Teacher Survey

Instructions: Please complete the following evaluation.

1. Did you make any adjustments to the learning module? If so, what did you change or omit?

2. From your observations, are the students more interested in atmospheric science?

3. What part of the lesson was most effective or interesting to them?

4. What concept did the students have most trouble understanding or applying?

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Student Survey

Please distribute this survey to the students before and after completing the module.

Instructions: Circle the answer that best describes your feelings about science.

1. I like science.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

2. How often do you talk to your *family* about what you do in science class?
    a. Never
    b. Rarely (less than once a week)
    c. Once a week
    d. A few times a week
    e. Every day

3. How often do you talk to your *friends* about what you do in science class?
    a. Never
    b. Rarely (less than once a week)
    c. Once a week
    d. A few times a week
    e. Every day

4. I think science will be useful when I am older.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

5. I would like to be a scientist when I am older.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

Effectiveness Assessment

Part 1: Pre and Post Assessment (Student Evaluation)

Instructions: Please distribute and score the **Student Evaluation** for each student before and after completing the module. Each question is worth 1 point.

Student Evaluation

Instructions: After completing the lesson on hurricanes, please have the students answer the following questions below.

1. What is a tropical storm?
    a. A tropical cyclone that has not reached hurricane strength yet
    b. A tropical cyclone that has surpassed hurricane strength
    c. A tropical cyclone that has already made landfall
    d. An extremely weak tropical cyclone with winds 20 – 30 mph

2. What is the name of the scale that is used to categorize the strength of a hurricane?
    a. Enhanced Fujita Scale
    b. Fujita Scale
    c. Barometer Scale
    d. Saffir-Simpson Scale
    e. Cyclone Scale

3. Which of the following is necessary for hurricanes to form?
    a. Warm ocean waters
    b. Thunderstorms
    c. A low-pressure system
    d. High relative humidity in the Troposphere
    e. All of the above

4. Hurricane season in the United States
    a. begins in June
    b. ends in September
    c. is all year long
    d. only occurs every 3 years

5. A typhoon
    a. is the same as a tsunami.
    b. is a weaker hurricane.
    c. is a tropical cyclone that occurs in the western Pacific Ocean.
    d. causes more damage than a hurricane.

6. Winds circulate _____ around tropical cyclones in _____.
    a. clockwise, the Northern Hemisphere
    b. counterclockwise, the Northern Hemisphere
    c. clockwise, the Southern Hemisphere
    d. counterclockwise, both hemispheres

7. Where are the heaviest rain and fastest winds found in a hurricane?
    a. Within the eye
    b. Just outside of the rainbands
    c. In the eyewall
    d. Toward the top of the hurricane

8. Which of the following is <u>not</u> a destructive force associated with hurricanes?
    a. Tornados
    a. Flooding
    b. Hurricane force winds
    c. Extreme cold temperatures
    d. Storm surge

9. Why do tropical cyclones rarely form north of 30^{o}N or south of 30^{o}S? Briefly explain.

10. Calculate the Coriolis force at 15^{o}N using the following equation. Make sure your calculator is in degrees!

$$\textbf{Coriolis} = 2 \times \Omega \times \sin \Theta$$

where $\Omega = 7.292 \times 10^{-5}$/sec and Θ is the latitude in degrees

    a. Coriolis = 0/sec
    b. Coriolis = 0.0000948/sec
    c. Coriolis = 0.0000377/sec
    d. Coriolis = 474,189.89/sec
    e. Coriolis = 948,379.79/sec

Part 2: Math & Science Proficiency (Take Home Assignment: Part 1)

Please score **Take Home Assignment**: **Part 1** for each student using the rubric below. This problem is aligned with the following academic standards:

NGSS.MS-ESS2.5
MS-ESS2-5. Weather and Climate: Provide evidence for air pressure systems and resulting weather conditions.

CCSS.ELA-LITERACY.RST.6-8.3
Grade 6-8: Science and Technical Subjects: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Scoring Rubric

Questions	Score (0 – 3)
Did the student correctly identify the strength of the tropical system (Table 1)?	
Did the student demonstrate knowledge of relating the wind speed to the strength of a hurricane using the Saffir Simpson scale (Q1)?	
Did the student demonstrate knowledge of the atmospheric conditions necessary for hurricane formation (Q2)?	
Did the student demonstrate understanding of the features associated with a landfalling hurricane (Q3 & Q4)?	

0 – Incomplete
1 – Completed with incorrect answer
2 – Complete with small errors
3 – Complete with correct answer

Take Home Assignment: Part 1. Hurricane Patricia (2015)

Hurricane Patricia formed off the western coast of Mexico from a low-pressure system on October 20, 2015. Patricia strengthened from a tropical storm to a Category 5 hurricane in 24 hours! The storm peaked in strength on the 23rd with maximum sustained winds of 200 mph and a central minimum pressure of 879 mb, as measured by NOAA's Hurricane Hunters. Patricia was the most intense tropical cyclone recorded in terms of barometric pressure in the Western Hemisphere!

Hurricane Patricia 2015 Reference

Instructions: The table below provides Hurricane Patricia's minimum central pressure and maximum sustained wind speeds (data obtained from the National Hurricane Center). Using this information, determine the strength of the tropical cyclone during its lifecycle. Fill in the last column in Table 1 with Tropical Depression (**TD**), Tropical Storm (**TS**), or Hurricane (**H**). If it is hurricane strength, be sure to include the category (see Table 2 for example).

Table 1. Before Landfall

Date/Time	Minimum Pressure (mb)	Sustained Wind Speed (mph)	Strength
Oct. 20 at 10 a.m.	1006 mb	35 mph	
Oct. 20 at 10 p.m.	1004 mb	40 mph	
Oct. 22 at 1 a.m.	987 mb	75 mph	
Oct. 22 at 10 a.m.	973 mb	100 mph	
Oct. 22 at 1 p.m.	958 mb	130 mph	
Oct. 22 at 10 p.m.	924 mb	160 mph	

Questions

1. Briefly explain how you determined the strength of Patricia from October 20 – 22.

2. Patricia was slow to strengthen over the open waters of the Pacific, but favorable environmental conditions led to a rapid intensification on October 22. List the environmental conditions necessary for hurricane development.

Patricia made landfall near Cuixmala, Mexico late on October 23. At landfall Patricia had weakened with winds of 165 mph, still a Category 5 storm. Patricia's damage was remarkably limited to no fatalities. The largest impact was agriculture losses. As Patricia moved inland it quickly weakened to a remnant low on the 24th after interacting with high terrain in western Mexico. Over the next few days the remnant low moved into the southern U.S. where significant flooding was observed across Texas and the Gulf Coast.

Table 2. During/After Landfall

Date/Time	Minimum Pressure (mb)	Sustained Wind Speed (mph)	Strength
Oct. 23 at 1 p.m.	879 mb	200 mph	H Cat 5
Oct. 23 at 10 p.m.	946 mb	130 mph	H Cat 3
Oct. 24 at 1 a.m.	970 mb	100 mph	H Cat 2
Oct. 24 at 4 a.m.	986 mb	75 mph	H Cat 1
Oct. 24 at 7 a.m.	998 mb	50 mph	TS
Oct. 24 at 10 p.m.	1002 mb	35 mph	TD

Questions

3. Estimate the date and time of Patricia's landfall (use information from Table 2 and underlined sentence above). How did you come to this conclusion?

4. After landfall, Patricia's pressure increased and wind speed rapidly decreased. What do you think caused Patricia to weaken?