4H Weather Project – Units I, II, III Leader's Guide
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LEADER'S GUIDE

RURAL DEFENSE OFFICE

4-H WEATHER PROJECT

UNIT I: UNDERSTANDING WEATHER
UNIT II: BUILDING A WEATHER STATION
UNIT III: WEATHER MAPS AND FORECASTING

COOPERATIVE EXTENSION SERVICE — 4-H — YOUTH PROGRAMS — MICHIGAN STATE UNIVERSITY

Weather is a fascinating study that can be adapted to every age level. While the youngest club members can learn about the elements that make up our weather, older youths can apply this knowledge in many useful ways such as forecasting weather, making homes more comfortable, protecting crops from weather extremes or safeguarding themselves and their families from violent weather conditions.

ABOUT THE UNITS . . . . .

This project on weather has been divided into three units, each progressively more difficult. The first unit explains and demonstrates basic principles. Even older youths starting their weather study at a more advanced level may want to review or refer back to these fundamentals. The second unit includes instructions for building a weather station. Although designed to follow the first unit, this unit is very flexible and can be adapted to any special weather interests club members might have, individually or as a group. Club members learn how to read a weather map and recognize continually reoccuring weather patterns in Unit 3.

ABOUT THE GUIDE . . . . .

This Leader's Guide gives a general idea of what should be accomplished in each unit and suggests programs to help sustain a high level of interest and participation. Answers to questions or problems posed in the units are also included in the guide. The kit, of which this guide is a part, contains the following additional materials:

Climate of Michigan — A description of the unique climate features of Michigan and why our climate differs from other nearby states.

Cloud Chart — Clouds illustrated in color with descriptions of characteristic weather and wind relationships for short-term forecasting.

List of Publications, Books and Films

Tornado — U. S. Weather Bureau booklet which describes the nature of a tornado, how they are formed, and the precautions one might take for protection.

Michigan Weather Stations — Map which shows locations of Weather Stations and Weather Bureau Offices in Michigan.

Daily Weather Maps — Four maps which show the development and movement of a typical weather system across the U. S.

ABOUT YOU . . . . .

Must you be an expert on weather to conduct these units? Not at all. The entire leader's kit has been prepared for a person with very limited knowledge of how weather works. All essential information has been included. Should you want to explore any part of the weather story in greater depth, your community offers many resources—libraries with excellent books on the subject, weather stations to visit, amateur and professional weathermen willing and eager to help. More important than previous knowledge is your enthusiasm and willingness to learn with your group. Your interest will spark theirs, and your encouragement can open the door to an extremely useful and enjoyable hobby or future career.

UNIT I — UNDERSTANDING WEATHER

In this unit, club members discover how four basic elements—Sun, Air, Water and Earth—influence weather. Each principle discussed is demonstrated by an experiment. By the end of the unit, club members should understand that:

1. *Air* takes up space, has weight and exerts pressure. It rises when warm and settles when cooled. They should also understand that an ocean of air, or atmosphere, surrounds us and acts as a shield, protecting us from the sun's most harmful rays.
2. The *Sun* is the source of our heat and light. Direct rays from the sun are warmer than slanting rays, and this accounts for heat differences at various latitudes and for our changing seasons.

3. The *Earth* absorbs the sun's rays and, warming up, gives off heat that warms the air. Darker soils absorb more heat than light colored soils. Other differences of topography such as altitude also affect weather conditions.

4. *Water*, because it warms and cools slower than land, modifies temperature. Club members should also understand the water cycle and that clouds can act as a blanket, trapping the earth's heat and keeping the air warmer.

AREAS RECOMMENDED FOR SPECIAL STUDY

1. *The Atmosphere* The nature and importance of our atmosphere is only briefly mentioned in the unit. To explore the subject further, club members might prepare an exhibit of the various layers of atmosphere (troposphere, stratosphere, ionosphere, exosphere) showing how high up each extends, temperature ranges and other characteristics, as well as the importance of each level in the study of weather.

2. *Effects of the Earth's Rotation* Use a globe (or ball) and lamp to demonstrate how the earth rotates on its own axis (giving us night and day) and also travels around the sun, tilting toward and away from the sun to give us seasons. The earth's rotation has another important effect—the deflection of our winds. This is called the Coriolis effect and is explained in Unit II. However, you might want to point out that trees, houses and everything else that is attached to the earth or held to it by gravity moves west to east with the earth as it rotates. The air, being unattached, continues in a certain path while the earth slips by under it. For example, consider a mass of northern air headed south for Detroit. By the time the "target area" is reached, the earth will have revolved so that Chicago might be at that spot instead.

3. *How Weather Affects Us* Your group might want to develop an exhibit or make a scrapbook of how weather and climate influence our clothing, shelter, occupations and other activities.

OTHER PROGRAM SUGGESTIONS

1. Have the group keep a record comparing observed and predicted weather. You might also include almanac predictions to see which forecasts are more accurate over a period of several months.

2. Make a display of items or pictures that illustrate the principles studied. Possibilities: a drinking straw, baster, medicine dropper, "old-fashioned" fountain pen, siphon, hot air balloon, Christmas "angel chimes", barometers, greenhouse. Club members can bring in items or pictures and explain how they work.

3. Borrow several introductory weather books from the library. Have members share new and interesting information from the books.

4. Show a film on the atmosphere or on weather in general (see film listing in kit).

5. Enliven meetings with discussions of questions posed throughout the unit. Answers are given briefly below:

   Do other planets have weather like ours? (Page 1) Other planets in our solar system have weather, but not like ours. To our knowledge, only Mars has any oxygen in its atmosphere. Besides Earth, no other planet appears to have any appreciable amount of liquid water. No other planet has rain like ours. "Rain" falling from the clouds over Jupiter or Saturn would probably be in the form of liquid ammonia. Except for Mercury which has almost no atmosphere, all other planets do have winds and probably dust storms. Jupiter's winds may travel at a speed of over 10,000 miles-per-hour (compared to the 200 to 500 mile-per-hour speed of earth's worst tornadoes). See what else your group can find out.

   If you pump too much air into a tire on a cold day, what could happen when the weather warms up? (Page 5) The tire could blow out. Air inside the tire expands as it warms, stretching the tire. If the tire has a weak spot, the expanding air could break through it.

   How does a greenhouse work? Light and short heat-rays from the sun easily travel through the glass panes of a greenhouse. These are absorbed by the soil and produce heat. The soil warms up and gives off heat, but in the form of longer rays. These long heat rays cannot pass as readily through the glass and are trapped within the greenhouse. Try this for a demonstration:

   > Stand in front of a closed window with sunlight coming through. Feel the heat. Now stand near a stove with a piece of glass between the stove and your face. This time the glass blocks the heat and you feel very little on your face.

   Your group might also want to visit a greenhouse.

   Which is the warmest . . . and which is colder? (Page 9). In the question as posed, the temperature at 3 p.m. would be warmer because of heat buildup. Just before dawn would be the coldest part of the night because the earth continues to lose heat until the sun comes up.

UNIT II — BUILDING A WEATHER STATION

In this unit, club members should build the following weather instruments and know how to use them:

Barometer
Hygrometer or Psychrometer
Anemometer
Wind Vane
Rain Gauge

In addition, they should build a shelter for their instruments and keep daily records of what their instruments show. By the end of the unit, club members should also have a good understanding of two more principles: adiabatic heating and cooling, and the Coriolis effect.

AREAS RECOMMENDED FOR SPECIAL STUDY

1. *Adiabatic Heating and Cooling* This is the heating that takes place when a gas is compressed, and, conversely, the cooling that takes place when a gas is released from pressure and expands. Both can be demonstrated by pumping up a bicycle tire. As air is squeezed or compressed in the pump, the shaft of the pump heats up. After pumping up the tire as much as possible, let the compressed air in the tire escape, or expand, and feel the coolness. Adiabatic heating and cooling is an important principle in the study of weather. Warm, moist air currents rising into layers of the atmosphere where pressure is lower, expand and cool, eventually to the point where clouds form (see Unit II).

   Abiabatic heating of the air accounts for many of the world's great deserts. One may locate the deserts and see how many are in the horse latitudes or on the east side of mountain ranges. In both areas, air is generally sinking, warming as it compresses and drying out and increasing its capacity to hold water. This is one reason why so little rain falls over desert areas.

2. *Clouds* A special study of clouds could be included in either Units II or III. Clouds are discussed in both. Here are suggestions for increasing your group's basic knowledge of clouds:

   Display the cloud chart.

   Show a film on clouds.

   Judge the height of a cumulus cloud as a class project.

3. *Forms of Precipitation* Ask group members to find out differences between rain, snow, sleet and hail. Discuss.

4. *Fog and Smog* Investigate the differences between fog and smog. Find out what is being done to correct smog.

OTHER PROGRAM SUGGESTIONS

1. Obtain an aneroid barometer and have it available at meetings. Group members could be assigned to take the barometer home and record barometric pressure trends until their own barometers are completed. The aneroid readings could also be the guide for developing measurement scales for the homemade barometers.

2. If you can obtain materials for a mercury barometer, demonstrate how Torricelli made his. (Be sure you aren't allergic to mercury.)

3. If you live in one of Michigan's fruit growing areas, ask a fruit grower or agricultural engineer to talk before the group on the growing season and ways of protecting crops from frost (also appropriate for Unit I).

4. Ask a meteorologist to talk to the group on weather instruments and what changes in readings mean.

5. Preferably in March, April, or May, do a group study project on tornadoes. Bring in newspaper clippings and make up "fact" sheets with any information members can find on tornadoes. Some members may want to demonstrate how to be safe in a tornado. (See "Speak Up For Preparedness", MSU, 4-H Booklet No. 550, for suggestions).

UNIT III — WEATHER MAPS AND FORECASTING

By the end of this unit, members should understand air mass analysis, high and low pressure systems, warm fronts and cold fronts, and how to use a weather map. With this new information, plus their own daily observations of wind, clouds, temperature and pressure changes, club members should be able, with practice, to make short-term weather forecasts.

AREAS RECOMMENDED FOR SPECIAL STUDY

1. *Storms* The whole area of tornadoes, thunderstorms and hurricanes has been left for individual or group study. Excellent books and films are available on these subjects. This is also a good topic for a meteorologist to discuss with the group.

2. *Effects of Topography on Weather* Air masses are changed considerably by mountain ranges, smaller elevations, and bodies of water. Your group might want to construct a topographical map of the United States and Canada (one way: mix equal portions of salt and flour, and add enough water to make a clay-like substance for modeling) and then demonstrate what happens as air masses move overhead.

3. *Special Interest Subjects* Unit III refers to several related weather areas that might interest your group such as upper air current analysis, advances in weather control, weather protection for crops, solar heating for homes, and careers in meteorology. By developing a special topic, you can adapt this unit to any older group.

OTHER PROGRAM SUGGESTIONS

1. Visit a weather station (a list of stations is included in the kit).

2. Make a collection of weather sayings. Find out which are true and false, and why.

3. Ask a pilot (or Great Lakes navigator) to speak on what cloud formations and warm and cold fronts mean to him.

4. Subscribe as a club to U. S. Weather Bureau maps. Learn map symbols; study how fronts travel, etc. Reviewing the past week's maps try to make predictions for the next few days.

ANSWERS TO QUESTIONS

1. *Direction of Winds* As a Low approaches, winds will come from the southeast to northeast. As the Low passes over, winds change quickly to the NW. If the center of the Low passes north of you, winds change from SE to SW, then toward the NW. If the center of a Low passes south of you, winds change from NE to NW.

2. *Weather conditions*

	4 p.m.	8 p.m.
Fort Wayne	Fair weather	Will probably be fair
Toledo	Just getting thundershowers	Clear weather Very cool
Erie	Still raining but Clearing	Warm, cloudy
Buffalo	Rain	Still raining

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