MAST ACADEMY OUTREACH

MIDDLE SCHOOL PROGRAM

Adventures Aboard

WOW
(Weather on Wheels)

Teacher Instructions / Answer Keys

MAST Academy

Maritime and Science Technology High School

Miami-Dade County Public Schools

Miami, Florida

MAST ACADEMY OUTREACH
WEATHER ON WHEELS
MIDDLE SCHOOL PROGRAM
ON-SITE TEACHER INSTRUCTIONS/ANSWER KEYS
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Weather on Wheels On-Site Package
Teacher Instructions

If you have not already done so, show the Weather on Wheels Pre-site DVD to your students. Make a copy of the on-site package for each of your students. Distribute one package to each student the day of the Weather on Wheels visit. They will also need pencils or pens. Pencils will be provided only in an emergency.

Since there are ten lessons, divide the class into ten teams of equal size, and assign each team a number from 1-10. IF ESOL, ESE or other inclusion students are assigned to your class, make sure they are grouped with at least one student at grade-level reading ability. This grade-level student should be designated the team leader.

To save your student's photographs from lesson 6, you will need to provide **one** flash drive (USB drive).

Students are not to carry books, book bags, etc. to Weather on Wheels. These will get in the way. Clipboards will be provided for all students.

When your students arrive at Weather on Wheels, a brief introduction will be given. Each team will then begin at the lesson with their assigned number. **THE TEACHER MUST HELP SUPERVISE STUDENTS WORKING AT THE STATIONS SET UP OUTSIDE WEATHER ON WHEELS.**

After the Weather on Wheels visit, grade the on-site activities, using the answer key provided in this packet. Total the points. This grade will be used to award certificates to students who score 80% or higher. A Certificate of Achievement Request Form, along with a Program Evaluation Form, will be sent to you following the Weather on Wheels visit.

Discuss the correct answers with your students. All questions that address "critical thinking skills" are preceded by the icon to the left.

WEATHER STATION 1 **WEATHER MEDIA CENTER**	*11 total points: 5 for the first table, 2 for the second table, 1 for each question*

At this station you will learn about weather forecasting by making observations from the newspaper's weather report and by listening to a NOAA weather radio.

NEWSPAPER: Using the **FIVE DAY FORECAST** at the top of today's newspaper weather map that is on the table, find the data to complete the table below.

Three Day Forecast for Miami	Today	Tomorrow	Day after tomorrow
Sky condition (sunny, cloudy, etc)			
HIGH temperature	*Answers*	*will*	*depend*
LOW temperature	*on the*	*weather*	*conditions*
Wind direction	*for*	*that*	*day*
Wind speed			

Look at the MAP OF THE UNITED STATES and find the symbols for fronts.

1. **Are there any fronts in Florida? ____ If yes, what kind? (circle one) WARM COLD STATIONARY**
   Answers will depend on weather conditions that day

Find the SUNBURN ADVISORY.

2. **What is the maximum safe exposure for a high-level risk person?** *Answers will depend on weather conditions that day*

Find the MARINE OUTLOOK.

3. **In Miami Harbor, when is the next high tide?** *Answers will vary* **Next low tide?** *Answers will vary*

4. **Who would find the marine outlook important?** *Boaters, fishermen*

WEATHER RADIO: Press the "Weather" button to turn on the weather radio and listen for a few minutes to become familiar with the information being broadcast. In the table below, place a check next to any weather and or marine forecast terms you hear discussed on the radio. Press the "Alert" button to turn off the radio when finished.

Terms	Check	Terms	Check
temperature		seas	
humidity	*Answers*	bays and inland water	*Answers*
pressure	*will*	precipitation	*will*
winds	*depend*	forecast	*depend*
lightning	*on*	ultraviolet index	*on*
clouds	*the*	rain	*the*
chance of thunderstorms	*weather*	moderate chop	*weather*
sky condition	*conditions*	barometer	*conditions*
sunrise	*for*	showers	*for*
sunset	*that*	mostly sunny	*that*
high tide	*day.*	tropical storm	*day.*
low tide		hurricane	

WEATHER STATION 2 *8 total points: 1 for each question*
RELATIVE HUMIDITY

The amount of water vapor in the air is called humidity. Relative humidity is the amount of water vapor in the air at a certain temperature; warmer air can hold more water vapor than cold air. If the relative humidity is 50%, then the air is holding half the amount of water vapor it is capable of holding. If the relative humidity is 100%, then the air contains all the water vapor it can possibly hold.

It is easy to find relative humidity using the **hygrometer** on the table by reading the number at the end of the pointer.

1. **What is the relative humidity reading on the hygrometer?** *Answers will vary* **%**

A **sling psychrometer** (Sigh-krom-a-ter) also measures relative humidity, but its use involves several steps. Follow the directions on the table for using the two sling psychrometers. Two people in your team should perform the activity at the same time and in the same manner, so that similar readings are obtained. Record both the wet and dry bulb temperatures and then follow the directions on the table to calculate the relative humidity.

Psychrometer	Dry Bulb Temperature	Wet Bulb Temperature	Relative Humidity
Student 1	*answers*	*vary*	*day to day*
Student 2	*answers*	*vary*	*day to day*

2. **Find the average relative humidity (add two relative humidities above, divide by 2)** *varies* **%**

3. **Is the reading from the hygrometer** (circle one) **higher than** **lower than** *(it should be the same)* **the average relative humidity you calculated using the sling psychrometers?**

4. **Which instrument do you think may give you a <u>less</u> accurate reading? (Hint: Think about the number of steps you must follow to use each one.) Circle one. hygrometer (sling psychrometer)**
Why? *Sling psychrometer introduces human error (speed of rotaion, math errors, etc.)*

5. **Does today's relative humidity feel comfortable to you? YES NO** *Answers based on opinion*
Why, or why not? *Answers based on opinion*

6. **What does your body do to cool off when temperatures and humidities are higher than those in your "comfort zone?"** *your body sweats, or increases blood flow to the extremities*

7. **What does your body do to warm up when temperatures and humidities are lower than those in your "comfort zone?"** *your body shivers, or decreases blood flow to the extremities*

WEATHER STATION 3 *13 total points: 8 for the tables, 1 for each question*
WIND

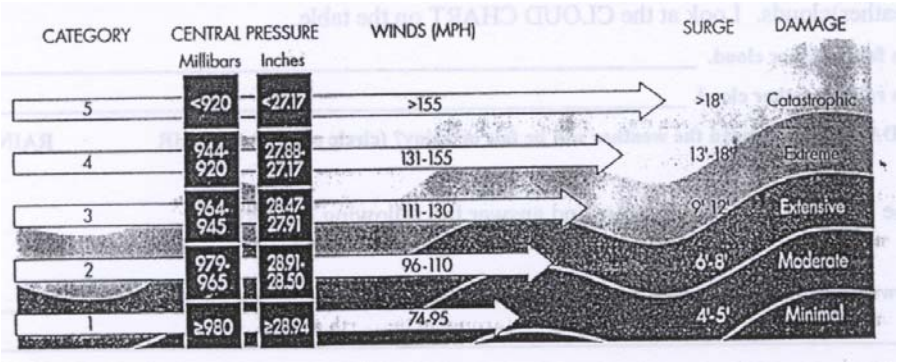
Wind is air in motion. It is caused by the unequal heating of the earth's land and water surfaces, which causes differences of pressure in the atmosphere. Follow the directions on the table for using the **TurboMeter** to record the wind speed in miles per hour.

1. Wind Speed (MPH) *Answers will vary*

A **hurricane** is a powerful tropical cyclone (rotating storm) with winds *over 74 miles per hour*. Using the hurricane plotting chart, follow the track of Hurricane Katrina in 2005. Record in the chart below Katrina's coordinates in latitude and longitude for each of the dates shown (a key to latitude and longitude is above the map).

DAT(11:00 PM)	LATITUDE	LONGITUDE
Aug. 23, 2005	23.5	76.0
Aug. 24	26.0	78.0
Aug. 25	25.5	81.0
Aug. 26	24.5	83.5
Aug. 27	25.0	86.0
Aug. 28	27.5	89.5
Aug. 29	33.5	88.5

Hurricanes are classified according to both the intensity of the winds and the damage produced by the storm. The method used to measure the intensity and damage caused by a hurricane is called the Saffir-Simpson Scale which is shown below. This system categorizes storm intensity on a scale of one to five.



2. What category hurricane has winds of 111-130 MPH? *Category 3*

3. What category has a central pressure of <920 millibars? *Category 5*

4. Hurricane Hugo in 1989 was a Category 4 hurricane. What type of damage did it cause? *Extreme*

5. Hurricane Camille in 1969 and the Florida Keys Hurricane of 1935 are the only two Category 5 hurricanes to strike the United States. What was the storm surge? *> 18 feet*

WEATHER STATION 4	*12 total points: 1 for cloud type/ drawing,*
CLOUDS AND PRECIPITATION	*1 for each question*

At this station, we will learn about different types of clouds and record the cloud types present in the sky today as well as record whether there has been any precipitation (rain).

Observe the sky in all directions as well as overhead. Using the CLOUD CHART on the table, determine the kind of clouds you see. Draw the clouds in the box below.

TODAY'S CLOUD TYPE *answers will vary*

Drawings will vary

1. **What is the current CLOUD COVER?** (circle one) *Answers will vary*

   CLEAR **PARTLY CLOUDY** **MOSTLY CLOUDY** **OVERCAST**

Some types of clouds form at high altitudes, while others form at low altitudes. Look at the CLOUD CHART on the table to answer the following questions.

2. **Name a high altitude cloud.** *Cirrus, cirrocumulus, cirrostratus*

3. **Name a low altitude cloud.** *Stratus, nimbostratus, cumulus, stratocumulus, cumulonimbus*

Some types of clouds are associated with rain while other types are considered "fair-weather" (sunny weather)clouds.

4. **Name a fair weather cloud.** *Cumulus, cirrus*

5. **Name a rainy weather cloud.** *Stratus, cumulonimbus, altostratus, nimbostratus*

6. **Do TODAY'S clouds mean the weather will be fair or rainy? (circle one)** **FAIR** **RAINY**

   Answers will vary

7. **According to the cloud chart, what is another factor other than cloud cover that will determine whether it will be fair or rainy?** *Wind direction and speed*

Look at the WATER CYCLE diagram and answer the following questions.

8. **Name two ways water is returned from the land to the air.** *Transpiration from vegetation, Evaporation from lakes/rivers, evaporation from ocean*

9. **Name two places where RUNOFF goes after returning to the earth as rain.** *To lakes/rivers, to vegetation, to the ocean, to ground storage*

Follow the directions on the poster for reading the RAIN GUAGE.

10. **According to the rain gauge, how much rain has fallen today?** *Answers will vary* **inches.**

11. Based on your answer to Question 6, did you expect rain today? YES NO *answers will vary*

WEATHER STATION 5 *10 total points: 1 for each question, 3 for map*
AIR PRESSURE

Air (barometric) pressure is the force exerted by the weight of the air above us. This weight creates a force on you much like the weight or force on a diver at the bottom of the ocean. The **barometer** is an instrument that measures changes in air pressure.

Read the directions on the poster for reading the **aneroid** ("without liquid") **barometer**. Look at the aneroid barometer on the table, and answer question 1 below.

1. What is the current barometric pressure in millibars (mb)? *Answers will vary*.

Hurricanes are areas of very low pressure (below 1000mb.) The lower the air pressure the more intense the hurricane.

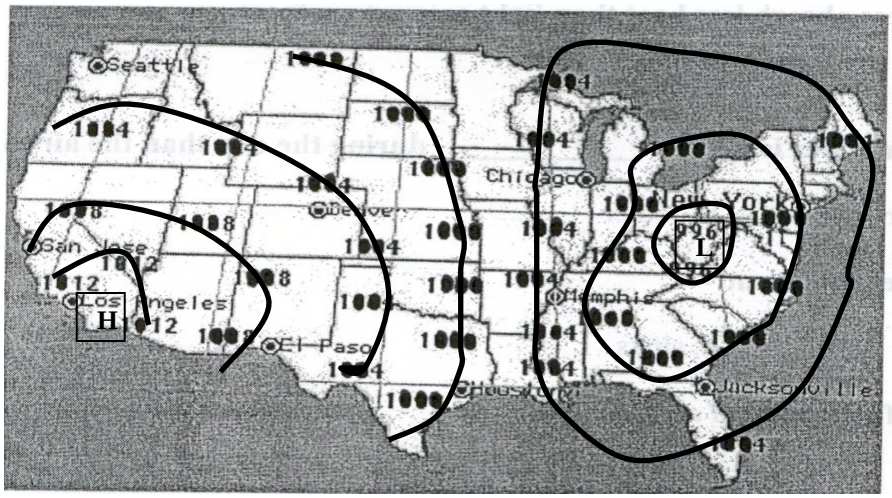
Look at the graph called **"Air Pressure During Hurricane Katrina"** and answer the following questions.

2. On what day was the air pressure the highest? *8/24/2005*
3. What was the air pressure on that day? *approximately 1007 mb*
4. Hurricane Katrina hit New Orleans on August 29th. Was Katrina more or less intense the day before it hit New Orleans? (circle one) More Less

5. Explain your answer to #4. *The air pressure was lower so the hurricane was more intense.*
6. If Katrina had hit New Orleans on August 28th, do you think it would have caused (circle one) more or less damage?

7. Explain your answer to #6. *Because is was more intense it would have done more damage.*

Look at the *sample* weather map on the table. The thick black lines are called isobars. These lines connect locations of equal barometric pressure and form sets of curves that do not cross each other. On the map to the right (*a different map than the sample map*), use the yellow highlighters to draw in the isobars by connecting numbers of equal pressure. The first isobar is drawn for you.



Isobars can be used to identify "Highs" and "Lows". The pressure in a high is greater than the surrounding air and usually brings clear, sunny weather. The pressure in a low is lower than the surrounding air and usually means cloudy or rainy weather. On the map above, label with an "**H**" the center of a high pressure area, and label with an "**L**" the center of a low pressure area.

WEATHER STATION 6 *6 total points: 3 for each story*

EVERY PICTURE TELLS A STORY

1. You will document your experience aboard Weather on Wheels by using the digital camera to take two photos of any of the Weather on Wheels stations and then writing about your photographs.

2. Look around and find something you want to photograph. If you are waiting to use the camera, you can look around, decide on what you want to photograph and start writing your story (see #3 below) before you take your photographs.

3. Write a story about each photograph. Use complete sentences in your story. Think about who or what is in your picture. If a person is in your photograph, what is he or she doing? If a computer is in your photograph, what is on the screen? If a piece of equipment or an instrument is in your photograph, what is it used for?

FIRST PHOTOGRAPH

This is a photograph of *Stories will vary.*

SECOND PHOTOGRAPH

This is a photograph of

WEATHER STATION 7 *9 total points: 1 for each question*
RAIN OR SHINE: UNDERSTANDING THE WEATHER

Put on headphones. Click on scenes 10 – 18. Click on picture 18 in the lower right hand corner of the screen. While watching the DVD, answer the following questions.

1. **Rather than heating the air directly, sunlight heats the ground first, and the ground then heats the air.**

   a. TRUE b. FALSE

2. **Dark surfaces absorb less heat than light colored surfaces.**

   a. TRUE b. FALSE

3. **The air over water is usually _____during the day than the air over land.**

   a. warmer b. cooler

4. **Heated air expands and**

   a. rises b. sinks

5. **A large uniform body of air is called**

   a. a front b. an air mass c. a thunderstorm d. a tornado

6. **The boundary between 2 air masses is called a:**

   a. edge b. front c. thunderstorm d. line

7. **A cold front usually brings cool, dry weather, but sometimes causes:**

   a. hurricanes b. snow c. tornadoes

8. **Which moves faster?**

   a. a cold front b. a warm front

9. **What instruments do meteorologists use to predict the weather?**

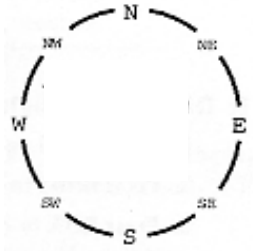
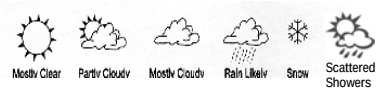
   a. computers b. satellites c. weather balloons d. all of these

Before moving to the next station, click on the "Menu" button.

WEATHER STATION 8 *10 total points: 4 for data chart, 1 for each question*
THE WEATHER MONITOR

The "**Weather Monitor**" collects information about the weather from the **Weather Station** set up outside. Using the poster on the wall to help you find the information on the computer screen, fill in the data table below.

Answers will vary

Time	**Date**	**Moon Phase** 	
Outside Temperature ^{0}**F**	**Inside Temperature** ^{0}**F**	**Outside Humidity** %	**Inside Humidity** %
Dew Point ^{0}**F**	**Heat Index** ^{0}**F**		
Wind Chill ^{0}**F**	**Wind Speed** mph		
CURRENT Rainfall Day in	**CURRENT Rain Rate** in	**Barometer** mb	
Sunrise _____ **AM** **Sunset** _____ **PM**	**Forecast** **(Circle one)** 	**Wind Direction (draw an arrow)**	

At the top of the screen, click on the 5th icon from the left. (The icon with 2 small graphs.) If the graph is not showing the current time on the horizontal axis, then click on the arrow at the bottom right of the scroll bar to move the graph to the current time. One click moves the graph forward one hour.

1. What does the red line represent? *outside temperature*

2. What does the blue line represent? *dew point*

Dew point is the temperature at which the atmosphere becomes 100% saturated (filled) with water. If the outside temperature falls to the dew point temperature, water vapor in the air will condense, and **dew** will form on the windows or grass. The dew evaporates once the outside temperature rises above the dew point.

3. On the graph shown on the computer screen, the outside temperature is higher than the dewpoint temperature. Under these conditions, would dew be able to form? _____Yes ***X*** No

4. Why or why not? *Because the outside temperature is higher than the dewpoint temperature.*

5. If both the dew point and the outside temperature were the same, what would happen to the water vapor in the air?
Water vapor in the air would condense to form dew.

6. If there was dew on the bus window early this morning but it is now gone, what happened to it?
It evaporated as the outside temperature increased.

At the top of the screen, click on the 3rd icon from the left to go back to the first screen.

WEATHER STATION 9 *11 total points: 6 for the data table, 1 for each question*
CLIMATE

How does one distinguish weather from climate? One simple way to think of it is that climate is what we expect; weather is what we get. To describe climate, researchers look at the average weather over a number of years in a particular region during a particular season. In this activity, you will be comparing the subtropical climate in Miami to a desert climate in Phoenix, Arizona by using temperature, precipitation and relative humidity as your data.

1. Click on the book with the title **"U.S. Climate Data."**
2. Click on the bar at the bottom right that says **"List All Cites."**
3. Scroll down and click on **Miami, FL**. (Cities are listed alphabetically by state.)
4. Click on the bar that says **"City Information."** There is a **yellow arrow** pointing to the month of January indicating that the information listed is for that month.
5. Record the **high temperature, precipitation (rain)** and **relative humidity** in the box for January in the data table below.
6. Click on March and record the data. Repeat for May, July, September, and November.

Miami	**January**	**March**	**May**	**July**	**September**	**November**
High Temperature	74	77	82	87	86	78
Precipitation (rain) in Miami (inches)	2.10	2.26	6.54	5.44	8.24	3.03
Relative Humidity	72	70	73	76	78	74

7. Click on the small square above the word "Miami."
8. Scroll up to Phoenix, AZ and click on this city. Click on "City Information."
9. Find and record the high temperature, precipitation (rain) and relative humidity for each month.

Phoenix	**January**	**March**	**May**	**July**	**September**	**November**
High Temperature	66	75	92	105	99	75
Precipitation (rain) in Phoenix (inches)	0.88	0.54	0.05	0.55	0.38	0.41
Relative Humidity	53	40	25	36	38	46

Using the data above, answer the following questions.

1. **What city has the highest temperature for any month? (circle one)** **MIAMI** **(PHOENIX)**
2. **What city has the highest rainfall for any month? (circle one)** **(MIAMI)** **PHOENIX**
3. **What city has the highest humidity for any month? (circle one)** **(MIAMI)** **PHOENIX**
4. **Describe the climate in Miami? (circle all that apply)** **(HOT)** **(RAINY)** **(HUMID)** **DRY**
5. **Describe the climate in Phoenix? (circle all that apply)** **(HOT)** **RAINY** **HUMID** **(DRY)**

How would your use of water be affected if the climate in Miami changed to that of Phoenix? *You may need to conserve water year round*

Click on the "**Home**" button to return to the main screen.

WEATHER STATION 10 *10 total points: 2 points each for questions 1-3; 4 points*
WEATHER WIZARDS *for question 5*

Weather Wizards contains experiments that ask you to make adjustments to the weather to solve a problem. You will use an "**atmosphere transmogrifier**" to solve a problem involving thunderstorms in the city of Sherman, Florida. Begin as a **Novice Weather Wizard**. Read the directions below.

A. Put on headphones. To listen to a weather newscast and look for the "Desired Conditions" for preventing a thunderstorm, first click on the **Novice** button. Next, click on **Thunderstorms** from the Experiments List.

B. Read the Objective and First Challenge. Click on the answer you think is the best. If your response is correct, answer question 1 below. Then click on **Continue** to go to the next challenge. If incorrect, click on **Continue** to try again until you get the correct answer. Do the same for the next two challenges. After answering question 3 correctly, **don't click on the Continue button.** Instead, read the directions in **red** at the bottom of the screen. Click on the flashing **Level** button at the top right of the screen to show the weather map.

1. You can reduce the likelihood of lightning by
a. reducing the humidity *good answer* **b. increasing the wind** **c. reducing the temperature** *best answer* **d. increasing the cloud cover**

2. Thunderheads are
a. cumulus clouds **b. cirrus clouds** **c. stratus clouds** **d. cumulonimbus clouds**

Remember, after answering question 3 corrctly, **don't click on the Continue button.** Instead, click on the flashing **Level** button at the top right of the screen to show the weather map.

3. Thunderstorms are usually associated with
a. strong low pressure systems **b. weak low pressure systems** **c. moderate high pressure systems**

You are now an **Advanced Weather Wizard**! Your objective now is to change different weather factors to prevent a thunderstorm from hitting the city of Sherman, Florida. Read the directions below. Use your answers from the questions above to decide how to make adjustments to the weather.

C. If you decide to remove the low pressure system, click on the yellow **LOW** button. If you decide to add a high pressure system, click on the green **HIGH** button. Click and drag the pressure system if you decide to move it to a new location.

D. If you decide to change the temperature, moisture (humidity), or strength of the pressure systems, slide the red buttons to the right (to increase) or left (to decrease.)

E. If you decide to change the cloud cover, click on one of the sky pictures.

F. After making all your desired adjustments, click on the **Engage** button (the **orange** button to the far right) to start the "atmosphere transmogrifier." Watch to see if your objective has been achieved.

4. Was your objective achieved? Yes No (If yes, click on **Continue** for the weather newscasters final report. If no, click on **Continue** to make adjustments until time runs out or you achieve your objective.) *Objective achieved if: low pressure system moved to east, high pressure system added, temperature decreased, sky clear or with Cumulus clouds.*

5. If a thunderstorm didn't hit, explain why your adjustments worked. If a thunderstorm did hit, explain why? (Hint: Use information from the weather newscasters' final report.)

If a thunderstorm was averted, it was because lower temperatures decreased evaporation; winds resulting from the position of the air masses slowed the formation of thunderclouds.

If a thunderstorm hit, it was because of a failure to lower the temperature, causing air masses to rise, forming thunderclouds.

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REVISED 8/1/01