DOCUMENT RESUME

ED 079 025 SE 014 877

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TITLE Applied Meteorology, Science (Experimental): 5343.06.
INSTITUTION Dade County Public Schools, Miami, Fla.
PUB DATE 71
NOTE 19p.; An Authorized Course of Instruction for the Quinmester Program

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Behavioral Objectives; *Earth Science; Instruction; Instructional Materials; *Meteorology; Physical Sciences; Resource Materials; *Secondary School Science; *Teaching Guides; Units of Study (Subject Fields)
IDENTIFIERS *Quinmester Program

ABSTRACT

This unit of instruction was designed to introduce the student to the elements of weather through a study of the instruments used to measure the elements and the U.S. daily weather map. The booklet lists the relevant state-adopted texts and states the performance objectives for the unit. It provides an outline of the course content and suggests experiments, demonstrations, field trips, and topics for student projects, reports, and additional activities. Also listed are relevant films, transparencies, slides, and filmstrips available from the Dade County Audiovisual Center. Reference books and teaching aids are recommended, and a master sheet is provided relating each suggested activity to the specific performance objectives. (JR)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

APPLIED METEOROLOGY

5343.06
5311.31
5312.31
5313.31

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

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Written by Charles Worthington
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

Published by the Dade County School Board

Copies of this publication may be obtained through

Textbook Services
2210 S. W. Third Street
Miami, Florida 33135

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APPLIED METEOROLOGY

COURSE DESCRIPTION:

The elements of weather will be presented through a study of the instruments used to measure the elements and the U. S. Daily Weather Map.

ENROLLMENT GUIDELINES:

This course is recommended for students interested in aeronautics.

STATE ADOPTED TEXTS:

1. Brandwein, Paul F.; Stollberg, Robert; and Burnett, R. Will. Matter-Its Forms and Changes. New York: Harcourt, Brace and World, Inc., 1968.

2. Brown, F. Martin; Kemper, Grace H.; and Lewis, John H. Earth Science. Morristown, N. J.: Silver Burdett Co., 1970.

3. Thurber, Walter A. and Kilburn, Robert E. Exploring Physical Science. Boston: Allyn and Bacon, Inc., 1968.

PERFORMANCE OBJECTIVES

1. Given appropriate laboratory experiences, the student will describe how the earth's rotation, revolution and inclination contribute to changes in weather and seasons.

2. Given appropriate laboratory experiences, the student will describe how the earth's land and water areas contribute to variations in weather and climate.

3. Given a list of characteristics, the student will use them to distinguish between the troposphere and the stratosphere.

4. Using common, inexpensive materials, the student will construct instruments for measuring temperature, pressure, relative humidity, wind velocity and precipitation.

5. The student will describe how radar, satellites and the radiosonde are used for gathering weather data.

6. Given the proper descriptive phrases, the student will distinguish between primary and secondary air circulation.

7. Given visuals of different types of clouds, the student will classify them.

8. Given a list of distinguishing characteristics, the student will classify air masses.

9. Given the proper descriptive phrases and visuals, the student will identify the warm, cold, stationary and occluded fronts.

10. Given weather maps and station models, the student will translate selected symbols.

11. The student will predict weather based upon observation and information on daily weather maps.

12. Given a teletype sequence report, a terminal forecast, an area forecast or winds aloft report, the student will describe the weather at a given place at a given time.

13. Given in-flight weather advisories, the student will write the weather forecast in English sentences.

14. The student will describe the causes of severe atmospheric disturbances.

COURSE OUTLINE

I. Basic Concepts

A. The earth's rotation and revolution

B. Inclination of the earth's axis

C. Terrain and geography of the earth

D. The atmosphere
   1. The troposphere; its composition
   2. The stratosphere; its composition

II. Measuring the Properties of the Lower Atmosphere

A. Temperature

B. Pressure

C. Humidity

D. Wind Velocity

E. Precipitation

III. Measuring the Properties of the Upper Atmosphere

A. Radiosonde

B. Radar

C. Satellites

IV. Atmospheric Circulation

A. Primary circulation

B. Secondary circulation

C. Factors affecting circulation
   1. Pressure gradient
   2. Coriolis force
   3. Friction
   4. Terrain
   5. Land and sea heating

D. Jet streams

V. Clouds

A. Formation

B. Types

C. Precipitation

D. Seeding

VI. Air Masses

A. Formation

B. Types

VII. Fronts

A. Formation

B. Types

C. Cyclones
   1. Tornadoes
   2. Hurricanes
   3. Thunderstorms

D. Anticyclones

VIII. Predicting the Weather

A. Map symbols and station models

B. Interpreting the daily weather map

C. Area and terminal forecasts

D. Sequence and winds aloft reports

EXPERIMENTS

Brandwein, Paul F.; Stollberg, Robert; and Burnett, R. Will. Matter-Its Forms and Changes: New York: Harcourt, Brace and World, Inc., 1968.

1. An apprentice investigation of air currents. (p. 280)
2. An apprentice investigation of the expansion of air. (p. 283)
3. Making a mercury barometer. (pp. 286-287)
4. How does the evaporation of rainwater compare to the amount that falls over a period of time? (p. 300)
5. What is the weather pattern where you live? (p. 301)
6. How air currents may be caused by temperature differences within a mass of air. (p. 301)

Thurber, Walter A. and Kilburn, Robert E. Exploring Physical Science. Allyn and Bacon, Inc., 1968.

7. Experiments with unbalanced pressures. (pp. 87-91)
8. Measuring atmospheric pressure. (p. 93)
9. Making humidity indicators. (p. 36)

Brandwein, Paul F.; Beck, Alfred D.; Strahler, Violet; Hollingworth, Leland G.; and Brennan, Matthew, J. The World of Matter-Energy. New York: Harcourt, Brace and World, Inc., 1964.

10. Cloud seeding. (p. 143)
11. Water cycle. (p. 143)
12. Relative humidity. (p. 144)
13. Convection currents. (p. 152)
14. Lightning. (p. 162)
15. Light and dark areas. (p. 166)
16. Charting cloud types. (p. 166)
17. Predicting weather from clouds. (p. 166)
18. Air pressure. (p. 174)
19. Differences in air pressure. (p. 185)
20. Making a humidity indicator. (p. 185)
21. An inquiry into the calibration of an instrument. (p. 187)
22. Water in the air. (p. 144)

Smith, Paul E. Our Environment-How We Adapt Ourselves To It. Boston: Allyn and Bacon, Inc., 1963.

23. How does dew form? (p. 68)
24. What is the relative humidity of the air? (p. 65)
25. Does an evaporating liquid absorb heat? (p. 63)
26. Making a fog in a milk bottle. (p. 70)
27. How can static electricity be made? (p. 85)
28. Which has the greater heat capacity, soil or water? (p. 119)
29. What causes unequal lengths of day and night? (p. 140)
30. What causes the changes of seasons? (p. 148)
31. Making and calibrating a hair hygrometer. (p. 62)
32. How does atmospheric pressure affect a barometer? (p. 50)

Davis, Ira C.; Burnett, John; Gross, E. Wayne; and Johnson, Theodore D. II. Science-Discovery and Progress. New York: Holt, Rinehart and Winston, Inc., 1965.

33. How the Coriolis force affects the weather. (p. 106)
34. How an aneroid barometer works. (p. 113)
35. Determining the dew point. (p. 115)

Brandwein, Paul F.; Stollberg, Robert; and Burnett, R. Will. Energy-Its Forms and Changes. New York: Harcourt, Brace and World, Inc., 1968.

36. Making a model barometer. (p. 127)

Namowitz, Samuel N. and Stone, Donald B. Earth Science-The World We Live In; 3rd ed. Princeton: D. Van Nostrand Company, Inc., 1965.

37. Making a mercury barometer. (p. 450)
38. Finding the dew point. (p. 480)
39. Finding the relative humidity in per cent. (p. 478)

DEMONSTRATIONS

Brinckerhoff, Richard; Cross, Burnett; Watson, Fletcher; and Brandwein, Paul F. The Physical World, 2nd ed. New York: Harcourt, Brace and World, Inc., 1963.

1. Showing what happens when a warm front meets a cold front. (p. 233)
2. Making a gut string and hair hygrometer. (p. 228)
3. Making a cloud. (p. 233)

Smith, Paul E. Our Environment-How We Adapt Ourselves To It. Boston: Allyn and Bacon, Inc., 1963.

4. Results of the whirling movements of air currents. (p. 56)
5. Direct rays vs. slanting rays. (p. 144)
6. Air contains water. (p. 60)

Davis, Ira C.; Burnett, John; Gross, E. Wayne; and Johnson, Theodore D. II. Science-Discovery and Progress. New York: Holt, Rinehart and Winston, Inc., 1965.

7. How latitude affects climate. (p. 102)
8. What happens when two air masses meet? (p. 108)

PROJECTS

1. Set up a school weather observation station. Keep accurate records and make daily forecasts.

2. Construct models out of such things as plastic, glass, cotton and cardboard to illustrate the different fronts.

3. On the same day, determine the relative humidity in different places such as the classroom, gymnasium, outside and in the attic. Explain why there are differences.

4. Photograph various cloud formations.

5. On a large graph, plot rainfall and temperature data for different parts of the world.

6. Using weather bureau data, plot curves to show the daily range of temperature at several cities in different parts of the U. S.

7. Make a graph of air pressures at the same time of day for a month.

8. Find out why lightning and thunderstorms are most common during July, August and September.

9. Make a labeled drawing of the formation of a thundercloud studied from observations.

10. List the principal occupations in your community and tell how each is related to the weather conditions.

11. Cover a map of the U. S. with a sheet of clear plastic and with a marking pencil, trace the weather for several days across the U. S.

REPORTS

1. History and Techniques of Rainmaking.

2. A Destructive Hurricane of the Florida Coast.

3. The Effect of Climate (in a specific region) on Civilization.

4. A Severe Storm

5. Governmental and Private Agencies Interested in the Forecasts of Hurricanes and Tornadoes, and in River Flood Heights. (Explain their interest in each instance).

6. Scientists Who Have Contributed to the Science of Meteorology.

7. How Electronic Computers Serve the Weather Bureau.

8. Use of Radar and Satellites in Weather Forecasting.

9. Radiosonde and the Meteorologist.

FIELD TRIPS

1. FAA weather station, on the Palmetto Expressway, Miami.

2. ESSA weather station, University of Miami Campus.

3. Meteorological Laboratory, University of Miami Campus.

4. Class could take daily 10 or 20 minute excursions outside to make weather measurements such as temperature, relative humidity, pressure and cloud cover.

FILMS AVAILABLE FROM DADE COUNTY AUDIOVISUAL CENTER

1. Clouds
   AV#1-02129, 10' BW

2. Clouds Above
   AV#1-02135, 9' C

3. The Inconstant Air
   AV#1-30373, 29' C

4. Modern Weather: Theory and Structure of Storms: Development and Characteristics of Atmospheric Waves
   AV#1-12986, 15' BW

5. Modern Weather: Theory and Structure of Storms: Primary Circulation
   AV#1-13110, 18' BW

6. Reading Weather Maps
   AV#1-10995, 14' BW

7. The Story Behind Hurricanes
   AV#1-02100, 6' BW

8. The Unchained Goddess, Part 1
   AV#1-30382, 33' C

9. The Unchained Goddess, Part 2
   AV#1-30384, 33' C

10. Weather: Understanding Storms
    AV#1-02128, 10' BW

11. Winds and Their Causes
    AV#1-02113, 10' BW

12 Earth in Motion
   AV#1-01607, 11' BW

13. The Earth: Its Atmosphere
    AV#1-02124, 11' C

14. How Weather is Forecast
    AV#1-02080, 10' BW

TRANSPARENCIES AVAILABLE FROM DADE COUNTY AUDIOVISUAL CENTER

1. Earth Science: Meteorology, Set 1
   AV#2-30149, 9 transparencies, C

2. Weather: Cloud Formations
   AV#2-00219, 1 static and 4 overlays, C

3. Annual Precipitation
   AV#2-00267, 1 static and 5 overlays, C

4. Average Temperature
   AV#2-00281, 1 static and 2 overlays, C

5. Climates
   AV#2-00266, 1 static and 5 overlays, C

6. Meteorology
   AV#2-30025, 3 statics and 2 overlays, C

7. Weather: The Water Cycle
   AV#2-00255, 1 static and 4 overlays, C

SLIDES AND FILMSTRIPS AVAILABLE FROM DADE COUNTY AUDIOVISUAL CENTER

1. Clouds and Weather
   AV#5-70019, 40 color slides

2. Clouds, Lightning and Rainbows
   AV#5-20091, 33 color slides

AVAILABLE FROM EYE-GATE HOUSE, INC.

3. Meteorology
   A set of 4 color filmstrips

ADDITIONAL ACTIVITIES

1. Check the fixed points of the thermometer in boiling water and melting ice. Account for any differences in your findings and those published in scientific literature.

2. Carry an aneroid barometer from the ground floor to the roof of your school or of any tall building. Record the readings at each level.

3. Make a simple cloud chamber with which you can demonstrate the effect of condensation nuclei.

4. Find the relative humidity with a sling psychrometer. Do this for both indoors and outdoors and compare the results.

5. Make a climatic map of the United States.

6. Note how the wind direction changes as a rainstorm approaches and then passes away.

7. Prepare a map of the U. S. showing the principal tracks of middle latitude cyclones or lows.

8. Go outside when a storm is near and find out if you can feel a change in the wind and a change in the temperature. Describe the pattern and types of clouds.

9. Examine the structure of hailstones.

10. Produce an artificial rain with a garden hose and spray nozzle during the late afternoon. How must you stand to see a rainbow?

11. Find the direction of breezes at the sea shore at night and during the day.

12. Find how hurricanes and tornadoes are similar and different.

13. Make a model of the vertical cross section through a hurricane.

REFERENCES

1. Air Masses and Line Weather. Glendale, California: Aviation Book Company, 1966.

2. Aviation Weather Maps. Glendale, California: Aviation Book Company, 1968.

3. Brandwein, Paul F.; Beck, Alfred D.; Strahler, Violet; Hollingworth, Leland G.; and Brennan, Matthew, J. The World of Matter-Energy. New York: Harcourt, Brace and World, Inc., 1964.

4. Brandwein. Paul F.; Stollberg, Robert; and Burnett, R. Will. Energy-Its Forms and Changes. New York: Harcourt, Brace and World, Inc., 1968.

5. Brinckernoff, Richard; Cross, Burnett; Watson, Fletcher; and Brandwein, Paul F. The Physical World. 2nd ed. New York: Harcourt, Brace and World, Inc., 1963.

6. Ceiling and Visibility. Glendale, California: Aviation Book Company, 1965.

7. Davis, Ira C.; Burnett, John; Gross, E. Wayne; and Johnson, Theodore D. II. Science-Discovery and Progress. New York: Holt, Rinehart and Winston, Inc., 1965.

8. Federal Aviation Agency. Aviation Weather. Washington: U. S. Government Printing Office, 1965.

9. Interpreting Teletype Weather Data. Glendale, California: Aviation Book Company, 1965.

10. Leeds, Willard L. Weather and You. Middletown, Conn.: Xerox Corporation, 1967.

11. Namowitz, Samuel N. and Stone, Donald B. Earth Science-The World We Live In. 3rd ed. Princeton: D. Van Nostrand Company, Inc., 1965.

12. Ramsey, William L. and Burckley Raymond E. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1961.

13. Smith, Paul E. Our Environment-How We Adapt Ourselves To It. Boston: Allyn and Bacon, Inc., 1963.

14. Temperature, Pressure, and the Wind. Glendale, California: Aviation Book Company, 1966.

15. Wolfe, C. Wroe; Battan, Louis J.; Fleming, Richard H.; Hawkins, Gerald S.; and Skornik, Helen. Earth and Space Science. Boston: D. C. Heath and Company, 1966.

TEACHING AIDS

1. Rain gauge
2. Chalk-markable weather map
3. Thermometers: maximum, minimum and standard
4. Sling psychrometer
5. Wind speed and direction indicator
6. Recording barometer

Objective	Text	References	Experiments	Demonstrations	Projects	Reports	Field Trip	Films	Transparencies	Slides, Filmstrips	[illegible]	
1	#1 pp. 128-133 #2 pp. 141-144	#7 p. 102 #10 p. 7 #11 pp. 403-411 #12 pp. 101-106 #15 pp. 136-153	5,29,30	5,7	5	3		8,9,12	6			
2	#1 pp. 279-282 #2 pp. 178-180	#3 pp. 161-165 #4 p. 224 #7 p. 104 #10 pp. 12-13 #11 pp. 458-459, 468-469, 5[illegible] #12 p. 519 #13 p. 45 #15 pp. 347-358	1,[illegible],11, 12,13, 15,22,23, 24,25,26, 28,35,38, 39	6	3,5,10	3,6		8,9	1,3,5,7, 6	3	4,5, 10,11	
3	#1 pp. 175-176 #2 pp. 154-156	#3 pp. 132-135 #5 pp. 14-16 #8 pp. 1-3 #10 p. 9 #11 pp. 432-435 #12 pp. 498-507 #13 pp. 46-48 #15 pp. 353-354	7		7			8,9,13	6	1,3	2,10	
4	#1 pp. [illegible]89 257-265 264 #2 pp. 187-190 130-131 123-125 #3 pp. 81-89	#3 pp. 168-174 #4 pp. 120-128 #5 pp. 224-228 #7 pp. 112-117 #8 pp. 4-8, 9-15, 29-32 #10 pp. 21-25 #11 pp. 31-35 #12 pp. 504-507 #13 pp. 25-52 #15 pp. 360-374	3,4,7,8, 9,12,16, 19,20,21, 22,31,32, 34,35,36, 37,38,39	2	3,7	6		8,9	1,4,6		1,2,3	1,5,[illegible] 6,[illegible]
5	#1 p. 296	#1 pp. 430-432 #5 pp. 422-423 #7 pp. 117,121 #10 pp. 32-35 25 #11 pp. 379,505 #12 p. 558 #13 pp. 106-108 #15 pp. 370-371	24			6,8,9		8,9	6			
6	#1 p. 290 #2 pp. 192-195 171-184	#3 pp. 150-152 #7 pp. 106-107 #8 pp. 13-28 #10 pp. 10-13 #11 pp. 456-475 #12 pp. 513-521 #14 pp. 1-8 #15 374-389	1,2,6,33					3,5,8, 9,11	1,6	3	11	

Objective	Text	Reference	Experiences	Demonstrations	Projects	Reports	Field Trips	Film	Transparencies	Slides & Filmstrips	Activity	
7	#2 pp. 122, 219-224	#3 pp. 153-156 #7 p. 109 #8 pp. 58-61 #10 pp. 17-20 #11 pp. 482-486 #12 pp. 527-531 #13 pp. 11-15 #15 pp. 416-429	2,10,11, 13,16, 17,26	3	4	1		1,2,8,9	1,2,6	1,2	3,9	
8	#1 pp. 291-293 #2 pp. 174-181	#1 pp. 1-11 #3 p. 161 #5 p. 229 #8 pp. 62-72 #10 pp. 14-16 #11 pp. 502-505 #15 pp. 391-393		8	3,8	1		8,9	6		7	2
9	#1 pp. 291-293 #2 pp. 205-208	#7 p. 107 #8 pp. 73-90 #10 pp. 15-16 #11 pp. 506-511 #12 pp. 540-544 #13 pp. 55-56 #15 pp. 393-395		1	2,3,8	1		8,9	1,6	1	6,7,8	2
10	#1 pp. 293-295 #2 pp. 208-217	#2 pp. 1-8 #3 pp. 174-179 #7 p. 120 #8 pp. 184-196 #10 p. 30 #11 pp. 460,487 #12 pp. 559-562 #15 pp. 395-400	5		1,6,11	7,5	1,2,3	6,8,9, 14	1,6	3		
11	#1 pp. 293-295 #2 pp. 208-217	#2 pp. 1-8 #3 pp. 174-179 #7 pp. 118-121 #8 pp. 184-196, 162-183 #10 pp. 29-31 #11 pp. 521-529 #12 p. 562 #13 pp. 103-116 #15 pp. 397-400	5		1,6,11	7,5	1,4,2, 3	6,8,9, 14	1,6	3		1,2,3,
12		#6 pp. 1-8 #8 pp. 197-205, 162-183 #9 pp. 1-6			6	7,5	1,2,3	8,9	6	3	14	
13	#8 pp. 205-209 #9 pp. 6-8					7,5	1,2,3	8,9	6	3	14	
14	#1 pp. 296-298 #2 pp. 198-202 pp. 218-224	#3 pp. 157-160 #5 p. 230 #8 pp. 92-111, 226-258 #10 pp. 39-41 #11 pp. 517-521 #12 pp. 546-550 #13 pp. 82-83 #15 pp. 402-415	14,27	4	8,9	2,4,5		4,5,7, 8,9,10	6			