges for the anemometer).

Engage
I ask students to touch and describe some cold water. The students use words like, "Freezing," "Brrr," and "Icy." I say, "You've all felt the same temperature water but described it to me with different words; is there a way we can be more specific about our temperature observations?"

Explore
We agreed that a thermometer would be an instrument that could help us measure temperature in an accurate way. We spent the remainder of the class and the next one practicing reading thermometers in both Fahrenheit and Celsius scales, by taking the temperature of warm and cold water samples, making predictions about the resulting temperature of "mixed" water. Students also made predictions about the hottest and coldest spots in our classroom and on the playground and then tested our predictions. I found that the best way to focus student observations and assist with recording was to prepare data sheets with outlines of thermometers and ask students to draw in the missing "red line" to the appropriate mark. Some students recorded the temperature numerically.

Explain
I explain that not only does knowing the temperature help us to dress properly for hot or cold weather, but it also helps us to predict whether there will be rain, or whether that rain will turn to snow! Using a teaching thermometer, I show the students the freezing temperature of water (32 degrees F or 0 degrees C) and practice determining whether there will be rain or snow depending on the temperature I put on the thermometer. This is not only very important for meteorologists, but also for students hoping for a snow day! We then read several pages from the book, *What Will the Weather Be?*, which explains the importance of accurate weather forecasts, the use of different weather instruments including thermometers, and shows a weather map including thermal contours (colors depicting particular temperatures around the country).

Evaluate
In order to evaluate my students' thermometer-reading skill, as well as ascertain whether students are grasping the concept that when hot and cold samples are mixed, the resultant temperature is somewhere in-between, I do our "target test." The "target test" consists of my placing a hot and cold water sample at each table and asking students to take and record the temperatures on the data sheet. I then give students a "target temperature" which is somewhere between the two samples. Students carefully mix samples in a third

cup and re-take the temperature, trying to add hot or cold water to get it "just right." The students love this challenge and it is a quick and efficient method of allowing me to see who is having difficulty reading the thermometer or understanding the concept that higher numbers mean hotter temperatures, and vice versa. To my students' delight, I allowed them to take their thermometers home to join their other "weather station" instruments as I was able to find inexpensive plastic student thermometers (about $1 each) at various online sites.

Stormy Weather

Engage

I displayed a satellite photo of Earth and asked students to hunt for clues of a storm! After several moments of observation, they noticed a swirling mass of clouds with a "hole in the center" that might indicate a storm.

Explore

I demonstrated a "tornado tube," a model of a tornado consisting of two plastic bottles partially filled with water joined by a "coupler" with a hole in the center (see Internet Resources). I focused the discussion on the formation of a vortex, or swirling motion, which allows air to escape from the bottom bottle. "Where have you observed a vortex before?" (bathtubs, sinks, toilets). Students then constructed tornado tubes and observed them.

Explain

We analyzed the tornado tubes using a Venn diagram. One circle is labeled, "Real Tornado," and the other is labeled, "Tornado Tube Model." The intersecting section is labeled, "Both." My students agree that both the real tornado and the tornado tube model have a vortex (swirling motion), an "eye," and pull air up as they swirl. They also distinguish our model from real tornadoes as it uses water rather than air (which would be impossible to see or "swirl," is much smaller, and is contained in bottles. The Venn diagram helps students to focus and analyze their observations and see that once again, observing models has helped us to understand important weather phenomena!

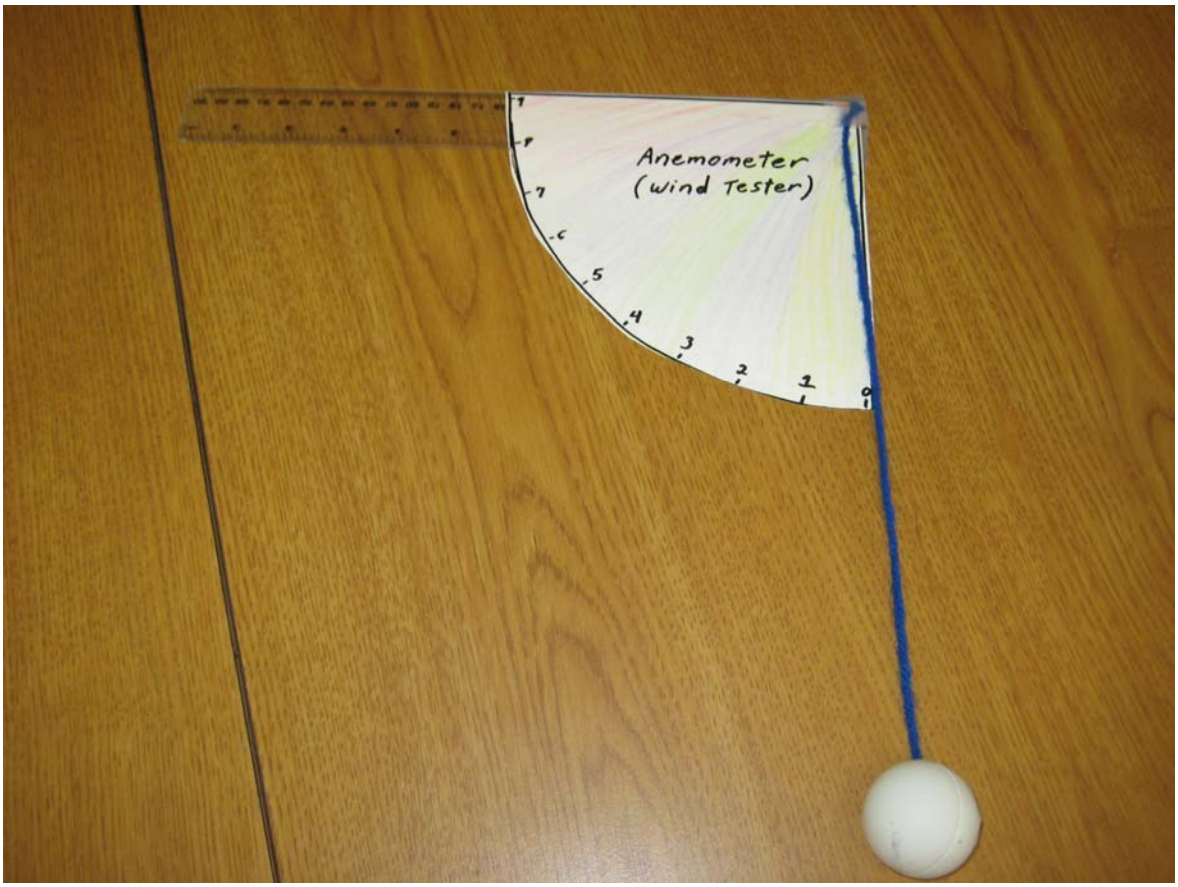
Evaluate

In order to assess my students' understanding, I end the class with team "brainstorms" to answer the following questions: 1) Why doesn't the water from the top bottle go to the bottom bottle if you don't swirl it? (air in the bottom bottle takes up space and prevents the water from coming in); 2)How does creating a vortex help? (it allows the air from the bottom bottle to move up so that the water can come down); 3) Why do scientists make models? (they help us to understand things that are too big or difficult to experiment with in nature). I listen carefully to the team discussions and guide students as needed.

Blowin' in the Wind

Making a Ping-Pong Anemometer

1) On a piece of paper, draw a “pizza slice” wedge shape with approximately 6-in. straight edges.
2) Create a scale on the rounded side (I use 0–9) by placing numbers at regular intervals. (I find that for younger students, an inch between numbers is ideal; for older students, a more precise scale might be preferred).
3) Copy this template onto cardstock paper. If you are unable to copy onto cardstock, simply copy the template onto paper and then have students glue the paper onto pre-cut cardstock wedges.
4) Have students attach the wedges to rulers using tape, taking care to match the corner of the wedge with the edge of the ruler (and with the top number on the scale in the middle of the ruler). See photo below.
5) Have students tape the string to the edge of the ruler so that it hangs straight down to the “0” mark.
6) Have students tape the bottom of the string to the ping-pong ball.
7) To use the anemometer, hold the ruler with the wedge and ball facing away from you. Turn into the wind and watch the ball fly up! The wind strength can be read by simply noting where the string crosses on the scale.



Engage

While displaying a photo of a beach right before a storm, I asked, “What clues about the weather can you observe in this photo?” My students noticed the gray clouds, the churning waves, and the swaying palm trees. I asked, “What would it feel like to be in this photo?” Students described the feeling of wind on their faces and bodies.

Explore

We read *Feel the Wind* (Dorros 1990) and then created “Ping Pong Anemometers,” which are rulers with a cardboard scale (0–9) on the end and a ping pong ball attached with a string (Figure 1). As wind blows on the ball, the string crosses the markings on the scale and can be easily read. I demonstrated the use of the anemometer by having my students blow on the ping pong ball to see how big a wind they could create. We went outside to measure the wind strength.

Explain

We then discussed our results and I asked, “Why was it important that we all used the scme scale? What if my scale was from 0-9 and your scale was from 0-50?” My students suggested that it was important for us to have a common scale for measuring wind strength so that we could communicate with each other and know just how strong the wind was…and that it was more precise than just saying “a little windy” or “a lot windy.” We then read selected pages from the book, *Close to the Wind: The Beaufort Scale*, which explains the development of a standardized scale to help sailors navigate. The book describes and visually shows the effects of wind at various points on the 0-12 scale. I explain that scientists need to measure the wind and then use scales to communicate easily with each other about their observations, just as we did. Our anemometers go from “0-9” rather than “0–12” because I found that having too many numbers close together was difficult for my first graders to use. (There is about an inch between the markings on our anemometer for easy reading). In addition, we were not performing the precise measurements that would be necessary to have an accurate Beaufort Scale reading. However our anemometer does allow for standardization among my students’ observations. Using the anemometer helped students quantify their observations (“The wind was a “6” on our scale today”), use an appropriate instrument for measurement, and understand that scales are often used by scientists to show relative strengths or speeds.

Evaluate

In order to evaluate my students’ understanding of their new instrument, I use a fan in our classroom to assess students’ ability to utilize their anemometers in a practical way. I have children come up to the fan in pairs and ask them to tell me how strong the wind is. The fan has three settings so I can actually vary correct results. This is actually much more useful for an assessment than going outside since I can control the wind strengh and speed, and each child can have different readings. The most common correction I need to make is ensuring that the child holds the anemometer level rather than raising it to get a higher reading!

References

DeWitt, Lynda. 1993. *What will the weather be? New* York: Harper Collins

Dorros, A. 1990. *Feel the wind*. London, England: Collins.
Malone, P. 2007. *Close to the wind: The Beaufort Scale*. New York: Penguin Group.

Internet Resources
Thermometer outline
www2.scholastic.com/content/collateral_resources/pdf//t//TeachNow_Temperature.pdf
Tornado Tubes
www.tornadotube.net