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National Standards Correlations

Benchmarks for Science Literacy
(Project 2061 – AAAS) Grades 3–5

The Physical Setting - The Earth (4B)
By the end of the fifth grade, students should know that:

• Air is a substance that surrounds us, takes up space, and whose movement we feel as wind.

• When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made up of tiny droplets of water.

National Science Education Standards
(Content Standards: K–4, National Academy of Sciences)

Earth and Space Science - Content Standard D
As a result of their activities in grades K-4, all students should develop an understanding of:

Changes in Earth and Sky
• Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation.

Science and Technology - Content Standard E
As a result of their activities in grades K-4, all students should develop:

Understanding about Science and Technology
• People have always had questions about their world. Science is one way of answering questions and exploring the natural world.
Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

• Define weather as the condition of the lower atmosphere close to Earth.

• Understand that weather is constantly changing.

• Understand that predicting the weather is a very challenging task.

• Summarize the four main factors which interact to make up weather, including: heat energy, air pressure, wind, and moisture.

• Understand that the Earth receives heat energy from the sun.

• Describe what air pressure is, what causes air pressure, and why we don’t feel air pressure.

• Describe how wind is formed by differences in air pressure.

• Differentiate between local winds, which only cover small areas, and global winds, which cover large portions of the Earth.

• Describe the process of evaporation.

• Explain that clouds are made up of tiny droplets of water vapor.

• Understand the process of condensation, and describe the role it plays in the formation of clouds.

• Identify various types of precipitation, including rain, snow, sleet, and hail.

• Compare and contrast the processes of evaporation, condensation, and precipitation.
Assessment

Preliminary Test (p. 14–15):

The Preliminary Test is an assessment tool designed to gain an understanding of students’ preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Post-Test (p. 16–17):

The Post-Test can be utilized as an assessment tool following student completion of the program and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.

Video Review (p. 18):

The Video Review can be used as an assessment tool or as a student activity. There are two sections. The first part contains questions displayed during the program. The second part consists of a five-question video quiz to be answered at the end of the video.
Introducing the Program

Before showing the program to students, ask a volunteer to go to the window and describe the weather conditions outdoors. Instruct the student to specifically describe the weather conditions, including the color and appearance of the sky, wind direction and speed, the temperature, and any precipitation. Write these observations on the blackboard. Next ask students if this description could be used for the weather every day. Have the class explain why not.

Ask students to describe some of the different types of weather they experience throughout the year. Add other weather descriptions to those already listed on the blackboard. Ask students what factors account for the different types of weather we experience day to day, and month to month. Write the list of suggestions on the board. Tell students to pay close attention to the video to learn more about the weather around us. After showing the class the program, discuss some of the factors responsible for causing different weather conditions.

Program Viewing Suggestions

The student master “Video Review” is provided (p. 18) for distribution to students. You may choose to have your students complete this Master while viewing the program or do so upon its conclusion.

The program is approximately 14 minutes in length and includes a five-question video quiz. Answers are not provided to the Video Quiz in the video, but are included in this guide on page 12. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.
Video Script

1. When you traveled to school this morning, chances are the weather was different than . . .
2. . . . it was yesterday.
3. Even though you may not notice it, the weather around us is constantly changing.
4. In some cases, these changes are small.
5. But in other cases, changes in weather are extreme and really catch our attention.
6. What exactly is weather?
7. What are the elements which make up weather?
8. Why does the weather change day to day?
9. And what forces are responsible for these changes?
10. During the next few minutes we are going to try to answer these questions, . . .
11. . . . and others as we explore the weather around us.
12. **Graphic Transition – What is Weather?**
13. If you live in a place such as New England, Canada, Michigan, or even a warm place such as Florida, you know the weather changes frequently, . . .
14. . . . perhaps several times during the course of a day!
15. This is what makes weather so interesting.
16. And, if you live in a northern place in the northern hemisphere, you have experienced cold and snowy weather.
17. And no matter where you live you have experienced windy days, . . .
18. . . . sunny days, . . .
19. . . . and rainy days. These are all characteristics of weather.
20. **You Observe!** Describe the characteristics of the weather seen here.
21. The weather in northern New England during mid-January tends to be cold, snowy, and windy.
22. What exactly is weather? Weather is the condition of the lower atmosphere, close to earth, at any given time.
23. Heat energy, air pressure, wind, and moisture are the main factors which interact to make up weather. Let’s first take a look at heat energy.
24. **Graphic Transition – Heat Energy and Weather**
25. Understanding the causes and forces responsible for weather is a very challenging scientific task.
26. In fact, scientists who study the weather, called meteorologists, are still trying to understand many of the complex characteristics of weather.
27. The bottom part of Earth’s atmosphere, called the troposphere, is very dynamic – meaning it is constantly changing.
28. Many of the changes in the troposphere result from the interaction between Earth’s surface, and heat energy that the Earth receives from the sun.
29. All you need to do is sit outside on a sunny day to realize that the energy we receive from the sun contains heat.
30. This heat energy that the Earth receives from the sun drives the weather.
31. Earth and the atmosphere reflect and scatter the sun’s energy in various ways.
Video Script

32. But some heat energy is absorbed by Earth.
33. **Graphic Transition – Air Pressure**
34. **You Predict!** What will this person feel as these books are stacked on her hand?
35. This person is experiencing pressure on her hand. A force pushing against something is often referred to as pressure.
36. Believe it or not, at this very moment air pressure is pushing down on our bodies.
37. A column of air 800 kilometers high is pressing down on our heads.
38. We don’t feel the air pressure because we are used to it.
39. The air pressure around us is constantly changing, influenced by changes in temperature, . . .
40. . . . the amount of water vapor in the air, and elevation.
41. When listening to a weather forecast you have probably heard the meteorologist mention a high pressure system or a low pressure system that is coming your way.
42. Low pressure systems and high pressure systems generate different types of weather.
43. Therefore, air pressure has a big influence on the types of weather we experience.
44. **Graphic Transition – Wind**
45. Wind is an essential element needed to fly a kite.
46. Even though you can’t see wind, you can see the effects of wind, and you can feel wind against your body.
47. Wind is simply moving air. But what causes air to move?
48. Simply put, wind is created by differences in air pressure. Pressure differences on Earth’s surface are commonly the result of differences in temperature.
49. The greater the air pressure difference, the faster the wind blows.
50. There are two general types of winds: local winds and global winds.
51. Local winds are the type you feel on a beach when cooler wind from the ocean blows toward land.
52. Mountains and valleys are also known to produce local winds.
53. Global winds cover a much larger area on the Earth’s surface.
54. For example, westerly winds and trade winds are global winds and they tend to predominantly flow in the same direction over large areas.
55. Both local winds and global winds play a significant role in influencing weather.
56. **Graphic Transition - Moisture**
57. **You Observe!** How does the air in this scene look different from the air in this scene?
58. In this scene the air looks much hazier. Much of this haze is made up of tiny water droplets called water vapor.
59. Water vapor, or moisture in the air, is called humidity.
60. Moisture enters the air through the process of evaporation which occurs, when liquid water changes to a gas.
61. Oceans, rivers, lakes, . . .
62. . . . and even plants are sources of water vapor.
Video Script

63. The amount of moisture in the air usually varies greatly from day to day and from place to place.
64. Here in the desert of Arizona, water vapor in the air tends to remain low.
65. But, near the ocean here in Maine, the amount of moisture in the air can be quite high.
66. The amount of moisture in the air plays a big role in the formation of clouds.
67. Let's take a closer look at clouds.
68. **Graphic Transition – Clouds and Precipitation**
69. If you have ever taken a walk through fog, you may not realize it, but you were actually walking through a cloud.
70. What is a cloud and how do clouds form?
71. The answer lies in a process called condensation.
72. You have probably seen water droplets form on the outside of a glass of ice water as seen here.
73. **You Decide!** Where did the water droplets come from?
74. The droplets came from moisture in the surrounding air, and collected on the cool glass due to the process of condensation.
75. Condensation is the process of water vapor changing to liquid water.
76. A similar process occurs in the formation of clouds.
77. Clouds form in many ways. One common way clouds form is when warm, moist air rises.
78. As the air rises it cools until the water vapor in it condenses, and turns to small droplets of water.
79. So when you look up at a cloud, you are actually seeing millions of tiny water droplets, . . .
80. . . . or in some cases millions of tiny ice crystals.
81. There are many different kinds of clouds.
82. Some clouds are capable of producing precipitation. Precipitation is water that falls from the atmosphere to Earth. When water droplets or ice crystals become too large to remain suspended in a cloud, they fall as precipitation.
83. When we think of precipitation we usually think of rain.
84. **You Decide!** What are some other types of precipitation?
85. Snow, hail, and sleet are examples of other types of precipitation which fall from clouds.
86. Precipitation is one of the features which makes weather so interesting.
87. **Graphic Transition – Summing Up**
88. During the past few minutes we have discussed some of the fascinating features of weather.
89. We explained what weather is and we took a look at some of the factors responsible for creating different types of weather, including . . .
90. . . . heat energy, . . .
91. . . . air pressure, . . .
Video Script

92. . . . wind, . . .
93. . . . and moisture.
94. We then briefly discussed the formation of clouds and precipitation.
95. So, the next time you take a walk in the rain, . . .
96. . . . fly a kite, . . .
97. . . . or look up at some clouds, . . .
98. . . . think about some of the things we discussed during the past few minutes. You just might look at weather a little differently.

Graphic Transition – Video Assessment
Fill in the correct word to complete the sentence. Good luck, and let’s get started.
1. The _______ energy that Earth receives from the sun drives weather formation.
2. _______ is created by differences in air pressure.
3. Water vapor in the air is called _______.
4. _______ is the process of water vapor changing to liquid water.
5. _______ are made up of tiny water droplets or ice crystals.

Answers can be found on page 12.
Answer Key to Student Assessments

Pre-Test (p. 14-15)
1. c - troposphere
2. a - air pressure
3. d - heat energy
4. c - global winds
5. a - gas
6. a - precipitation
7. d - humidity
8. c - condensation
9. b - water vapor
10. d - low
11. true
12. false
13. false
14. true
15. true
16. Weather is the condition of the lower atmosphere, close to Earth.
17. Heat energy comes from the sun. Heat energy is responsible for driving weather processes such as evaporation.
18. Moisture gets into the air through the process of evaporation.
19. Clouds are made up of millions of tiny drops of water.
20. Some types of precipitation include rain, snow, sleet, and hail.

Post-Test (p. 16-17)
1. a - gas
2. c - condensation
3. d - low
4. d - humidity
5. d - heat energy
6. b - water vapor
7. c - troposphere
8. a - precipitation
9. c - global winds
10. a - air pressure
11. false
12. true
13. true
14. true
15. false
16. Moisture gets into the air through the process of evaporation.
17. Some types of precipitation include rain, snow, sleet, and hail.
18. Heat energy comes from the sun. Heat energy is responsible for driving weather processes such as evaporation.
19. Weather is the condition of the lower atmosphere, close to Earth.
20. Clouds are made up of millions of tiny drops of water.

Video Review (p. 18)
1. The weather in northern New England during mid-January tends to be cold, snowy, and windy.
2. The person with books stacked on their hand is feeling pressure on their hand.
3. The water droplets came from moisture in the surrounding air, and collected on the cool glass due to the process of condensation.
4. Snow, hail, and sleet are examples of other types of precipitation which fall from clouds.

1. The heat energy Earth receives from the sun drives weather formation.
2. Wind is created by differences in air pressure.
3. Water vapor in the air is called humidity.
4. Condensation is the process of water vapor changing into liquid water.
5. Clouds are made up of tiny water droplets or ice crystals.
Answer Key to Student Activities

Vocabulary (p. 19)
1. meteorologist
2. wind
3. weather
4. precipitation
5. troposphere
6. pressure
7. clouds
8. heat energy
9. condensation
10. humidity

Writing Activity (p. 20)
Everyday, newspapers report the conditions in the lower atmosphere we refer to as weather. Heat energy from the sun is one of the very important forces which drive weather. A person who studies and sometimes predicts weather is a meteorologist. Air pressure is the downward force of the atmosphere which varies from day to day. Humidity is a measure of water vapor in the air. When warm air rises it often cools resulting in the condensation of water leading to the formation of clouds. Precipitation consists of snow, hail, rain, or sleet which falls from clouds.

In Your Own Words (p. 20)
1. Weather is the condition of the lower part of the atmosphere closest to the Earth.
2. Wind is moving air. Wind is caused when air moves from high pressure areas toward low pressure areas.
3. Clouds form when evaporated water condenses in the sky.

Head in the Clouds (p. 21–23)

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Cloud Type(s)</th>
<th>Current Weather</th>
<th>Predicted Weather</th>
<th>Prediction Accurate?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: 1/30 10:32 am</td>
<td>cumulus</td>
<td>fair and pleasant, 18° C</td>
<td>for 24 hours</td>
<td>very accurate</td>
</tr>
</tbody>
</table>

Observations will vary.

1. Factors such as a cloud’s shape and its height in the sky enable you to identify cloud types.
2. Cumulonimbus clouds are huge and are often dark in color. They indicate a coming thunderstorm.
3. Different cloud types often indicate current weather conditions, or future weather conditions.

Windchill
1. Windchill is how cold people and animals feel while outside in a given amount of wind. The windchill is based on the rate of heat loss from skin that is not covered caused by wind and cold.
2. As wind speed increases the windchill temperature decreases.
3. If the wind speed is 20 km/h and the temperature is -5°C, the windchill would be -11.6°C.
4. If the wind speed is 20 mph and the air temperature is -15°F, the wind chill would be -42°F.
5. Some of the precautions you would need to take when the windchill is low is to dress in layers. Another precaution would be to make sure that a minimal amount of skin is exposed. Wear a hat, gloves or mittens, and a scarf or neck warmer. A pair of warm socks and boots to keep your feet warm should also be worn.
Pre-Test

Circle the best answer for each of the following questions.

1. The bottom part of Earth’s atmosphere is called the:
   a. air pressure  b. ionosphere  c. troposphere  d. sky

2. Wind is created by differences in:
   a. air pressure  b. rain  c. clouds  d. time

3. Earth receives this from the sun:
   a. sky energy  b. air pressure  c. weather power  d. heat energy

4. Westerlies and easterlies are examples of:
   a. hurricane winds  b. local winds  c. global winds  d. North American winds

5. Evaporation is the process by which water changes from a liquid to:
   a. gas  b. gel  c. solid  d. mixture

6. Sleet, snow, rain, and hail are all types of:
   a. precipitation  b. evaporation  c. condensation  d. troposphere

7. A measure of water vapor, or moisture in the air, is called:
   a. rain  b. low pressure system  c. air pressure  d. humidity

8. The process of water vapor changing into liquid water is called:
   a. humidity  b. precipitation  c. condensation  d. wind

9. Oceans, rivers, lakes, and plants are all sources of:
   a. weather  b. water vapor  c. wind  d. air pressure

10. In deserts, humidity tends to be:
    a. high  b. dense  c. foggy  d. low
Write true or false next to each statement.

11. ________________ Scientists who study the weather are called meteorologists.
12. ________________ The top layer of the Earth’s atmosphere is called the troposphere.
13. ________________ Earth does not absorb heat energy.
14. ________________ Wind is moving air.
15. ________________ Clouds are formed via the process of condensation.

Write a short answer for each of the following.

16. What is weather?

____________________________________________________________________________________

____________________________________________________________________________________

17. Where does heat energy come from and how does it affect weather?

____________________________________________________________________________________

____________________________________________________________________________________

18. How does moisture get into the air?

____________________________________________________________________________________

____________________________________________________________________________________

19. What are clouds made of?

____________________________________________________________________________________

____________________________________________________________________________________

20. What are some examples of precipitation?

____________________________________________________________________________________

____________________________________________________________________________________
Circle the best answer for each of the following questions.

1. Evaporation is the process by which water changes from a liquid to a:
   a. gas        b. gel        c. solid        d. mixture

2. The process of water vapor changing into liquid water is called:
   a. humidity    b. precipitation    c. condensation    d. wind

3. In deserts, humidity tends to be:
   a. high        b. dense        c. foggy        d. low

4. A measure of water vapor, or moisture in the air, is called:
   a. rain        b. low pressure system    c. air pressure    d. humidity

5. Earth receives this from the sun:
   a. sky energy   b. air pressure    c. weather power    d. heat energy

6. Oceans, rivers, lakes, and plants are all sources of:
   a. weather    b. water vapor    c. wind    d. air pressure

7. The bottom part of Earth’s atmosphere is called the:
   a. air pressure    b. ionosphere    c. troposphere    d. sky

8. Sleet, snow, rain, and hail are all types of:
   a. precipitation    b. evaporation    c. condensation    d. troposphere

9. Westerlies and easterlies are examples of:
   a. hurricane winds    b. local winds    c. global winds    d. North American winds

10. Wind is created by differences in:
    a. air pressure    b. rain    c. clouds    d. time
Write true or false next to each statement.

11. ____________ The top layer of the Earth’s atmosphere is called the troposphere.
12. ____________ Clouds are formed via the process of condensation.
13. ____________ Wind is moving air.
14. ____________ Scientists who study the weather are called meteorologists.
15. ____________ Earth does not absorb heat energy.

Write a short answer for each of the following.

16. How does moisture get into the air?

________________________________________________________________________________________
________________________________________________________________________________________

17. What are some examples of precipitation?

________________________________________________________________________________________
________________________________________________________________________________________

18. Where does heat energy come from and how does it affect weather?

________________________________________________________________________________________
________________________________________________________________________________________

19. What is weather?

________________________________________________________________________________________
________________________________________________________________________________________

20. What are clouds made of?

________________________________________________________________________________________
________________________________________________________________________________________
Video Review

While you watch the video, answer these questions:

You Observe!
1. Describe the characteristics of the weather seen here.

You Predict!
2. What will this person feel as these books are stacked on their hand?

You Observe!
3. Where did the water droplets come from?

You Decide!
4. What are some other types of precipitation?

After you watch the video, test your knowledge with these questions.

1. The __________ energy that Earth receives from the sun drives weather formation.

2. __________ is created by differences in air pressure.

3. Water vapor in the air is called ________________ .

4. ________________ is the process of water vapor changing into liquid water.

5. __________ are made up of tiny water droplets or ice crystals.
1. ____________ A scientist who studies the weather.

2. ____________ Moving air created by differences in pressure.

3. ____________ The condition of the lower atmosphere, close to Earth, at any given time.

4. ____________ Snow, hail, rain, and sleet are all examples.

5. ____________ The bottom part of Earth’s atmosphere which is closest to the Earth.

6. ____________ A force pushing against something. In the case of weather it is the downward force of air in the atmosphere.

7. ____________ These are made of water vapor that has condensed forming millions of small droplets of water.

8. ____________ Energy that Earth receives from the sun.

9. ____________ The process of water vapor changing to liquid water.

10. ____________ A measure of water vapor, or moisture in the air.
Use the correct word from above to complete the sentences in the following paragraph.

Everyday, newspapers report the conditions in the lower atmosphere we refer to as _______________. _______ _________ from the sun is one of the very important forces which drive weather. A person who studies and sometimes predicts weather is a ___________________. _______ ___________ is the downward force of the atmosphere which varies from day to day. _____________ is a measure of water vapor in the air. When warm air rises it often cools resulting in the ________________ of water leading to the formation of clouds. ____________________ consists of snow, hail, rain, or sleet which falls from clouds.

In Your Own Words
1. What is weather?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

2. What is wind and what causes it?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

3. How do clouds form?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Head in the Clouds

Background: Clouds form when water vapor condenses in the atmosphere. When you see a cloud, you are looking at millions of tiny droplets of water. You already know that rain falls from clouds. But did you know that not all clouds cause rain?

There are many different types of clouds. Different clouds indicate different conditions in the atmosphere. When looking at clouds, observe their shape and height in the sky. These two factors help you identify the different types of clouds.

In this activity you will learn about different types of clouds. You will also observe clouds. Then you will use the information you have learned to make predictions about the weather.

Materials: cotton balls or cotton stuffing, blue or black construction paper, glue, A Key to the Clouds (page 23), additional images of various cloud types

Directions:
1. Carefully read about each of the seven clouds types on A Key to the Clouds. Study the drawings of each type of cloud.

2. On a large piece of construction paper, use cotton balls to create models of each type of cloud. Look at the drawings on A Key to the Clouds and additional images your teacher provides as references. Use glue to stick your models to the paper. Label each cloud type.

3. Now you will use everything you have learned to observe the clouds outside. Look up at the sky and try to identify the types of clouds you see. Often there will be more than one type of cloud present. Write your observations in your chart.

4. Use the information on A Key to the Clouds to predict any changes in the weather during the day. Later, observe whether or not your predictions come true. Repeat your observations at least three times.

5. Answer the questions below the chart on the next page. If you want, you can also make a larger chart and continue to observe the clouds and predict the weather.
Head in the Clouds
Cont.

Observations:

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Cloud Type(s)</th>
<th>Current Weather</th>
<th>Predicted Weather</th>
<th>Prediction Accurate?</th>
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Questions:
1. What factors enable you to identify cloud types?

2. What are the characteristics of a cumulonimbus cloud? What type of weather do cumulonimbus clouds indicate?

3. Describe how cloud types may be helpful in predicting the weather.
A Key to the Clouds

There are many different types of clouds. On this page, you will learn to recognize seven basic cloud types.

**Cirrus:** High, wispy clouds made of ice particles. Cirrus clouds often exist in calm weather, but sometimes indicate a coming weather change.

**Altostratus:** High sheet clouds that are light gray in color. Altostratus clouds spread over large areas, and usually bring precipitation.

**Altocumulus:** Mid-level, puffy clouds. When altocumulus clouds spread across the sky, precipitation may shortly follow.

**Cumulus:** Fluffy low clouds that are mostly white. Cumulus clouds are usually fair weather clouds, unless they grow and darken into cumulonimbus clouds.

**Cumulonimbus:** Huge, tall, dark clouds. Cumulonimbus clouds are a probable sign thunderstorms or heavy precipitation are close by.

**Stratocumulus:** Low, dark, puffy clouds that blanket the sky. Stratocumulus clouds almost always signify approaching rain or snow is.

**Stratus:** Low flat clouds, similar to fog, that cover most of the sky. If stratus clouds are present, it may be misty or drizzling.
**Windchill**

**Directions:** Read the following information and then answer the questions on the following page.

Have you ever been outside and the temperature felt relatively warm, but when the wind blew you were chilled? This is a common occurrence in northern places, but even if you live in a southern region you can experience the chill of the wind. This phenomenon is called windchill. Windchill factor is how cold people and animals feel outside in a wind. Windchill is based on the rate of heat loss from skin that is not covered caused by wind and cold. As wind speed increases, it draws more heat from the body. If the windchill is low enough it can present a dangerous situation by lowering body temperature, and even causing frostbite. Therefore, wind can make the body feel much colder.

The windchill temperature is calculated using a specific formulation. To make windchill easier to calculate you can use a windchill chart. If you know the air temperature and the wind speed you can identify the windchill by finding where the column and row meet. Listed below are two windchill charts: one using the English system and another using the metric system.

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1. Briefly describe what is meant by windchill.

2. What happens to windchill as wind speed increases?

3. Let’s say the wind speed is 20 km/h and the temperature is -5°C. What is the windchill?

4. Let’s say the wind speed is 20 mph and the air temperature is -15°F. What is the windchill?

5. What precautions do you need to take when the wind chill is low?