In Task 3-2, the team learned that not all mosquitoes spread diseases to humans. We also learned more about the medically significant mosquitoes that can spread disease to humans. These are the mosquitoes we will focus our research on. A big question we must investigate is where these mosquitoes live. We also need to learn about the environmental conditions that affect where mosquitoes like to live.

In this task, the team will look at various maps to help us with these questions. Then the team will determine how to monitor the local environment over time. This data can be used to support decisions about when mosquitoes may be a problem in the community.

In this task, the team will be focusing on the following questions from the question map in Task 1-10. Where do mosquitoes live? What factors influence where they live?

Go to the Task 3-3 folder and get the Mosquito Distribution Maps. This task has only one version.

1. Follow the directions in the task folder to complete the Mosquito Distribution Map analysis on the following:
   • Political distribution
   • Aedes and political distribution
   • Temperature, Aedes, and political distribution
   • Precipitation, temperature, Aedes and political distribution
   • Anopheles, precipitation, temperature and political distribution
   • Culex, precipitation, temperature and political distribution
2. As a team, discuss:
   • How can maps be helpful when studying mosquitoes and mosquito-borne diseases?
   • How do the environmental conditions (temperature and precipitation) change throughout the year in your location?
     • Does it rain more or less in your community at different times of year?
     • Does it snow in your community?
     • Does the temperature change at different times of the year in your community?
   • How does understanding the environmental conditions (temperature and precipitation) of your location help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?
   • How could you monitor the changes in temperature and precipitation in your community throughout the year?

3. To understand the mosquito problem better in your local community, it is useful to collect some data evidence in your research site about the environmental conditions of temperature and precipitation. This data can then be used to determine if there are different times of the year when the conditions are better for mosquitoes.

4. Go to the Task 3-3 folder and get the Monitoring Local Weather instructions. Use the information and data sheet to determine how you will monitor the local weather over time in your community. Determine how this information could be useful to your local community when thinking about mosquitoes.

Hooray! You completed Task 3-3. Check it off the task list. Go to Task 3-4!
3-3 Investigating Mosquito Distribution:

Monitoring Local Weather Instructions and Log Table

When studying mosquitoes, it is useful to understand changes in local weather throughout the year. The team will need to compare this local weather data to your observations of mosquitoes in the research site. This information will help support your claims about when mosquitoes may be more of a problem for the community. It will also help support claims about the possible future effects on mosquitoes of changes in the climate in your community. Depending on what resources you have available, you can monitor your local weather in many different ways. Pick the method that works best for you.

1. Use current and historical weather data collected by regional weather stations. This data can be collected online or from television or radio broadcasts.

2. Use tools to manually collect temperature and precipitation data in your research site.
   a. Build your own weather station. Use the NOAA instructions to build your own weather collection tools to track data over time in your research site.
   b. Purchase and set up a weather station in your research site.

3. The team will focus mainly on temperature and precipitation data at this time. However, please collect any other weather data you think could be useful for your research or would like to explore. These could include:
   a. Wind speed
   b. Wind direction
   c. Atmospheric pressure

4. Use or make a data table to collect daily or weekly measurements in your research site throughout the year.

5. Mark on your research site map from Task 2-1 where you are taking your daily or weekly measurements.

6. When collecting weather data, make a daily general mosquito observation in your research site. Do you see adult mosquitoes in or around your site? If so, can you do a general count?

7. If you are collecting mosquito eggs as outlined in Task 3-1, note on your data sheet what days you did or did not collect eggs.

8. Compare your temperature, precipitation, and egg and adult collection data.

9. How could this data be useful to address the problem question: How can we ensure health for all from mosquitoes?
## Weather Observation Data Table

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Outside temperature (°C)</th>
<th>Precipitation (mm)</th>
<th>Notes (observations of mosquitoes in research site, atmospheric pressure, wind)</th>
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Task 3-3 Investigating Mosquito Distribution

Mosquito Distribution Maps

Questions from Map:
Where do mosquitoes live?
What factors influence where they live?
Step 1 – Political Distribution

• Look at the Political map of the World on the next slide.
• As a team, find the country where you live. Where inside this country do you live?
• What are the names of some other countries near or around you?
Step 2 – Aedes and Political Distribution

- Look at the Global Distribution Map of the Aedes Mosquito on the next slide
  - Work with your team to read the instructions and understand the color scale
- Find where you live on this Aedes distribution map
- Using the color key, what is the probability or chance that Aedes live where you live?
- Describe the distribution of Aedes in countries near or around where you live.
- Describe the distribution or patterns of Aedes in other parts of the world.
- Using the World Political Map and Global Aedes Map together, make a list of the names of some different countries where Aedes has a very high probability or chance of living.
- Identify some clear lines of divide between areas of high and low mosquito distribution.
- What do you think could be causing these patterns?
- What could this relationship possibly tell you about the environment Aedes prefer to live in?
Global Distribution Map of Aedes Mosquito

The color tells us how likely it is to be present at that location.

Blue indicates low probability or chance of there being Aedes mosquitoes

Yellow indicates higher probability or chance of there being Aedes mosquitoes

Red indicates very high probability or chance of there being Aedes mosquitoes

Step 3 – Temperature, Aedes and Political Distribution

• Look at the Average annual Temperature map
  • This map tells you how hot or cold on average a place is throughout the year.
  • Red indicates it is hotter
  • Blue indicates it is colder

• Find where you live on the Temperature map

• What is the approximate average annual temperature where you live?

• Describe any patterns you notice on the temperature map.

• List some countries where the average temperature is very low. List some countries where the average temperature is very high.

• Compare and contrast the patterns on the Aedes map to the Average Annual Temperature map.

• Do you see any similarities between where Aedes live and the temperature?

• List some countries and places where you see very similar patterns between the temperature and Aedes mosquitoes.

• What does this relationship possibly tell you about the environment Aedes prefer to live in?
Average Annual Temperature

Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosphere
Center for Sustainability and the Global Environment
University of Wisconsin - Madison
Step 4 – Precipitation, Temperature, Aedes and Political Distribution

- Look at the Annual Total Precipitation map
  - This map tells you how much it rains in a place throughout the year.
  - The darker areas mean it rains more there.
  - The lighter areas mean it rains very little there.
- Find where you live on the Precipitation map.
- What is the approximate annual precipitation where you live?
- Describe any patterns you notice on the precipitation map.
- List some countries where the precipitation is very low. List some countries where the average precipitation is very high.
- Compare and contrast the patterns on the Aedes map to the Precipitation map.
- Do you see any similarities between where Aedes live and the amount it rains there?
- List some countries and places where you see very similar patterns between these two maps.
- List some countries and places where you see very similar patterns between the Aedes map, the Annual Total Precipitation map, and the Average Annual Temperature map.
- What does these relationships possibly tell you about the environment Aedes prefer to live in?
Step 5 - Anopheles, Precipitation, Temperature and Political Distribution

- Look at the map showing the distribution of the mosquito Anopheles globally.
  - Work with your team to read the instructions and understand the color scale
- Find where you live on the Anopheles map. Do anopheles mosquitoes live where you live?
- Describe any patterns you notice on the Anopheles map.
- What are some countries that might have high probability of Anopheles, use the political map to see the names?
- Compare and contrast the patterns on the Anopheles map to the Aedes mosquito map.
- List some countries where both Aedes and Anopheles mosquitoes are probably living.
- List some countries where Aedes mosquitoes are probably living, but Anopheles are not.
- List some countries where Anopheles mosquitoes are probably living, but Aedes are not.
- Compare the Anopheles map with the Annual Total Precipitation map and the Average Annual Temperature map.
- What do these relationships possibly tell you about the environment Anopheles prefer to live in?
Distribution of Anopheles mosquitos

The orange area indicates where they are likely to be found. The grey indicates areas where they are not likely found.

Source: CDC | Kiszewksi et al., 2004. American Journal of Tropical Medicine and Hygiene

© DW
Step 6 - Culex, Precipitation, Temperature and Political Distribution

- Look at the map showing the distribution of the mosquito Culex globally.
  - Work with your team to read the instructions and understand the color scale
- Find where you live on the Culex map. Do Culex mosquitoes potentially live where you live?
- Describe any patterns you notice on the Culex map.
- What are some countries that might have high probability of Culex, use the political map to see the names?
- Compare and contrast the patterns on the Culex map to the Anopheles and Aedes mosquito maps.
- List some countries where Culex, Aedes and Anopheles mosquitoes are all potentially living.
- List some countries where Culex are living, but Aedes or Anopheles are not.
- Compare the Culex map with the Annual Total Precipitation map and the Average Annual Temperature map.
- What do these relationships possibly tell you about the environment Culex prefer to live in?
Distribution of Culex mosquitoes

The orange area indicates where they are likely to be found. The grey indicates areas where they are not likely found.

Source: WHO
Every year, thousands of lives and millions of dollars are saved by severe weather warnings from the National Weather Service. From its earliest beginnings (on February 9th, 1870), the primary mission of the National Weather Service has been to protect life and property by providing information about dangerous weather conditions. Originally, the National Weather Service was called “The Division of Telegrams and Reports for the Benefit of Commerce” and was part of the U.S. Army. Later, its name was shortened to the Weather Bureau and it became part of the Department of Agriculture, then the Department of Commerce.

The first “weathermen” were “observing-sergeants” of the Army’s Signal Service Corps. Weather forecasting in those early years was based almost entirely on the assumption that the weather observed in one location on a particular day would move to downwind locations on following days. Today, satellites, computers, and a variety of scientific instruments are added to this basic assumption to make accurate weather predictions and provide warnings about dangerous weather.

Here’s how you can make your own weather observation station!

What You Will Do

Build six instruments that you can use to make scientific measurements of your local weather

Standing tall on North Dakota snow. A March blizzard nearly buried utility poles. Caption jokingly read “I believe there is a train under here somewhere!”

Courtesty Dr. Herbert Kroehl, NGDC
Build an Anemometer to Measure Wind Speed

What You Will Need

- Five paper cups - Three ounce size
- Two straight plastic soda straws
- Straight pin
- Paper punch
- Stapler
- Sharp pencil with eraser
- Felt tip marker
- Watch or timer

Warning

Be careful with the straight pin!

How to Do It:

1. Using a paper punch, punch a hole in four paper cups about 1/2-inch below the rim of the cups.

2. Punch four equally spaced holes in a fifth paper cup about 1/4-inch below the rim, and a fifth hole in the center of the bottom of the cup (you will probably need to use the pencil to make the hole in the bottom).

3. Push a soda straw through the hole in one of the first four cups. Flatten the end of the straw and staple it to the side of the cup opposite the hole. Repeat this step with the other straw and another of the first four cups.

4. Slide one of the cup and straw assemblies through two opposite holes in the side of the fifth cup. Push another one-hole cup onto the straw, and turn this cup so that the open ends of the two cups on the straw face in opposite directions. Flatten the end of the straw, and staple it to the side of the second cup. Measure the distance between the centers of the two cups. This is the diameter of your anemometer.
5. Repeat Step 4 with the remaining cup and straw assembly and the remaining one-hole cup. Before stapling the end of the straw to the last cup, turn the cups so that the open end of each cup faces the closed end of the next cup.

6. Adjust the cup and straw assemblies so that they are centered inside the fifth cup. Push the straight pin through the two straws where they intersect.

7. Push the eraser end of the pencil through the hole in the bottom of the fifth cup, and push the straight pin into the eraser as far as it will go. Now your anemometer is ready to use.

8. To use the anemometer, hold the pencil vertically in a wind, and count the number of revolutions per minute (use the felt tip marker to make a mark on one cup so that you can easily see when the cup has travelled through one complete revolution). To convert revolutions per minute (rpm) into approximate wind speed:

   a. Multiply rpm by the diameter (in inches) of your anemometer (measured in Step 4)
   b. Multiply the result by 0.003. This is the approximate wind speed in miles per hour.

This calculation does not give exact wind speed, because drag, friction, and other forces also affect the speed at which your anemometer rotates.
Build a Weather Vane to Find Wind Direction

What You Will Need

- Broomstick or long wooden dowel, about one inch diameter
- Aluminum baking dish, about six inches x nine inches
- Wood stick, about 3/4 inch square and 12 inches long
- Nail, about one inch long
- Metal washer with a hole slightly larger than the nail
- Duct tape
- Small saw or serrated knife
- Scissors strong enough to cut the aluminum baking dish
- Ruler or tape measure
- Silicone or other glue that will stick to aluminum
- Leather gloves
- (Optional) Hand drill, and small drill bit slightly larger than the nail

Warning

Be careful of the sharp edges on the pieces of cut aluminum! Use gloves to protect your hands until the edges are taped.

How to Do It

1. Use the saw or serrated knife to cut a notch about 1/2-inch deep into each end of the wood stick. The notches should be parallel (see drawing on page 65).

2. Rotate the stick so that the two slots are vertical. Use the ruler or tape measure to find the exact center of the wood stick.

3. Cut the head and tail pieces of the Weather Vane from the aluminum baking dish using the pattern as a guide. Be Careful—The Edges Are Sharp! Use duct tape to cover the sharp edges.
4. Fit the head piece into one of the slots in the wood stick and fit the tail piece into the other slot. Glue the head and tail pieces into place and allow the glue to dry.

5. Attach the Weather Vane to the broomstick or dowel, by placing the washer on one end of the dowel and hammering the nail through the wooden stick into the dowel. Be sure the stick still moves freely around the nail.

6. Mount your Weather Vane outside where there are no nearby obstructions to block the wind. Try to get the dowel as high as you can while still keeping it steady and secure.

Winds are named according to the direction from which the wind is blowing, so a “north wind” is blowing from the north. The head of the Weather Vane will point to the direction from which the wind is blowing.
Build a Barometer for Measuring Atmospheric Pressure

What You Will Need

- 12-inch ruler
- Drinking glass or other container with sides tall enough to support the ruler
- Clear plastic drinking straw or piece of clear plastic tubing, about 12-inches long
- Modeling clay or chewing gum
- Clear tape
- (Optional) Food coloring

How to Do It

1. Tape the plastic straw or plastic tubing to the ruler so that one end is lined up with the “1/2-inch” mark on the ruler.

2. Stand the ruler-tubing assembly upright in the glass (or other container), and tape the assembly to the top of the container.

3. Fill the container about 3/4-full of water. If you want colored water, first mix food coloring with the water in another container.

4. Use the modeling clay or chewing gum (you’ll have to chew it until it is soft enough) to plug the end of the straw or plastic tubing near the top of the ruler.

5. Carefully pour out some of the water so the container is about half full. Be sure the lower end of the straw or tubing stays beneath the water surface while you do this! When you are finished, the water in the straw or tube should be higher than the water in the container. Your barometer is now finished. Since barometers are sensitive to minor changes in weather conditions, keep your barometer indoors for greatest accuracy.

6. Keep a daily record of the height of the water in the tube, using the scale on the ruler. The water level in the tube will rise and fall as atmospheric pressure changes. When atmospheric pressure increases, air presses on the surface of the water in the container causing the height of the water in the tube to rise. When atmospheric pressure decreases, there is less pressure on the surface of the water in the container so the height of the water in the tube falls. Decreasing atmospheric pressure usually indicates that a low pressure area is approaching, and this often brings clouds and rain. Increasing atmospheric pressure often indicates fair weather.
Build a Screened Thermometer to Measure Air Temperature

What You Will Need

- A wooden or plastic box, large enough to hold the thermometer and your hygrometer; see Step 1 under “How to Do It”
- Thermometer, about 0°F to 120°F
- White paint and paint brush
- Nails, screws, glue, or tape to attach the thermometer to the box

How to Do It

1. The wood or plastic box is supposed to protect your weather instruments from wind, rain, and direct sun, but still allow air to circulate so the instruments can get accurate readings. A box with a hinged lid that can be turned on its side is perfect. Turn the box on its side, and cut several slots near what is now the bottom of the box. Paint the outside of the box with white paint, and find a safe, shady outdoor location. The north side of buildings has the most shade. Try to find a location that is three to four feet above the ground.

2. Attach the thermometer to the back of the box with tape, glue, screws, or nails. The bulb of the thermometer should be about two inches above the bottom of the box.

Build a Hygrometer to Measure Humidity

What You Will Need

- Piece of wood or styrofoam about nine inches long and four inches wide
- Flat piece of plastic, thin enough to cut with scissors; about three inches long and one inch wide (an old credit card or laminated luggage tag works well)
- Two small nails
- Three strands of human hair, about eight inches long
- Dime
- Glue
- Tape
- Hammer
- Scissors

How to Do It

1. Cut the plastic into a pointer as shown on the pattern below.

2. Poke one of the nails through the pointer near the base of the triangle. Wiggle the nail around until the pointer moves freely and loosely around the nail.

3. Tape the dime onto the pointer near the tip of the triangle.

4. Glue the hair strands onto plastic between the nail hole and the dime.

5. Use a nail to fasten the pointer to the wood or styrofoam base about 3/4 of the way down the side. Be sure the pointer can still turn freely on the nail.

6. Attach the other nail to the base about one inch from the top of the base, in line with the spot where the hair is glued to the pointer.

7. Pull the free ends of the hair tight so that the pointer is horizontal. Wrap the hair
around the upper nail and glue to hold the hair in place.

8. Make a photocopy of the scale and cut it out. Glue the scale to the base so that the pointer is pointed to the “0” mark. Your hygrometer is finished!

9. Human hair will expand and lengthen when the air is moist, causing the pointer to move down. When the air is dry, the hair will contract and shorten, causing the pointer to move up. Use the scale to record the pointer’s position. Keep your hygrometer in a sheltered location. The box used for the screened thermometer is ideal.
Build a Rain Gauge to Measure Rainfall

What You Need

- Straight-sided glass or plastic container, with a diameter of about two inches or less (such as an olive jar)
- Coat hanger or wire bent to make a holding rack (see picture)
- Measuring spoons: One teaspoon and 1/4 teaspoon
- Hammer and nails to secure the rack
- Felt tip marker

How to Do It

1. Rain gauges measure the amount of rainfall in cubic inches. So your first task is to make a scale for your container that shows how many cubic inches of water are in the container. One cubic inch of water is about 3 1/4 teaspoons, so you can draw the scale on your container by measuring 3 1/4 teaspoons of water to your container, then drawing a short line at the level of the water. If you look closely, the top of the water will seem to be slightly curved and thickened. Draw your line so that it matches the bottom of the curved surface (which is called a meniscus). This line corresponds to a rainfall of one inch.

2. Add another 3 1/4 teaspoons of water to the container and draw another line. The second line corresponds to a rainfall of two inches.

3. Repeat Step 2 until you have at least five marks on the container. This will be enough for most rain events; but you may want to add another line or two, just in case!

4. Find a location for your rain gauge where there is nothing overhead (such as trees or a building roof) that could direct water into or away from your gauge. The edge of a fence away from buildings is often a good spot. Another possibility is to attach your rain gauge to a broomstick driven into the ground in an open area. Be sure to record rainfall soon after a rain event to avoid false readings caused by evaporation.

Empty your gauge after each reading, and you are ready for the next event!

This activity is adapted from “Build Your Own Weather Station” by the Educational Technology Programs Team at the Franklin Institute, Philadelphia, PA (http://www.fi.edu/weather/todo/todo.html).