4H Weather Project – Units 1-5 Leader's Guide
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LEADER'S GUIDE

4-H WEATHER PROJECT

UNIT 1: UNDERSTANDING WEATHER
UNIT 2: BUILDING A WEATHER STATION
UNIT 3: WEATHER MAPS AND FORECASTING
UNIT 4: SEVERE WEATHER
UNIT 5: AIR POLLUTION AND FALLOUT

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 five 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.

Units 4 and 5 are a survey of weather-influenced disaster conditions with which we must live in our modern world. Unit 4 covers natural phenomena that affect us adversely, such as thunderstorms, tornadoes, hurricanes, and blizzards. Unit 5 points out the role of weather in two far more serious threats to our well-being, air pollution and fallout—both of which have resulted from man's own activities.

Unit 5 is designed to follow Unit 4. Many of the experiments and projects in Unit 5 can be conducted meaningfully with limited weather knowledge. But to apply what is learned from these experiences, club members need a basic understanding of the structure of the atmosphere, upper winds, and air stability, all of which are included in Unit 4.

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.

List of Publications, Books, and Films

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

Reading the Weather Map—To be used along with the weather maps to interpret the weather systems on the maps.

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 1 — 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 2. 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 2 — 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 eventually cools to the point where clouds form (see Unit 2).

   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 2 or 3. Clouds are discussed in both. Here are suggestions for increasing your group's basic knowledge of clouds:

   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 1).
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," 4-H Bulletin No. 550, for suggestions.)

UNIT 3 — WEATHER MAPS AND FORECASTING

By the end of this unit, members should understand air mass analysis, high and low pressure systems, warm fronts and coid 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 3 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.
2. Make a collection of weather sayings. Find out which are true and which are 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

UNIT 4 — SEVERE WEATHER

Unit 4 offers you many opportunities as a youth leader to develop resourcefulness and good citizenship in your club members. Through this advanced weather study you can:

- **Instill in Club Members the Excitement of On-Going Discovery** Much of what is presented in Unit 4 is theory—sound theory accepted by most scientists today, but still subject to change as our advanced technology makes new information available. Involve your members in this discovery process. Point out that the turntable experiments are basically the same as meteorologists are conducting. Encourage them to clip and save newspaper and magazine articles on meteorological advances. What do scientists hope to accomplish with each new weather satellite launched?

  Your club might also subscribe to "Weatherwise," a bi-monthly publication of the American Meteorological Society.

  Another good source of up-to-date information is "Science News," a weekly digest of advances on all scientific fronts. Issues are available at most libraries.

- **Encourage Members to Conduct Their Own Research** Unit 4 can be a good starting point for many individual projects on the atmosphere: tornadoes, hurricanes, upper winds, winter storms and others. Some club members might devise models and charts that would make fine entries for 4-H shows and science fairs.

  Be alert to every question asked. These could be the basis for excellent research projects. A club member might ask, "How could a hurricane be stopped?" This could lead to a study of "Project Stormfury," an attempt to weaken a hurricane by seeding with silver iodide crystals. An interested club member might write to the U. S. Dept. of Commerce, Environmental Science Services Administration, Public Information Dept., Rockville Maryland, 20852, for information; or he could look up references to "Project Stormfury" in the library.

  Do your club members know how to use the library card catalog and "Guide to Periodical Literature"? A meeting held at the library to acquaint them with resource materials might be very helpful. If special books are needed, your librarian can obtain them from the State Library.

- **Help Members Use What They Learn** Thunderstorms, tornadoes and winter storms all threaten us directly. After learning the nature of each of these conditions, club members will realize that they can act beforehand in many ways to lessen the danger should such an emergency arise. Encourage them to develop safety rules for their families and friends. They can also practice tornado drills, learn first aid skills, and prepare shelter, food and other supplies for an emergency.

  Some members might want to give demonstrations on emergency preparedness. "Speak Up for Preparedness," 4-H Bulletin 550, available from your county extension agent includes several demonstration ideas.

  There is always the possibility that a tornado may strike your area. In the aftermath of such a disaster, many volunteers are needed. Club members may be able to perform a real community service by offering their help.

PROGRAM SUGGESTIONS

1. Develop a chart of the atmosphere as a group project. One person could find out how high jet and propeller planes fly. Others might investigate how high man has penetrated the atmosphere with balloons, rockets and satellites. Another could report back about the ionosphere — where it is located and how it is used for high frequency radio communication. (The ionosphere extends about 50 to 200 miles above the earth's surface. It is a region so heavily bombarded by the sun's rays that gases, especially oxygen and nitrogen, are split into ions. High frequency radio waves bounce off these ions and are reflected back to earth. This makes it possible for us to hear radio signals from great distances.)

2. Invite a pilot to a meeting to describe the different atmospheric conditions he encounters in flying a jet or propeller plane. Ask him why weather is important to a pilot and what career opportunities are open to meteorologists in aviation.

3. Look over the section on winds and pollution in Unit 5. Your group might want to carry out the balloon-tracking project now.

4. Study weather maps at meetings, noting how the winds aloft steer and intensify weather below. Watch the changing pattern of the index cycle. Try to predict long-term weather changes.

5. Since a turntable might be difficult for some members to locate, plan to do the turntable experiments at meetings. For best results, use an old record player with the spindle removed.

   For the "dishpan weather" experiment, you need to heat the outer edges of a pan of water and cool the center. Then add a few drops of food coloring and set the pan spinning on a turntable. To heat the edges, use an electric burner with the inner coils removed, or possibly the heating unit of an electric popcorn popper, again removing the inner coils, Or, if two or three immersable heating rods are available (the kind used to heat a cup of coffee) they might also be arranged so that water at the edge heats uniformly. At the same time, place a can of crushed ice and salt at the center of the pan. Try this experiment a few times to be sure you can get good results with your equipment before attempting it at a meeting. Be especially careful of electrical shock.

6. Invite your civil defense director or a state police representative to talk on emergency preparedness. Find out how your club can cooperate in community emergency preparedness programs.

7. Ask your local Red Cross chapter for a demonstration of artificial respiration or other first aid skills mentioned in the members manual. Some members might want to take a course in first aid.

ANSWERS TO QUESTIONS

1. **Exploring the Atmosphere** Ballons, rockets and satellites have different functions. The first two carry radiosondes to measure the temperature, pressure, humidity and winds of the upper air. Satellites send back pictures of cloud formations and also record how much of the sun's radiation reaches the earth and how much is reflected back.

2. **Why the Jet Stream Fluctuates in Height and Location** In the winter, the polar tropopause is much lower because the air is colder and denser. This places the jet stream at a lower altitude. Also in the winter, polar air has moved southward. The jet stream will be located in a more southerly latitude. Winds aloft are swifter in the winter because a greater temperature contrast exists between polar and tropical air.

3. **Index Cycle, Stage 3** The cut-off cell of cold air will dissipate first because it moves southward and mixes readily with the warmer surface air.

4. **Analyzing Weather** On the weather map shown, the winds are relatively slow. This indicates the season is summer. The air mass aloft is in the second stage of the cycle, possibly moving into the third stage. The swiftest winds are along the line of arrows with closed barbs, midway between the high pressure cell and the two lows. Notice how the winds flow with the isobars. The low to the left will move southeastward, then veer to the north. The area of Canada which lies northwest of the Great Lakes should be experiencing good weather. Weather has probably been stormy just below the Great Lakes but the storm center is now moving northeastward up the Atlantic coast.

5. **Mothball Experiment** The mothball does not continue rising into the air because it is denser than the air. When it reaches the top of the water, the mothball loses some of its gas bubbles, becomes denser and sinks.

6. **Four Ways Air Rises** A cold front lifts air upwards (see Unit 3). The heated mountain sides warm the surface air and the air begins to rise. Cooling of the upper layer may be sufficient to change the lapse rate thereby causing an exchange, or overturning, between the cooler, dense air above and the warm air layer below. The lower air will then rise. Heating of the earth's surface also creates instability. The lower air is warmed by the earth, becomes bouyant and rises.

7. **Temperature Profile Charts**

Explanation of Temperature Profiles

Chart A

As discovered earlier, the rising column of air would cool to the saturation point at about 2000 feet. At this point, a cumulus cloud would form. Notice on this chart that the rising column reaches the same temperature as the surrounding air at about 1500 feet. As a result, the column will not rise any further. Also, since its temperature is still higher than its dewpoint, no cloud would develop.

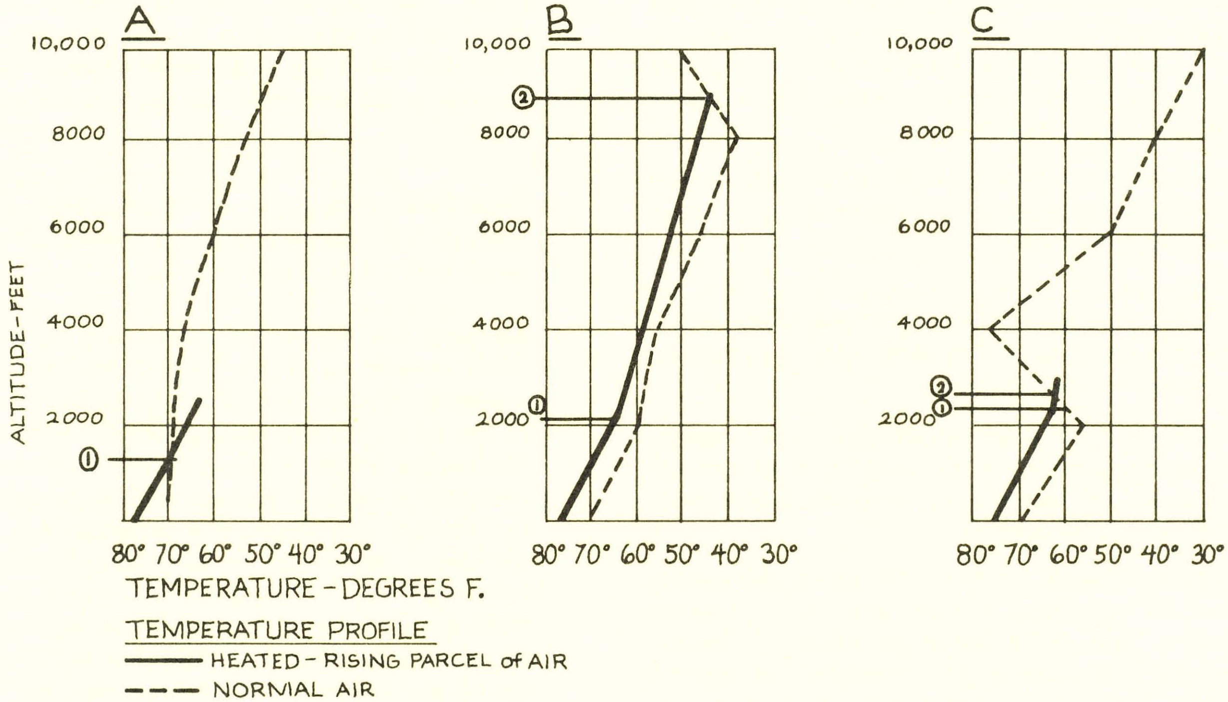

Chart B

Here the rising column of air will cool at the dry adiabatic rate until it reaches the dewpoint temperature at about 2000 feet at which time a cumulus cloud will develop as before (1). But, look at what happens at about 9000 feet (2). A temperature inversion in the surrounding air. The rising air and cumulus cloud will reach the same temperature as the surrounding air. This represents the point of stability which means that the air will not rise any further. The cloud will not develop any higher either.

Chart C

Like the previous chart, cloud begins to develop in the rising column at about 2000 feet (1). But there is a temperature inversion in the surrounding air at a much lower altitude this time. The point on the chart at which the two temperature profile lines cross is the point at which stability is reached and upward movement ceases. The cloud which began to develop at about 2000 feet will not develop beyond point (2) on your chart.

3. Encourage members to use scientific methods wherever possible. This might include keeping a log of procedures and observations, using control samples in experiments, or taking accurate measurements.

UNIT 5 — AIR POLLUTION AND FALLOUT

Unit 5 offers club members an even greater opportunity for individual research and community action. Your role as a leader will be primarily to guide their efforts, introduce them to community resources and help make available materials needed for the various projects. Specifically, you can:

1. Locate one or two microscopes and an induction coil. These may only be available in a general science classroom or high school science lab. However, if you have a mechanically-minded club member who is familiar with cars, he may be able to adapt an automobile induction coil for club use.
2. Make a list of other materials which are needed for experiments and may be hard to find. Locate them also for your members.
3. Encourage members to use scientific methods whereever possible. This might include keeping a log of procedures and observations, using control samples in experiments, or taking accurate measurements.
4. Enlist the cooperation of people in the community who can help with the unit: teachers, public health directors or other local officials concerned with air pollution control, meteorologists, automotive engineers, civil defense directors and others.
5. Learn about any pollution control laws or programs in your community. In what ways can your club assist with community efforts?
6. Decide with your group how extensive your air analyzing experiments will be. For example: will you collect pollen for viewing, or take several pollen counts, over a period of time? In Experiment 10, would you like to find out how far the dust settles from one pollution source, or will you compare the dust in city and country air?

Are some of your members interested in taking a pollen count? The efficiency of the sampler made in Experiment 4 depends on wind speed. In an extreme calm with winds of 2 miles an hour, only 25% of ragweed pollen moving past the flag will impinge on the back edge. With a wind of 4 miles an hour, the collection rate goes up to 75%. At 5 miles an hour, 80% of the pollen will be collected; at 8 miles an hour, 86%; at 12 miles an hour, 90%, and at 30 miles an hour, 95%.

With these percentages as a guide, a simple formula will give the concentration of pollen in the air:

$$X = \frac{C}{E \times V}$$

X is Concentration; C is the number of pollen counted; E is the Efficiency of the sampler, and V is the volume sampled. To get the volume sampled, you need another formula: V = A x T x W, in which A is the cross-sectional area of the sampler, T is time and W is windspeed. Our sampler is 0.1 cm. in diameter and 2.54 cm. in height. Let's see what volume of air would be sampled in one hour (3600 seconds) with a 5 mile per hour wind (1 mph = 44 cm/second; 5 mph = 220 cm/second):

$$\text{Volume} = \frac{0.1 \times 2.54 \times 3600 \times 220}{10^6 \text{ (centimeters per cubic meter)}}$$

Volume = 0.2 cubic meters per hour

Now let's assume that we have 100 ragweed pollens on our slide:

$$X \text{ (Concentration)} = \frac{100 \text{ (count)}}{.8 \text{ (efficiency)} \times .2 \text{ (volume)}}$$

X = 625 particles per cubic meter

If your members graph results each time they do the experiment, they can determine when the concentration of pollen is highest.

PROGRAM SUGGESTIONS

1. Try to hold a few meetings in a school science lab where microscopes are available. In advance, prepare slides of ragweed pollen (taken from a plant), salt, ash and ordinary household dust so that club members can distinguish the different forms. Members could also bring to the meeting any slides they have prepared from Experiments 4, 5, 11 or 13.
2. Are some of your members interested in cars? They might want to do a panel discussion or demonstration on automotive engines, pointing out why combustion may be faulty and why afterburners are being recommended to eliminate auto exhaust.
3. Take field trips to survey pollution in the community. Or assign members to check certain areas. Which survey methods should they use? Will they report back what they observe? Take photographs? Analyze smoke with a chart? Set out collection jars? Decide with your group.
4. Local factories or power plants may be using smoke control devices. A trip to see how they work might be possible. Or an official from the plant may be willing to talk to the club about problems and methods of control.
5. Invite a public health director or other air pollution control official to talk on air pollution and what is being done to combat it.
6. When special interest is shown in a topic only briefly discussed in the unit (for example, volcanoes, radiocarbon dating, or the use of radioactive isotopes) encourage the club member to find out more and report back to the group. A good meeting can develop from such an interest.
7. To supplement the section on radiation and fallout, visit a cyclotron or other nuclear energy facility.
8. Ask your civil defense director to demonstrate radiation detection and shielding.
9. Locate nearby public fallout shelters and visit them. Members might want to make a map of all public fallout shelters near their homes, schools, churches, and shopping centers.
10. Show a film on atomic energy and radiation.
11. Encourage club members to give demonstrations on pollution control and fallout protection. "Speak Up for Preparedness," 4-H Bulletin 550, has several suggestions.

ANSWERS TO QUESTIONS

1. **Experiment 3** The iron filings turn to iron oxide (rust). Water rises in the tube because the oxygen has been removed from the air. Gas remaining in the tube is almost pure nitrogen.
2. **Population Effect on Carbon Dioxide** Not only are there more people to exhale carbon dioxide; forest and fields that once used carbon dioxide are being replaced by cities.
3. **Geiger counter** A geiger counter detects radiation. Since there is always some radiation in the air, a functioning counter will always click or beep after being turned on.
4. **Spinthariscope Experiment** Hands must be washed carefully after handling radium dial material to lessen the danger of swallowing alpha particles.

FOR FURTHER STUDY

1. **The Problem of Hard Insecticides** Certain serious pollution problems have not been included in this project. One is the use of DDT and other **hard insecticides,** which do not break down easily and may

remain in the soil for many years. Conservation departments are very concerned about the long-range effects of these chemicals and are urging that other "soft" chemicals be substituted. 4-H clubs in rural areas may be especially interested in this insecticide problem. For information in Michigan, write to the Michigan Department of Conservation, Lansing 48926.

2. **Wind Erosion** The great dust storms of the 1930's led to many soil conservation practices. Club members who live on farms may want to study ways of lessening wind erosion. Ask your county extension agent for information.

3. **Effect of Pollution on Climate** Compare city weather with weather in outlying rural areas over a period of time and you'll find that cities have more fog, clouds and rain — partially due to the polluted air. Cities, on the average, have ten times more particles in the air than their rural environs. Many of these particles attract water, acting as condensation nuclei for rain and fog.

   Pollution can also affect world-wide weather. When Krakatoa erupted, an enormous quantity of dust and ash was injected into the stratosphere. Here the ash remained for a long time, blocking the sun's rays and producing cooler summers for three years. This raises the question of how a large quantity of radioactive fallout in the stratosphere would affect world climate. Your group might want to discuss the effect of air pollution and fallout on climate with a meteorologist.

4. **Atomic Energy** Some members may become quite interested in the atom. Encourage them to learn more. They could make models of reactors, cyclotrons, atom structure, etc. These would be very useful in school or as demonstration materials. They could also be exhibited.

SUPPLEMENTAL MATERIALS

Air Pollution — Pamphlets, reprints of magazine articles, and a copy of the state rules and regulations for air pollution control are available from: Michigan Department of Public Health, Division of Occupational Health, Air Pollution Section, 3500 North Logan, Lansing 48914. Pamphlets are also available from: Air Pollution Control Division, Detroit Department of Health, Room 414, City-County Building, Detroit, Michigan 48226. The air pollution control sections of many Michigan county health departments will also have information.

Selected Publications

Batten, Louis J., *The Unclean Sky. A Meteorologist Looks at Air Pollution.* Garden City, N. Y., Anchor Books, Doubleday & Company, Inc., 1966. 143 p. Science Study Series; sponsored by the AMS. Describes how the atmosphere has become a dumping ground, how this has affected the world of man and nature, and what can still be done to improve this worsening situation.

Blanchard, Duncan C., *From Raindrops to Volcanoes, Adventures with Sea Surface Meteorology.* Garden City, N. Y., Anchor Books, Doubleday & Company, Inc., 1967. Science Study Series; sponsored by the AMS. Describes how meteorology, oceanography, physics, chemistry, and volcanology merge in the study of the little, but all-important, raindrop.

Edinger, James G., *Watching for the Wind. The Seen and Unseen Influences on Local Weather.* Garden City, N. Y., Anchor Books, Doubleday & Co., 1967. 148 p. Science Study Series; sponsored by the AMS. Discusses in popular style the author's personal and professional experiences with local weather in California and South America.

Ohring, George, *Weather on the Planets. What We Know about their Atmospheres.* Garden City, N. Y., Anchor Books, Doubleday & Company, Inc., 1966. 146 p. Science Study Series; sponsored by the AMS. Describes how information about planets is obtained, what we know about planetary weather, and how this data is employed by earthbound meteorologists.

Reiter, Elmar R., *Jet Streams: How Do They Affect Our Weather?* Garden City, N. Y., Anchor Books, Doubleday & Company, Inc., 1967. 180 p. Science Study Series; sponsored by the AMS.

Films

"Tornado" — Vivid portrayal of actual tornado scenes, how they are formed, and protective measures individuals, families and communities can take. Available through your local Civil Defense Office or Weather Bureau.

"A Hurricane Called Betsey" — Portrays hurricane "Betsey" which struck the Louisiana coast creating millions of dollars worth of damage. Film shows Weather Bureau warning system and the operation of Civil Defense, state and city agencies, and volunteers who helped prepare the state and the city of New Orleans as well as the effects of the storm and recovery from its effects. Basic principles may be applied to most any form of community-wide emergency. Available through your local Civil Defense Office.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. G. S. McIntyre, Director, Cooperative Extension Service, Michigan State University, East Lansing, Michigan.

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