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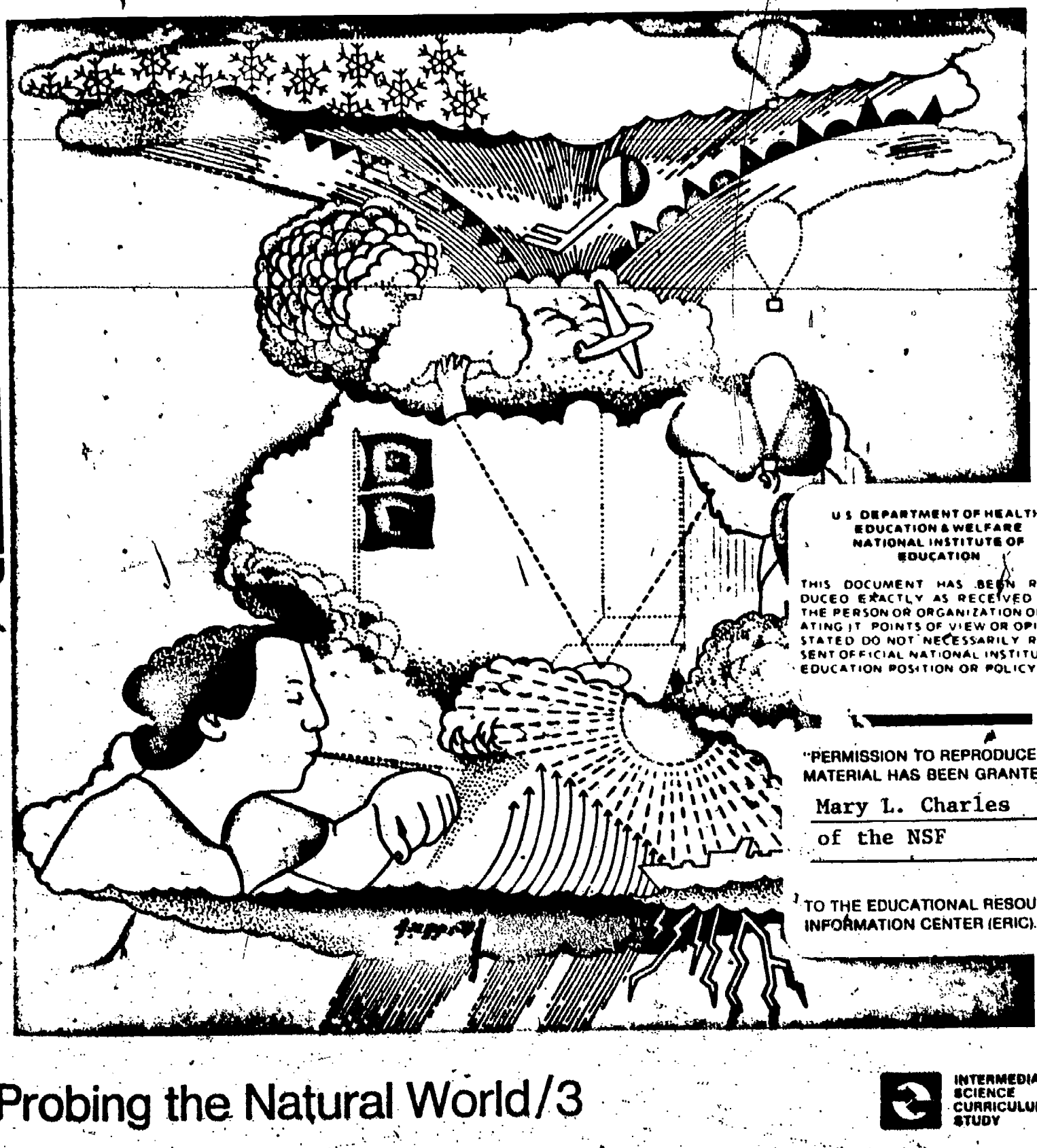
ABSTRACT

This is the teacher's edition of the Record Book for the unit "Winds and Weather" of the Intermediate Science Curriculum Study (ISCS) for level III students (grade 9). The correct answers to the questions from the student text are recorded. An introductory note to the teacher explains how to use the book. Answers are included for the activities and excursions. A self evaluation section is followed by its answer key. (SA)

Record Book

TEACHER'S EDITION

Winds and Weather



Probing the Natural World/3

INTERMEDIATE SCIENCE CURRICULUM STUDY

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INTERMEDIATE SCIENCE CURRICULUM STUDY TEACHER'S EDITION

Record Book

Winds and Weather

Probing the Natural World / Level III

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GENERAL LEARNING CORPORATION
Morristown, New Jersey · Park Ridge, Ill. · Palo Alto · Dallas · Atlanta

ISCS PROGRAM

LEVEL I
Probing the Natural World / Volume 1 / with Teacher's Edition
Student Record Book / Volume 1 / with Teacher's Edition
Master Set of Equipment / Volume 1
Test Resource Booklet

LEVEL II
Probing the Natural World / Volume 2 / with Teacher's Edition
Record Book / Volume 2 / with Teacher's Edition
Master Set of Equipment / Volume 2
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LEVEL III
Why You're You / with Teacher's Edition
Record Book / with Teacher's Edition / **Master Set of Equipment**
Environmental Science / with Teacher's Edition
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Record Book / with Teacher's Edition / **Master Set of Equipment**
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Foreword

A pupil's experiences between the ages of 11 and 16 probably shape his ultimate view of science and of the natural world. During these years most youngsters become more adept at thinking conceptually. Since concepts are at the heart of science, this is the age at which most students first gain the ability to study science in a really organized way. Here, too, the commitment for or against science as an interest or a vocation is often made.

Paradoxically, the students at this critical age have been the ones least affected by the recent effort to produce new science instructional materials. Despite a number of commendable efforts to improve the situation, the middle years stand today as a comparatively weak link in science education between the rapidly changing elementary curriculum and the recently revitalized high school science courses. This volume and its accompanying materials represent one attempt to provide a sound approach to instruction for this relatively uncharted level.

At the outset the organizers of the ISCS Project decided that it would be shortsighted and unwise to try to fill the gap in middle school science education by simply writing another textbook. We chose instead to challenge some of the most firmly established concepts about how to teach and just what science material can and should be taught to adolescents. The ISCS staff have tended to mistrust what authorities believe about schools, teachers, children, and teaching until we have had the chance to test these assumptions in actual classrooms with real children. As conflicts have arisen, our policy has been to rely more upon what we saw happening in the schools than upon what authorities said could or would happen. It is largely because of this policy that the ISCS materials represent a substantial departure from the norm.

The primary difference between the ISCS program and more conventional approaches is the fact that it allows each student to travel

at his own pace, and it permits the scope and sequence of instruction to vary with his interests, abilities, and background. The ISCS writers have systematically tried to give the student more of a role in deciding what he should study next and how soon he should study it. When the materials are used as intended, the ISCS teacher serves more as a "task easer" than a "task master." It is his job to help the student answer the questions that arise from his own study rather than to try to anticipate and package what the student needs to know.

There is nothing radically new in the ISCS approach to instruction. Outstanding teachers from Socrates to Mark Hopkins have stressed the need to personalize education. ISCS has tried to do something more than pay lip service to this goal. ISCS' major contribution has been to design a system whereby an average teacher, operating under normal constraints, in an ordinary classroom with ordinary children, can indeed give maximum attention to each student's progress.

The development of the ISCS material has been a group effort from the outset. It began in 1962, when outstanding educators met to decide what might be done to improve middle-grade science teaching. The recommendations of these conferences were converted into a tentative plan for a set of instructional materials by a small group of Florida State University faculty members. Small-scale writing sessions conducted on the Florida State campus during 1964 and 1965 resulted in pilot curriculum materials that were tested in selected Florida schools during the 1965–66 school year. All this preliminary work was supported by funds generously provided by The Florida State University.

In June of 1966, financial support was provided by the United States Office of Education, and the preliminary effort was formalized into the ISCS Project. Later, the National Science Foundation made several additional grants in support of the ISCS effort.

The first draft of these materials was produced in 1968, during a summer writing conference. The conferees were scientists, science educators, and junior high school teachers drawn from all over the United States. The original materials have been revised three times prior to their publication in this volume. More than 150 writers have contributed to the materials, and more than 180,000 children, in 46 states, have been involved in their field testing.

We sincerely hope that the teachers and students who will use this material will find that the great amount of time, money, and effort that has gone into its development has been worthwhile.

Tallahassee, Florida
February 1972

The Directors
INTERMEDIATE SCIENCE CURRICULUM STUDY

Contents

Notes to the Student

This Record Book is where you should write your answers. Try to fill in the answer to each question as you come to it. If the lines are not long enough for your answers, use the margin, too.

Fill in the blank tables with the data from your experiments. And use the grids to plot your graphs. Naturally, the answers depend on what has come before in the particular chapter or excursion. Do your reading in the textbook and use this book only for writing down your answers.

Notes to the Teacher

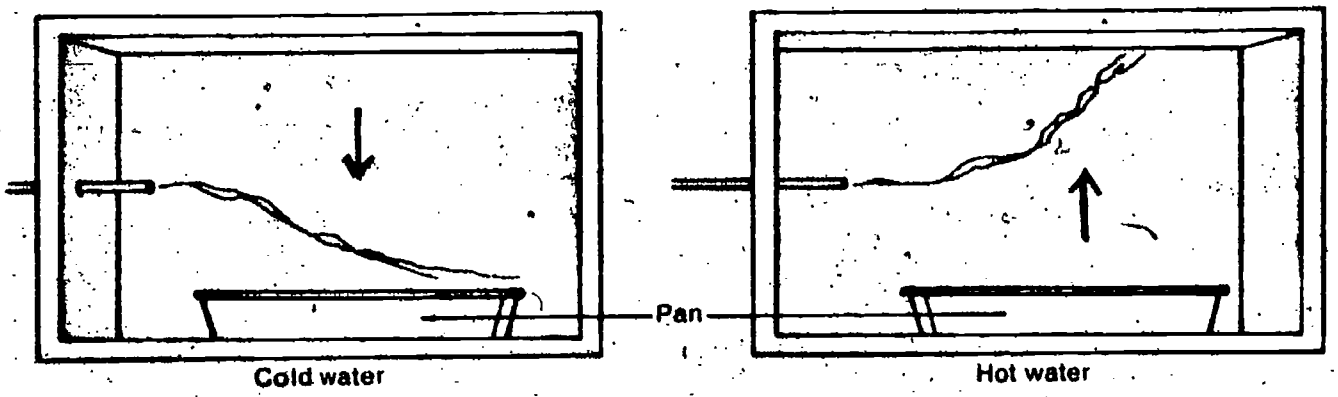
In almost every instance, variable answers are of a quantitative nature and are based on measurements the students themselves make. In these cases, other answers may also be accepted.

☐**1-1.** The smoke sank (went down toward the water).

☐**1-2.** The smoke rose (went up over the water).

☐**1-3.** Because there was a change in motion (or a change in the shape of the smoke stream).

☐**1-4. Figure 1-1**



☐**1-5.** The air is sinking (going down) over the cold surface.

☐**1-6.** The side with the heated air went up. After it had cooled sufficiently, it went back down slowly.

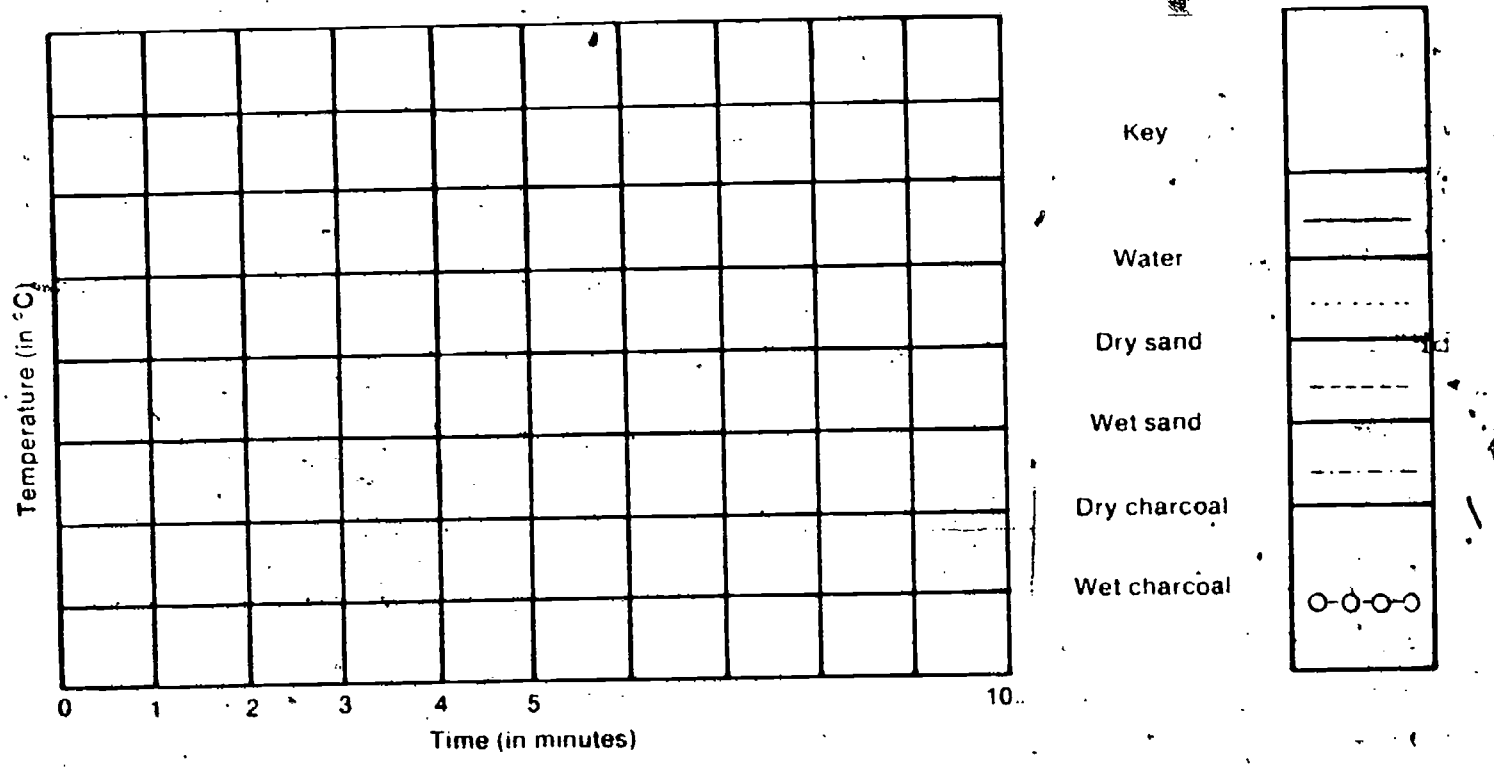
☐**1-7.** The bag of cool air.

☐ 1-8. The bag with the cool air

Table 1-1

Material	Light Off at Beginning of Experiment	Light Turned On			Light Off After 5 Minutes Cooling
		After 1 Minute	After 3 Minutes	After 5 Minutes	
	THERMOMETER READING (°C)				
Water					
Dry sand					
Wet sand					
Dry charcoal					
Wet charcoal					

FIGURE 1-4



☐1-9. Dry charcoal; dry charcoal

☐1-10. Wet charcoal

☐1-11. Yes

☐1-12. No

☐1-13. Dry charcoal

PROBLEM BREAK 1-1

Does air over different surfaces get hotter?
Plan:

Data:

Conclusions:

☐1-14. Yes

☐1-15. Air rises over a warm surface and sinks over a cool surface. When the glider flies into the area over the worm roofs, it goes up with the rising air. When it flies over the cool trees, it goes down with the sinking air. It goes up over the warm garden and down over the cool pond.

Chapter 2
Weather Watch

Table 2-1

1st Week	Weather-Watch Chart				
1. Date					
2. Time of day					
3. Temperature (°C)					
4. Wind direction					
5. Wind speed (mph)					
6. Cloud type					
7. Cloud cover					
8. Precipitation (in inches)					
9. Barometric pressure (in inches)					
10. Relative humidity					
11. Dew point (°C)					

Table 2-1

2nd Week	Weather-Watch Chart				
1. Date					
2. Time of day					
3. Temperature (°C)					
4. Wind direction					
5. Wind speed (mph)					
6. Cloud type					
7. Cloud cover					
8. Precipitation (in inches)					
9. Barometric pressure (in inches)					
10. Relative humidity					
11. Dew point (°C)					

Table 2-1

3rd Week Weather-Watch Chart

1. Date					
2. Time of day					
3. Temperature (°C)					
4. Wind direction					
5. Wind speed (mph)					
6. Cloud type					
7. Cloud cover					
8. Precipitation (in inches)					
9. Barometric pressure (in inches)					
10. Relative humidity					
11. Dew point (°C)					

Table 2-1

4th Week	Weather-Watch Chart				
1. Date					
2. Time of day					
3. Temperature (°C)					
4. Wind direction					
5. Wind speed (mph)					
6. Cloud type					
7. Cloud cover					
8. Precipitation (in inches)					
9. Barometric pressure (in inches)					
10. Relative humidity					
11. Dew point (°C)					

Chapter 3 Concentrating on Ups

☐**3-1.** It is deflected upward (it rises).

☐**3-2.** It is deflected downward (it sinks).

☐**3-3.** Cube A

☐**3-4.** The temperature would decrease (fall).

PROBLEM BREAK 3-1

How does air temperature vary with altitude?
Plan:

Data:

Conclusions:

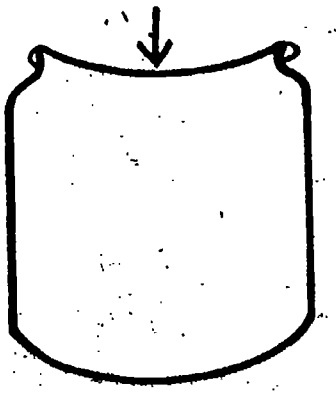


FIGURE 3-7

☐**3-5.** Cube A

☐**3-6.** Cube A

☐**3-7.** The balance arm with the inflated balloon went down. This means that the inflated balloon has more mass. The air in the balloon must have supplied the additional mass.

☐**3-8.** Cube A

☐**3-9.** The air pressure on cube B is less than on cube A.

☐**3-10.** It would bulge inward.

☐**3-11.** The pointer will move down.

☐**3-12.** Observe the pointer on the pressure measuring instrument over a period of time. Movement of the pointer shows changing atmospheric pressure, and the amount of movement shows how much change.

☐**3-13.** Yes. The pointer moved down.

☐**3-14.** Yes.

☐**3-15.** A decrease in air pressure

☐**3-16.** It should make the pointer move up.

PROBLEM BREAK 3-2

Effect of decreasing jar temperature on the pointer
Plan:

Data:

Conclusions:

☐**3-17.** The pointer moves up.

☐**3-18.** (Answers depend on atmospheric pressure.)

☐**3-19.** Yes. There is less air above the mountain top, so there would be less atmospheric pressure there than at sea level, and the barometer would show a lower reading.

PROBLEM BREAK 3-3

Calibrating the jar barometer

Chapter 4 Making Visible the Invisible

☐**4-1.** A film of moisture formed.

☐**4-2.** Moisture was forming out of the air on the cold container.

☐**4-3.** Moisture on the outside of a glass of ice water; moisture on a cold bottle of soft drink; moisture forming around the door of a refrigerator; moisture on the cold air duct of an air conditioner

☐**4-4.** Out of air

☐**4-5.** No

Table 4-1

Trial	Room Temp. (°C)	Temperature When Film of Moisture Forms (°C)
1		
2		
3		
Average		

☐**4-6.** (Depends on the humidity.)

☐**4-7.** It would have turned to frost (ice particles).

☐**4-8.** Warm air

☐**4-9.** The air contains half the water vapor it could hold at that temperature.

☐**4-10.** 20%

☐**4-11.** (Temperatures depend on local conditions.)

☐**4-12.** (Difference depends on local conditions.)

☐**4-13.** Find the difference in the wet- and dry-bulb thermometer readings with a psychrometer. Use the dry-bulb temperature and the difference in wet- and dry-bulb temperatures in the table to read relative humidity.

☐**4-14.** (Depends on local conditions.)

☐**4-15.** 100%

☐**4-16.** The same temperature as that of the wet- and dry-bulb thermometers

☐**4-17.** Find the difference in the wet- and dry-bulb thermometer readings with a psychrometer. Use this difference and the dry-bulb temperature in the table to read the dew point; or find the temperature at which condensation first appears on the outside of a polished container as the temperature inside is slowly lowered.

☐**4-18.** Because the temperature must be low enough for condensation to occur, and temperature normally decreases with altitude.

☐**4-19.** Visible water particles (clouds) would form.

Table 4-4

	Observations
1. Jar 1, with cold water	
2. Jar 2, with hot water	
3. Jar 2, with hot water and smoke	

☐**4-20.** Yes

☐**4-21.** The temperature decreases (falls, drops).

Chapter 5 More Reasons for Clouds

☐**5-1.** It expands with decreasing pressure; its density decreases.

☐**5-2.** Yes (probably)

☐**5-3.** (Depends on local conditions.)

☐**5-4.** A mist (fog, cloud) formed.

☐**5-5.** A heavier mist (fog, cloud) formed.

☐**5-6.** The mist (fog, cloud) disappeared.

☐**5-7.** It would aid cloud formation.

PROBLEM BREAK 5-1

What are the effects of changing air pressure and temperature at the same time?
Plan:

Teacher approval

Data:

Conclusions:

☐**5-8.** Yes. Air over land heats more rapidly during the daytime than air over water. This heated air rises, and the moisture in it condenses to form clouds.

☐**5-9.** Over land

☐**5-10.** Over land

☐**5-11.** The smoke moves horizontally toward the candle flame, and then rises toward the hole.

☐**5-12.** Cool moist air will flow in to take the place of the warm air that is rising.

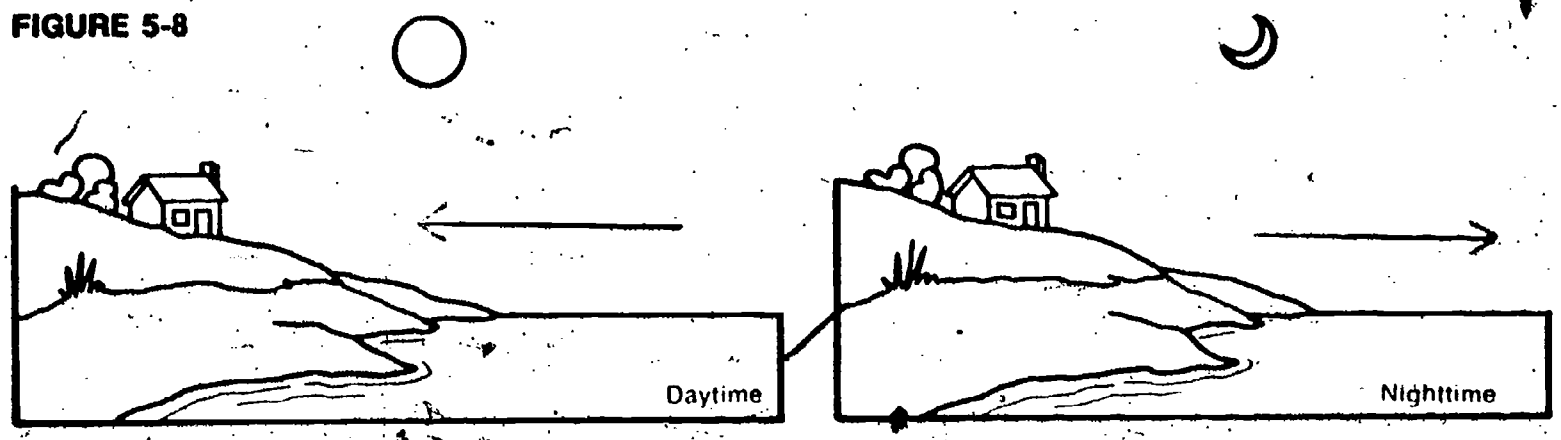
☐**5-13.** It is heated also, and rises.

☐**5-14.** Yes

PROBLEM BREAK 5-2

What is the direction of the wind during the day and during the night around a large body of water?

FIGURE 5-8



☐**5-15.** The air over the land is heated during the daytime more than the air over the water. It rises, and cooler air from the water takes its place. At night, the land loses its heat more rapidly than the water, so air over the land becomes cooler. The warmer air over the lake rises and cooler air flows from the land to take its place.

Chapter 6 Other Cloud Formers

☐**6-1.** Highest barometric pressure—A12, A14 (30.20″)

Highest wind velocity—F5, I3, J5 (13–18 mph)

Lowest barometric pressure—H5, H6, J5 (29.40″)

Highest temperature—A7 (26° C or 79° F)

Lowest temperature—H1 (3° C or 37° F)

☐**6-2.** Greatest cloudiness occurs where temperature differences are greatest, where pressure is lowest, where wind speed is greatest, and where wind direction changes most abruptly.

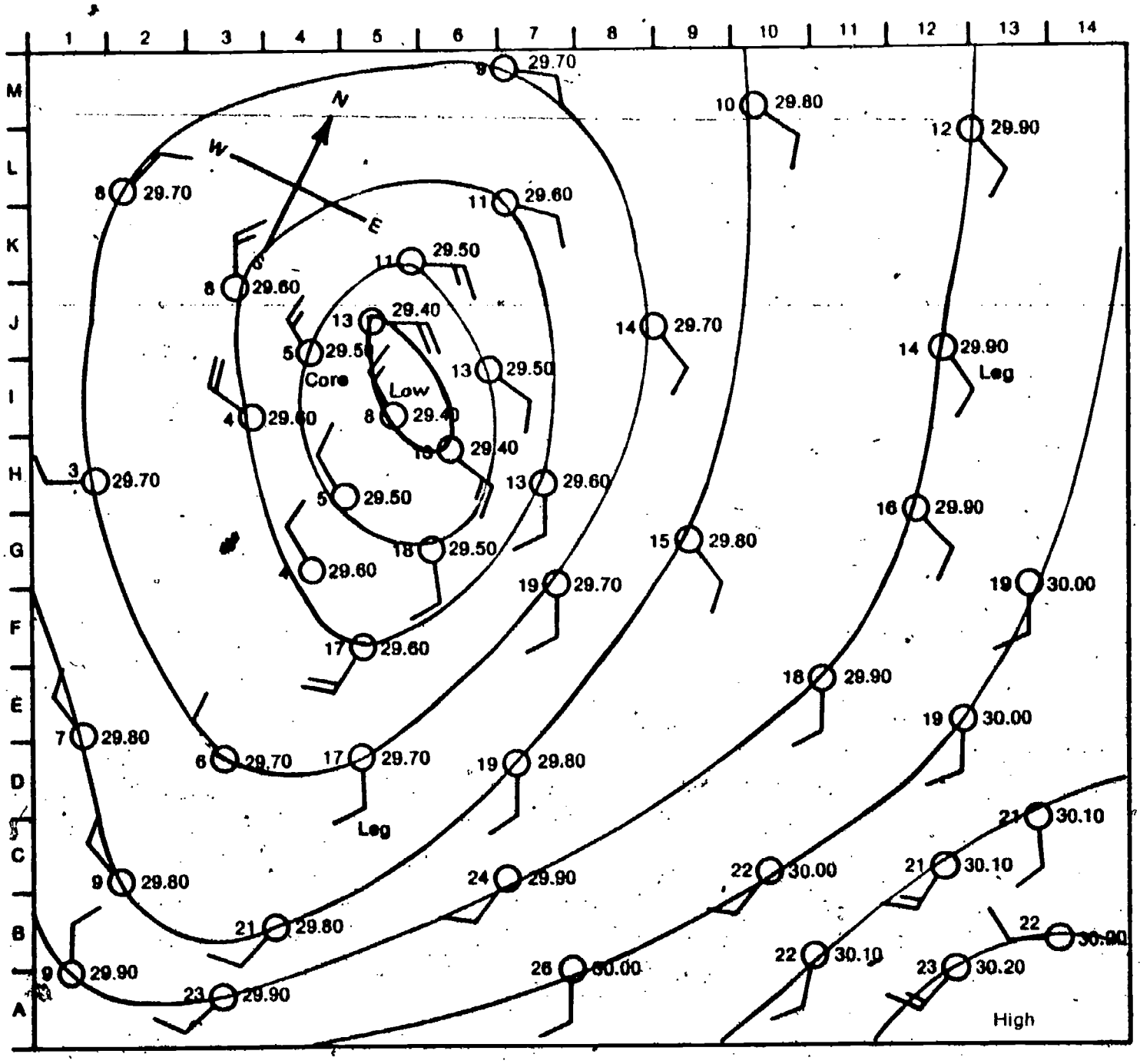
☐**6-3.** Temperatures are lower on the western side.

☐**6-4.** Temperatures are lower on the northern side.

☐**6-5.** There is a greater difference in temperatures across the legs than elsewhere.

☐**6-6.** Pressure differences

FIGURE 6-4



6-7. The pattern forms an area of decreasing pressures centered about I 5 and 6. Going outward from that area, pressures increase to the highest values in the lower right, at the area A14.

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☐**6-8.** Low

☐**6-9.** The wind direction forms a counterclockwise pattern around the low.

☐**6-10.** The spiral shape seems to generally follow the wind directions.

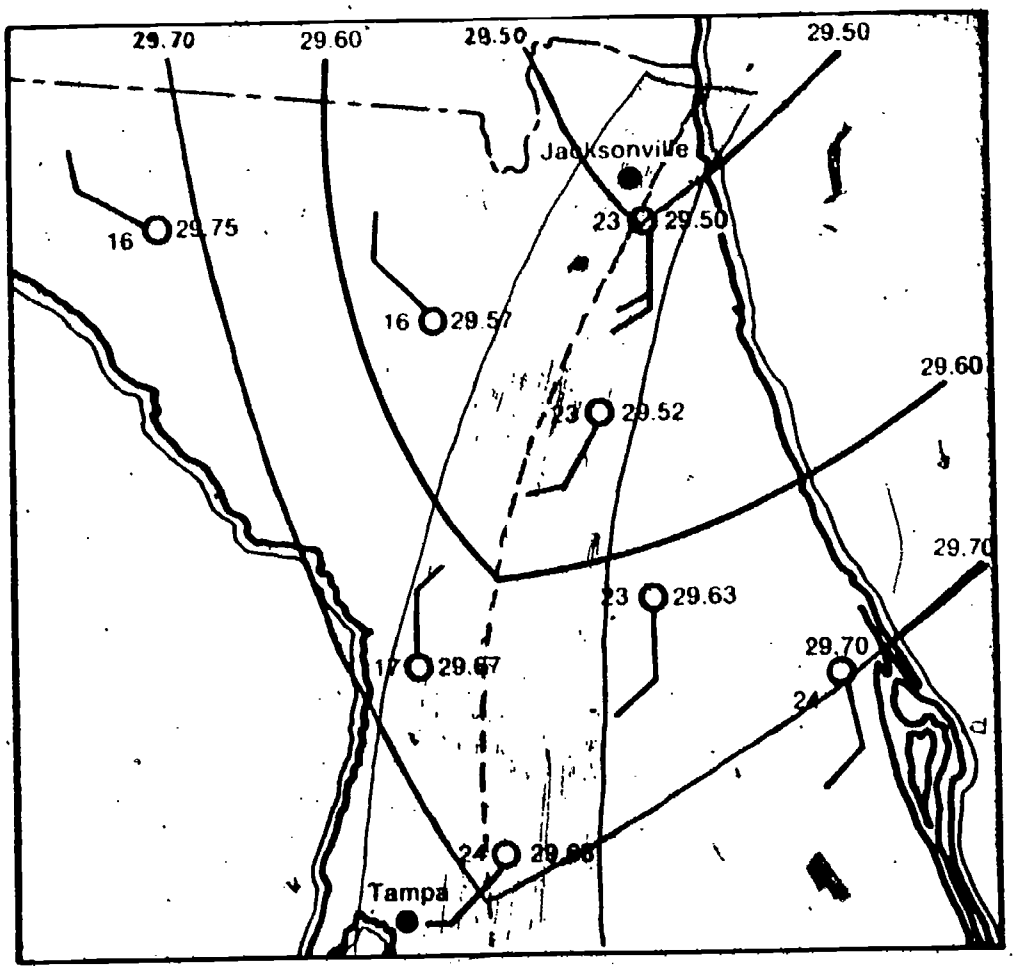
☐**6-11.** The flow of air is counterclockwise.

☐**6-12.** Clouds in general seem to center over areas of lowest pressure and along lines of sharp temperature differences.

☐**6-13.** Yes.

PROBLEM BREAK 6-1

FIGURE 6-9



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☐**6-14.** It would be cooled, pressure would be reduced, and condensation (clouds) should occur.

☐**6-15.** More precipitation (rain) falls there.

PROBLEM BREAK 6-2

Iggyville should have pleasant weather, with moderate rainfall, periods of cloudy and clear skies.

Iggyburg should have the poorest weather, with heavy rainfall, much cloudiness, little sunshine.

Iggytown should have dry weather, little or no rainfall, cloudless skies. The temperature at Iggytown should be much warmer, due to the heating of the air as it comes down the mountain.

Chapter 7
Moving Weather

☐**7-1.** Yes. From west to east.

☐**7-2.** Yes. From west to east.

☐**7-3.** It fell, then rose.

☐**7-4.** SE to S to N

☐**7-5.** Clear to cloudy to partly cloudy

☐**7-6.** Observations of falling barometric pressure, increasing cloudiness, shifting wind direction

☐**7-7.** Cooler

☐**7-8.** It rose sharply as the temperature line passed.

☐**7-9.** SW to S to W

☐**7-10.** Clear to cloudy to partly cloudy

☐**7-11.** Shift in wind direction, increasing cloudiness, and falling barometer reading

☐**7-12.** The temperatures behind the line (to the west) are lower than the temperatures ahead of the line (to the east) in Selma; the opposite is true in Fargo.

☐**7-13.** Clear to partly cloudy to cloudy to clear

☐**7-14.** SW to S to N

☐**7-15.** It dropped.

☐**7-16.** They dropped, then rose.

☐**7-17.** Falling barometer reading, increasing cloudiness, wind from the SW and S

☐**7-18.** Yes, they go through the centers of the low-pressure areas.

☐**7-19.** Yes

☐**7-20.** Cumulus and cumulonimbus

☐**7-21.** Cirrus, cumulus, stratus

Table 7-1

	COLD FRONT		
	Immediately Ahead of the Front	Along the Front	Immediately Behind the Front
Barometric reading	Falling	Lowest	Rising
Temperature	High	Dropping	Low
Cloudiness	Increasing	Cloudy	Clearing
Wind direction	Southerly	Shifting	Northerly

Table 7-2

	WARM FRONT		
	Ahead of the Front	Along the Front	Behind the Front
Barometric reading	Falling	Lowest	Rising
Temperature	Low	Rising	High
Cloudiness	Increasing and lowering	Heavy clouds	Clearing
Wind direction	Southerly	Shifting	Westerly

PROBLEM BREAK 7-1

How are two weather variables related?
Plan:

Tally Table:

Percentage (Probability):

Conclusions:

☐ 7-22. The weatherman is expressing a probability based on the observations of all the weather variables. Considering all the changing conditions, he is saying that 3 times out of ~~10 they result in rain at~~ a particular location.

Excursions

Excursion 1-1 Hot Air Balloon

☐1. (Answers will vary, but they should describe the puffing out of the bag and the increasing buoyancy.)

☐2. Continue to supply hot air to make up for losses and cooling.

Excursion 2-2 Billboards of the Sky

☐1. Because a cirrus cloud is already the highest type

☐2. (Answers at end of excursion.)

Excursion 2-3 The Conversion Excursion

☐1. 100 Celsius degrees

☐2. 180 Fahrenheit degrees

☐3. 50°C

☐4. 10 degrees on the Celsius scale

☐5. 16 km/hr; 32 km/hr; 40 km/hr

☐6. 120 km/hr (actually 120.7 km/hr)

☐7. 40 mph (actually 39.8 mph)

☐8. 6.35 cm

Excursion 3-1 The Pressure's On

CHECKUP:

1. **a.** 7 pounds (____) **d.** 4 square inches (____)
   b. 9 newtons (____) **e.** 8 newtons per square meter (✓)
   c. 6 pounds per square inch (✓)

2. A 500-pound metal bar is lying on a bench. The area of the bottom of the bar is 50 square inches. What is the pressure of the bar on the bench? (10 lb sq in)

☐**1.** Because the total weight (force) is spread over a bigger area of snow

☐**2.** 0.5 pounds on each square inch of snowshoe

Excursion 3-2 Measuring Air Pressure . . . in Inches?

☐**1.** 14.7 pounds per square inch

☐**2.** 14.2 pounds per square inch

☐**3.** (Answer depends on local conditions.)

☐**4.** 0.5 inch of mercury.

☐**5.** Fall

Excursion 4-1 The Shivering Thermometer

☐**1.** Before blowing, it felt warm; while blowing it felt cool.

Table 1	Temperature (°C)
Temperature A	
Temperature B	
Temperature C	

☐**2.** Little or no difference if alcohol is at room temperature; possibly 1–2°C.

☐3. Depends somewhat on local conditions; possibly 10-15°C.

☐4. The evaporation of the alcohol from the wick took heat away from the thermometer bulb, cooling it.

☐5. It changed to alcohol vapor.

☐6. The one with the alcohol on it

☐7. The alcohol

☐8. It requires heat energy to evaporate a liquid. This heat energy was furnished partly by your hands, lowering their temperature.

☐9. Because it evaporated faster

Table 2

Condition	Temperature (°C)			
	After 15 sec.	After 30 sec.	After 45 sec.	After 60 sec.
1. Thermometer (on table)	21°	19°	18°	17°
2. Thermometer (waved around)	16°	14°	13°	12°

Table 2. Temperatures are given as examples. Student readings will depend somewhat on local conditions.

☐10. The particle model says that particles are in rapid motion in a liquid. This motion may allow some of them to escape the liquid as a gas. The more of these particles there are in close proximity to the liquid, the less room there is for others to come out. But if the particles in the air around the liquid are removed, then more particles can come out any time. This allows more evaporation and more rapid cooling of the liquid.

☐**11.** It would speed it up.

☐**12.** They would be the same.

Excursion 5-1 How High Are the Clouds?

☐**1.** Because condensation starts when the air gets cold enough, and this happens at a particular altitude.

☐**2.** The bottom

☐**3.** (See answer to question 1.)

☐**4.** 4°C

☐**5.** 4°C

☐**6.** Air temperature

☐**7.** Height = 122 (26°C − 8°C)
= 122 × 18°C
= 2196 m (or 2200 m)

☐**8. Height of clouds today:**
Data:

Method:

Conclusions:

☐**9.** Temperature decreases 1°C per 100 m; this is 0.01°C per m. Dew point decreases 1°C per 550 m; this is 0.0018°C per m. Clouds form

at a height (h) where temperature and dew point are equal. Therefore $T_{air} - 0.01\,h$, the air temperature on the ground minus the decrease with altitude, must equal $T_{d.p.} - 0.0018\,h$, the dew point on the ground minus the decrease with altitude.

$$T_{air} - 0.01\,h = T_{d.p.} - 0.0018\,h$$
$$0.01\,h - 0.0018\,h = T_{air} - T_{d.p.}$$
$$0.0082\,h = T_{air} - T_{d.p.}$$
$$h = \frac{(T_{air} - T_{d.p.})}{0.0082}$$
$$h = 122\,(T_{air} - T_{d.p.})$$

Excursion 5-2 Building a Nephoscope

Table 1

Distance moved by reflection (d)	0.05 meter
Time to move 5 cm (t)	seconds
Height of eye above nephoscope (h)	meters
Estimated height of clouds (H) (See **Excursion 5-1**)	meters

☐**1.** (Depends on observations.)

☐**2.** (Depends on observations.)

☐**3.** (Depends on observations.)

☐**4.** The height of the aircraft and the time it took for the image to move across the radius of the circle

☐**5.** (Answers will vary. Radar would be a big help.)

Excursion 7-1
And the Rains Came Down

☐1. The spray was attracted to the comb.

☐2. They got larger and smaller.

☐3. The electrical charge on the comb attracts the oppositely charged part of the water molecule, moving the molecule toward it. In putting this force on the water molecules, it causes them to come closer together and form into larger drops.

☐4. If electrical forces are present in a cloud, these forces might cause water particles to be pushed together to form raindrops.

Excursion 7-2
Cumulonimbus

☐1. (Depends on observations, but they should have observed changes such as swelling, growth, changing shape, or, if the clouds are dissipating, shrinking and disappearing of parts.)

☐2. (Depends on observations and local conditions.)

☐3. 1:00 PM, 5,000 ft; 1:30 PM, 6,500 ft; 2:00 PM, 8,000 ft.

☐4. About 3,000 ft per hour

☐5. Because a solid object, like an ice particle or hailstone, would fall out of the cloud without a strong updraft. The updrafts carry it through successive trips so that it can build.

☐6. When the downward force of gravity exceeded the upward force of air, or when it got out of the updraft, or when it built up so much speed in the downward trip that it couldn't be overcome by the updraft.

☐1. A cold front

☐2.

Excursion 7-3
Weather Prediction and Forecasting

Table 1

Data	Time	Temp.	Wind Dir.	Wind Speed	Cloud Type	Cloud Cover	Pre-cip.	Bar. Pres.	Rel. Hum.	Dew Point
20	1:30	17°C	S	8–12	Stratus	◯	—	29.90	55%	13°C
21	2:05	20°C	S	8–12	Stratus	◯	—	29.88	83%	18°C
22	1:50	10°C	N	25–31	Cumulo-nimbus	◯	1.5 cm	29.81	100%	10°C
23	1:45	5°C	N	8–12	Clear	◯	—	29.92	29%	−9°C
24	—	—	—	—		—	—	—	—	—

Temperature should rise slightly; humidity should drop; clouds should be partly cloudy (cumulus); wind should be light; precipitation, none.

Activity 1. Three-day forecast of weather
1st day forecast:

2nd day forecast:

3rd day forecast:

	1st day	2nd day	3rd day
1. Cloudiness			
2. Probable wind direction			
3. Probable wind speed			
4. Barometer change			
5. Probable cloud types			
6. Probable temperature range			
7. Precipitation (amount and type)			

Activity 2. (Optional) Extended forecast.
Temperature:

Precipitation:

Movements of fronts through area:

How Well Am I Doing?

You probably wonder what you are expected to learn in this science course. You would like to know how well you are doing. This section of the book will help you find out. It contains a Self-Evaluation for each chapter. If you can answer all the questions, you're doing very well.

The Self-Evaluations are for your benefit. Your teacher will not use the results to give you a grade. Instead, you will grade yourself, since you are able to check your own answers as you go along.

Here's how to use the Self-Evaluations. When you finish a chapter, take the Self-Evaluation for that chapter. After answering the questions, turn to the Answer Key that is at the end of this section. The Answer Key will tell you whether your answers were right or wrong.

Some questions can be answered in more than one way. Your answers to these questions may not quite agree with those in the Answer Key. If you miss a question, review the material upon which it was based before going on to the next chapter. Page references are frequently included in the Answer Key to help you review.

On the next to last page of this booklet, there is a grid, which you can use to keep a record of your own progress.

Notes for the Teacher

The following sets of questions have been designed for self-evaluation by your students. The intent of the self-evaluation questions is to inform the student of his progress. The answers are provided for the students to give them positive reinforcement. For this reason it is important that each student be allowed to answer these questions without feeling the pressures normally associated with testing. We ask that you do not grade the student on any of the chapter self-evaluation questions or in any way make him feel that this is a comparative device.

The student should answer the questions for each chapter as soon as he finishes the chapter. After answering the questions, he should check his answers immediately by referring to the appropriate set of answers in the back of his Student Record Book.

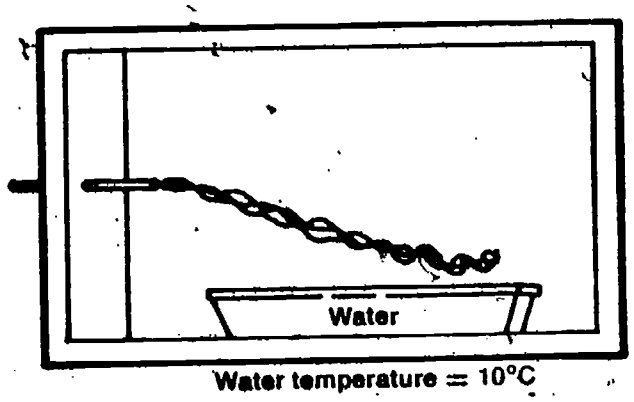
There are some questions that require planning or assistance from the classroom teacher or aide. Instructions for these are listed in color on the pages that follow. You should check this list carefully, noting any item that may require your presence or preparation. Only items which require some planning or assistance are listed.

You should check occasionally to see if your students are completing the progress chart on page 54.

If you did any excursions for this chapter, write their numbers here.

SELF EVALUATION 1

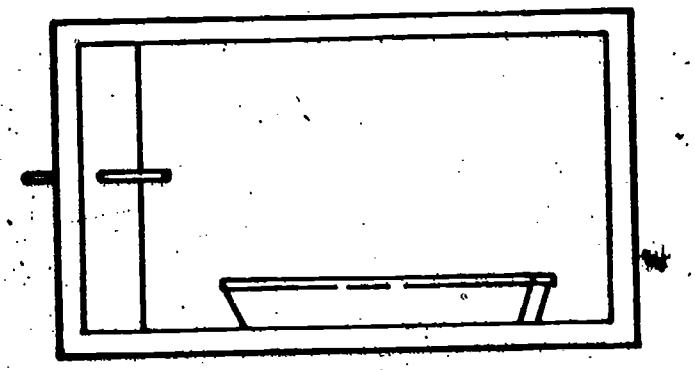
☐ **1-1.** The diagram below shows a sketch that an ISCS student made after using the observation box.



Temperature of air in box = 20°C

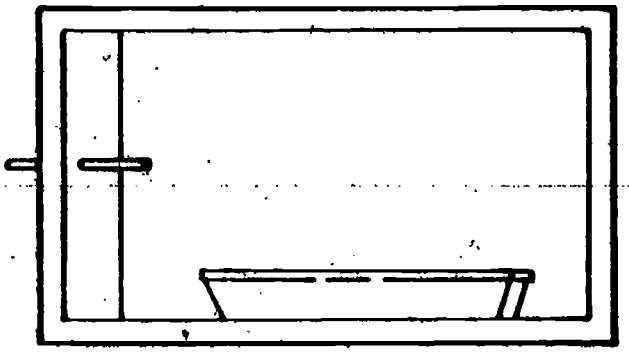
Water temperature = 10°C

A. Sketch the path of the smoke in the box below if the air temperature were 5°C and the water temperature were 15°C.



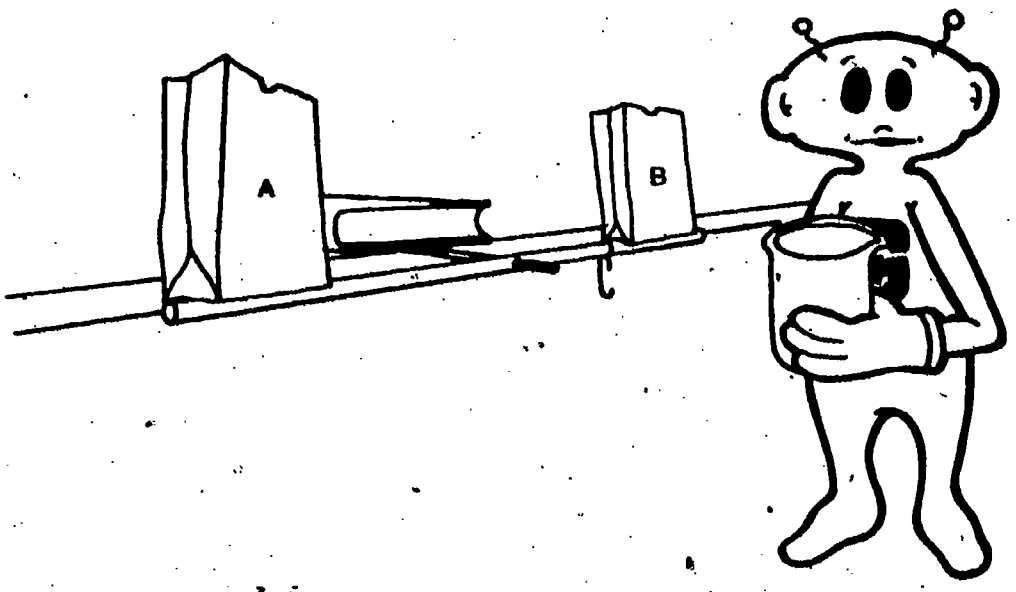
B. Explain your answer to part **A**.

C. Sketch the path of the smoke in the box below if the air temperature were 15°C and the water temperature were 15°C.



D. Explain your answer to part **C**.

☐**1-2.** Iggy has set up the balance that you used in Activities 1-6 and 1-7.. However, he has turned the bags right side up this time.



Iggy has a beaker that has been sitting in the freezer for several hours.

A. What will happen if Iggy inverts the beaker just above bag **B**?

_____

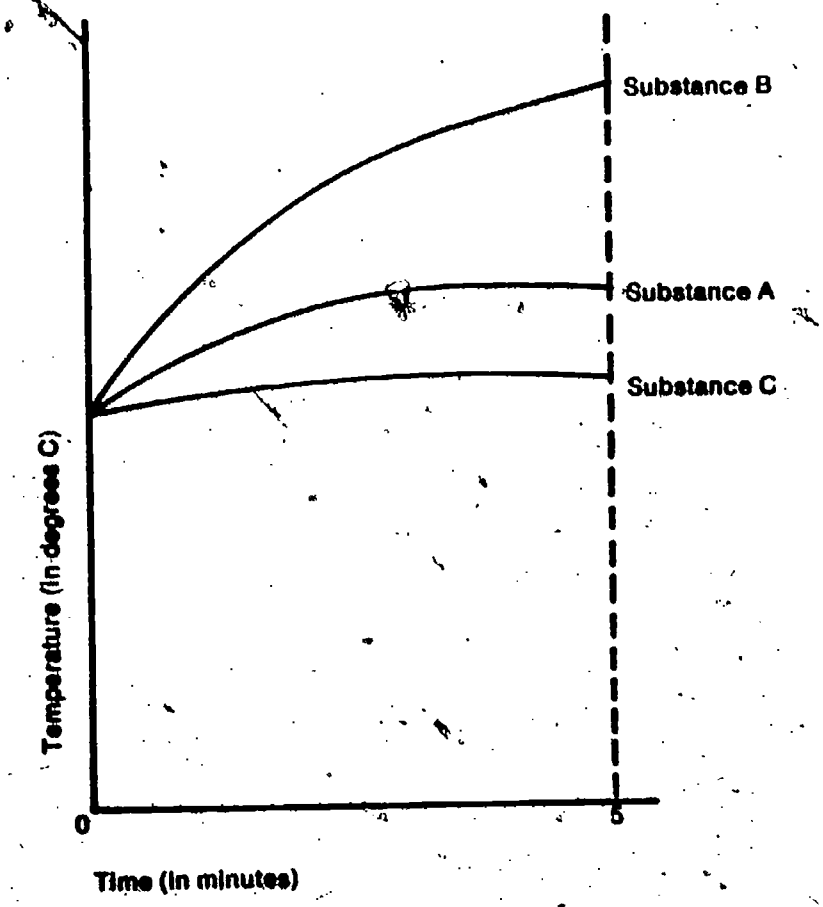
B. Explain your answer to part **A** in terms of the particle model.

_____

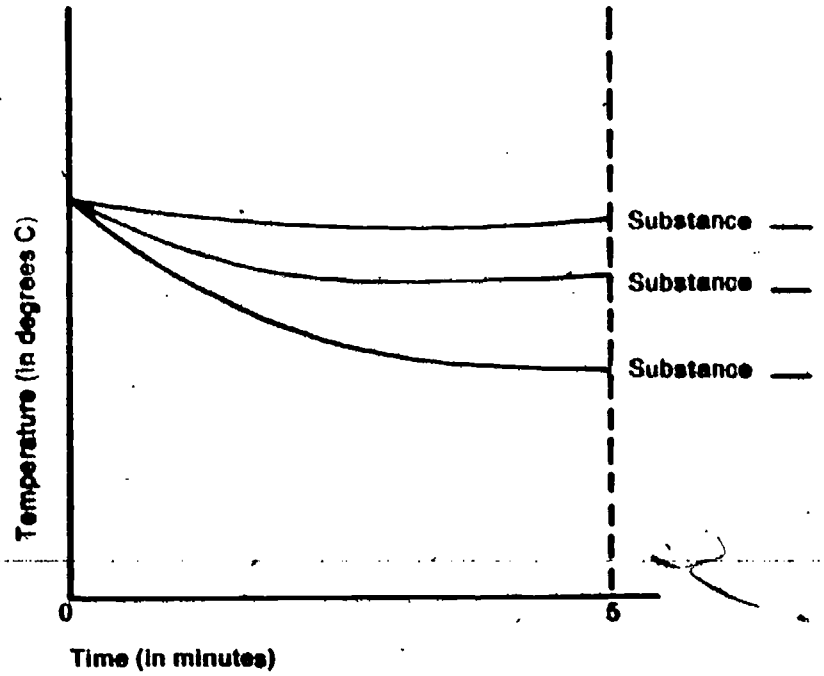
_____

_____

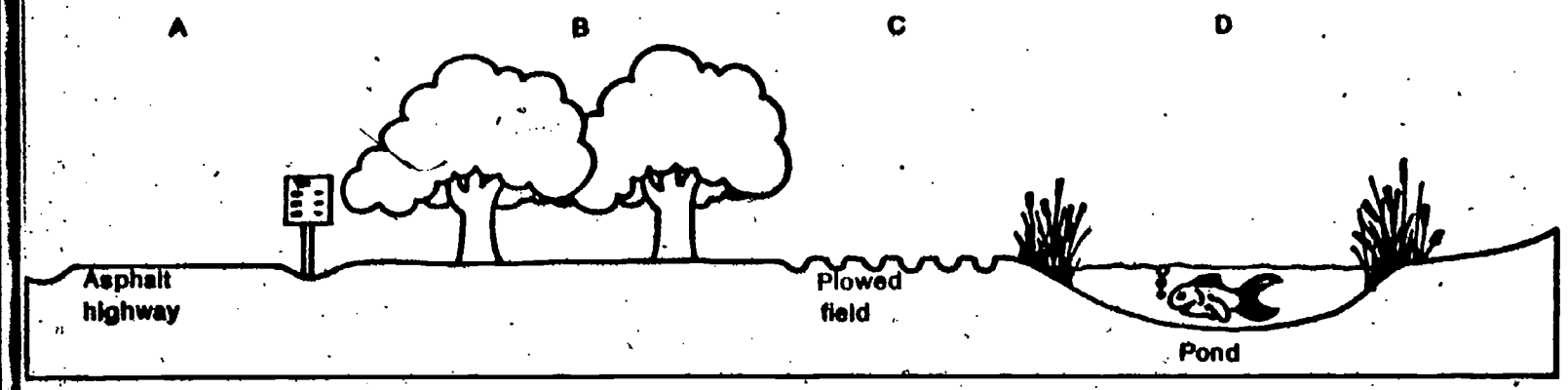
☐**1-3.** Three substances, A, B, and C, were warmed by a lamp in the same way that you warmed up dry sand, dry charcoal, wet sand, wet charcoal, and water. Their warming curves are shown below.



Later these three substances were put in a refrigerator and their temperatures recorded after five minutes. Indicate which of the lines corresponds to each of the substances by filling in the blank beside each curve.



☐**1-4.** Refer to the sketch below to answer parts **A**, **B**, **C**, and **D** that follow.



A. On a warm sunny day, in which of the areas (A through D) would you expect the air to be rising?

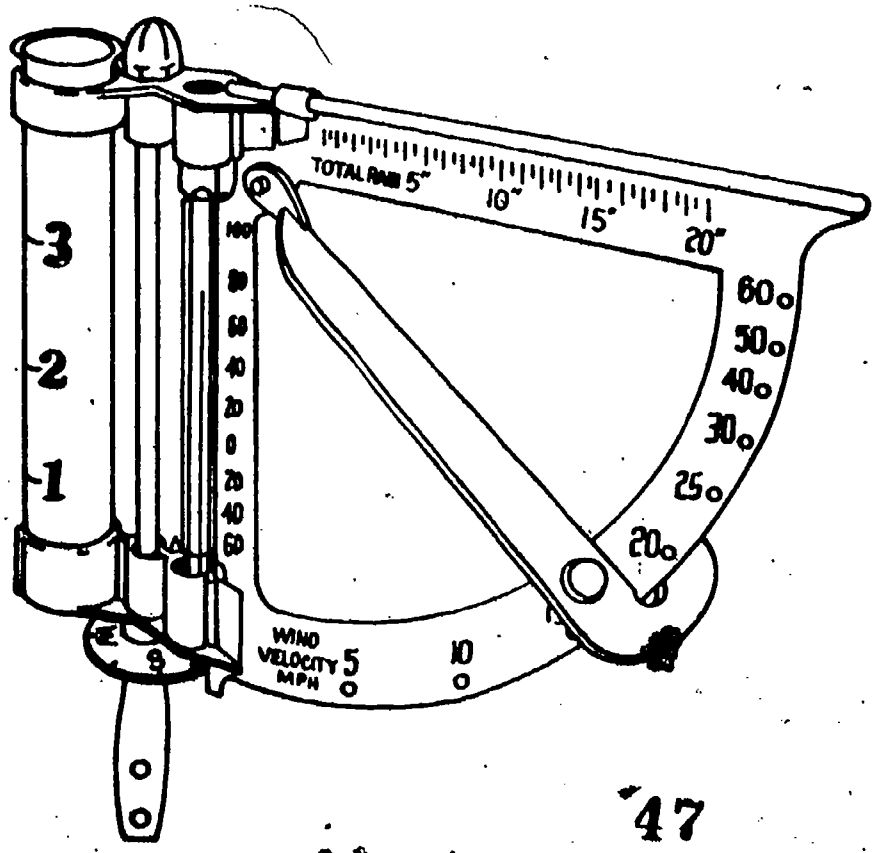
B. Explain your answer to part **A**.

C. On a warm sunny day in which of the areas (A through D) would you expect the air to be moving downward?

D. Explain your answer to part **C**.

If you did any excursions for this chapter, write their numbers here.

☐**2-1** Use the diagram below to answer the questions that follow. (Remember that speed in km/hr = 1.6 × mi/hr.)



A. What is the direction of the wind as indicated by the weather station?

_____

B. What is the speed of the wind (in mph) as indicated by the weather station?

_____

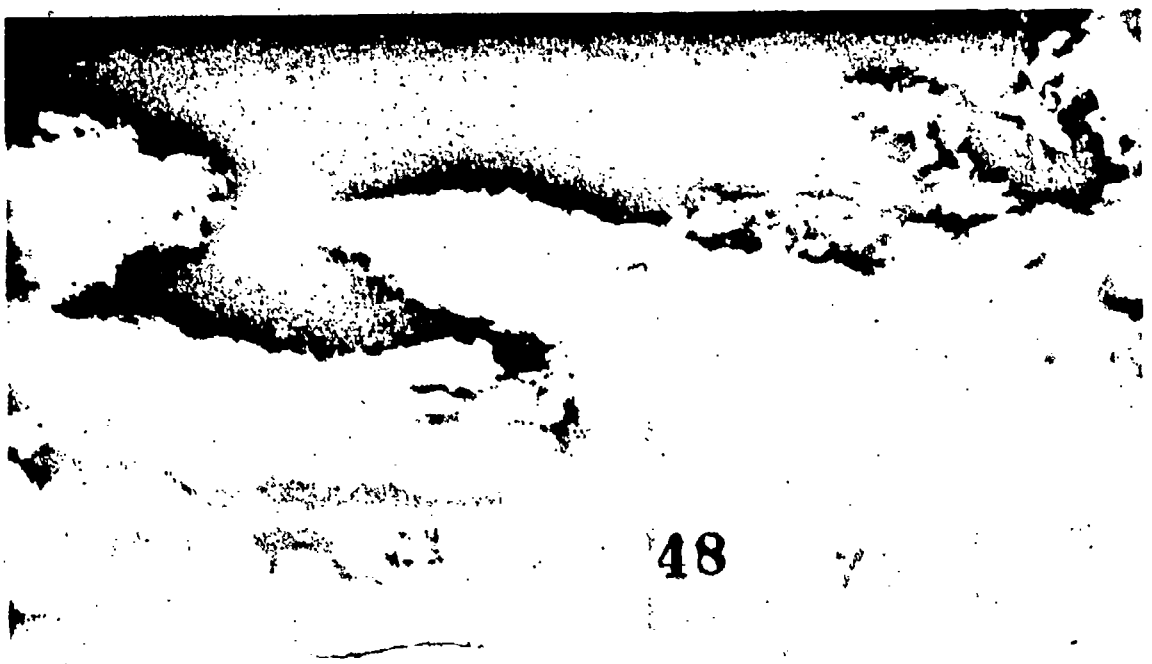
C. What is the speed of the wind (in km/hr) as indicated by the weather station?

_____

☐**2-2.** Use the photographs below to answer the questions that follow.

Photo 1

Photo 2



A. What type of cloud is shown in photo 1?

B. What type of cloud is shown in photo 2?

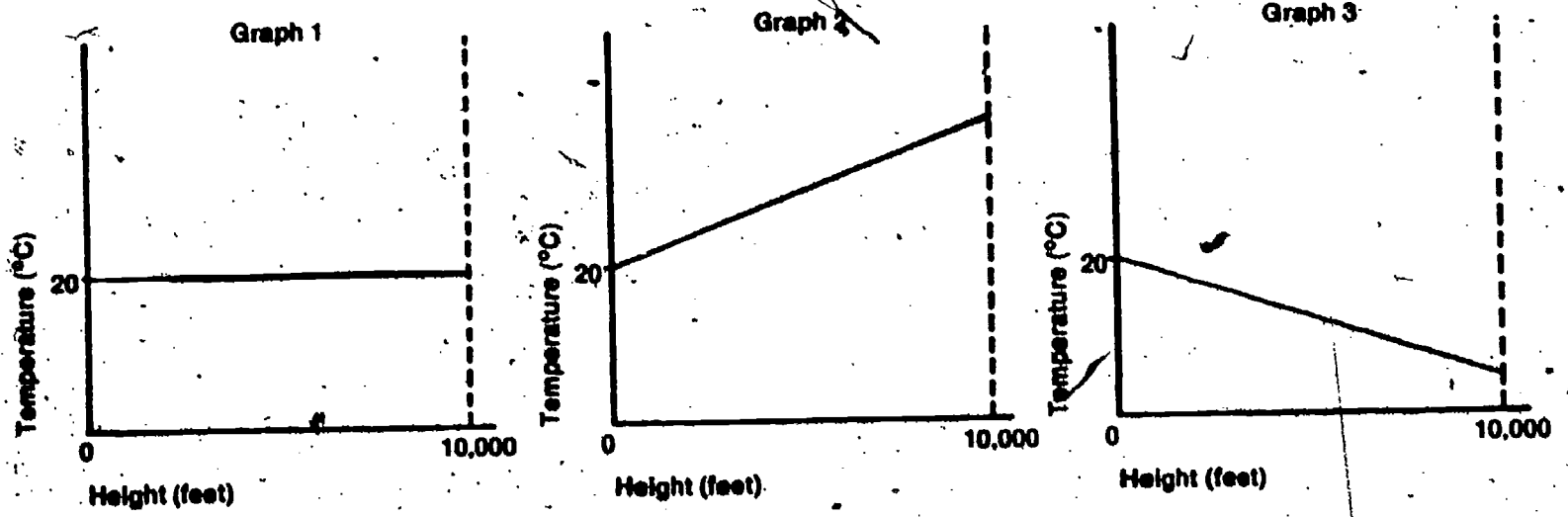
C. Draw the symbol to represent how much of the sky is covered by clouds in Photo 1.

D. Draw the symbol to represent how much of the sky is covered by clouds in photo 2.

☐**2-3.** If 1.5 inches of rain fell overnight, how many centimeters of rain should you record in your Weather Watch Chart? (Remember: 1 inch = 2.54 cm.)

If you did any excursions for this chapter, write their numbers here.

☐**3-1. A.** If you were riding in a small plane and plotted a graph of the temperature outside the plane at different altitudes, which of the following graphs would you expect to look most like yours?

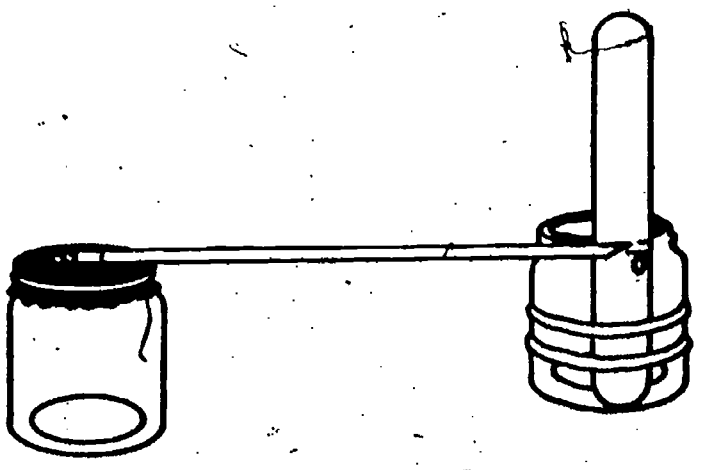


B. Explain your answer to part **A**.

☐**3-2** **A.** Suppose you were a deep-sea diver. As you dive deeper and deeper into the ocean would you expect the pressure to increase, decrease, or remain the same?

B. Explain your answer to part **A**.

☐**3-3.** **A.** An ISCS student built an atmospheric pressure measurer several days ago. Today the pressure measurer looks like the one shown below. Has the air pressure in the room increased, decreased, or stayed the same since he built the pressure measurer?



B. Explain your answer to part **A**.

☐**3-4. A.** On a cool summer morning your family starts on a trip in the car. After driving for several hours over the hot asphalt highway, you stop for lunch. Suppose you had measured the pressure of the air in the car's tires in the morning and again when you stopped for lunch. Would the pressure have increased, decreased, or remained the same?

B. Explain your answer to part **A**.

☐**3-5.** The air pressure at the top of a tall building is 29.4 inches of mercury. What will be the air pressure at street level at that time? (Check the best answer)

____**a.** Greater than 29.4 inches of mercury

____**b.** 29.4 inches of mercury

____**c.** Less than 29.4 inches of mercury

If you did any excursions for this chapter, write their numbers here.

SELF EVALUATION 4

☐**4-1.** In areas with cold winters, windows are sometimes covered with a layer of frost on the inside. Explain why the frost forms on the windows.

☐**4-2.** Suppose that a 1,000-milliliter sample of air could contain 32 milligrams of water. The 1,000-milliliter sample of air actually contains only 18 milligrams of water. What is the relative humidity of this sample of air?

☐**4-3.** Get a sling psychrometer from the supply area. Use it to measure the relative humidity in your classroom. (You may refer to tables in the chapter if you need to.)

Relative humidity = _____

☐**4-4.** An ICSC student was measuring the relative humidity in his classroom and obtained the following readings.

Dry-Bulb Temperature = 18°C
Wet-Bulb Temperature = 12°C

You may use any tables in the text to answer the following questions.
A. What is the relative humidity in the room?

_____

B. What is the dew point?

_____

☐**4-5.** What is the relative humidity of air that is at its dew-point temperature?

_____

☐**4-6.** Suppose there were a section of the country where the air was moist but there were very few solid particles in the air. Predict what would happen if a new electricity generating plant that gave off a lot of smoke were built in this area.

_____

_____

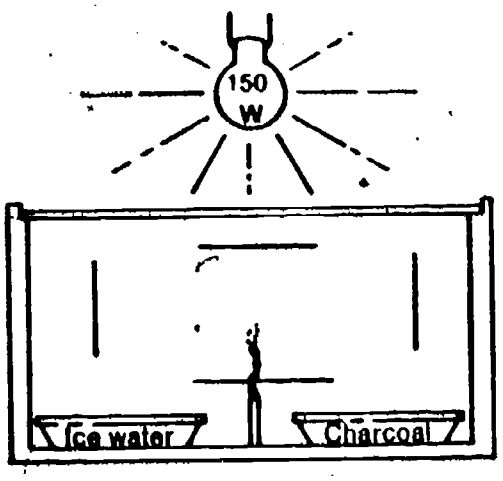
_____

_____

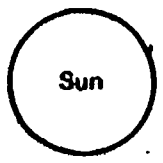
SELF EVALUATION 5 If you did any excursions for this chapter, write their numbers here.

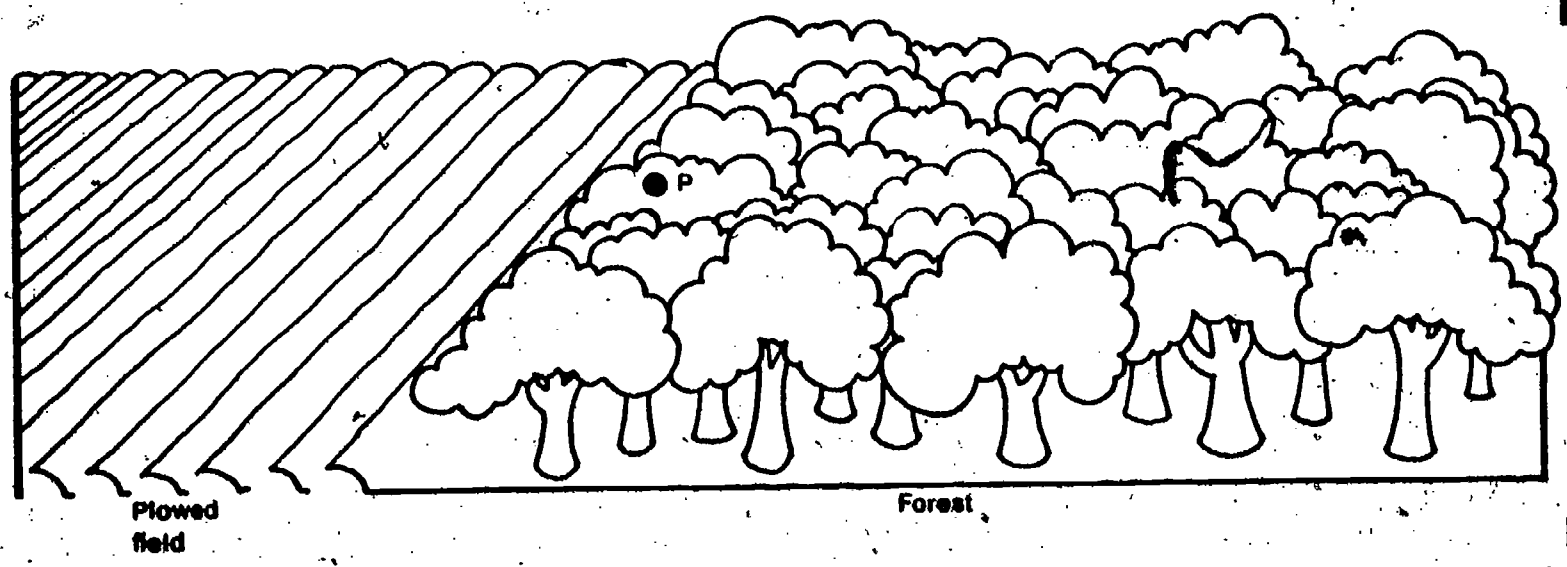
_____

☐**5-1.** The diagram on the next page shows an observation box with a glass top. Show the direction of motion of the smoke particles in the box when the light is on by drawing arrowheads on the lines.



☐**5-2.** Use the diagram below to answer the questions that follow. There is no prevailing wind.



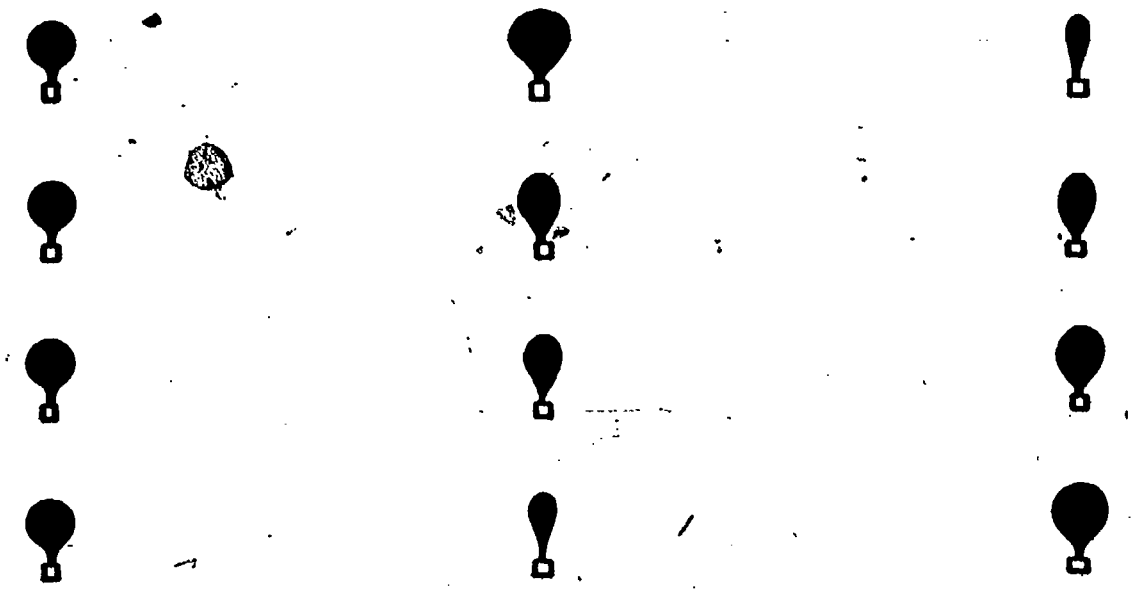


A. Draw an arrow on the diagram to indicate the direction that the wind would be blowing at point P.
B. By shading in on the diagram, indicate where you might expect clouds to form.

41

C. Draw an arrow pointing downward on the diagram to indicate where the air may be moving down.

☐**5-3.** Many types of high-altitude balloons are made out of thin plastic so that they can expand or contract easily.
A. Which sketch do you think best represents what you would see as you watched a balloon rise?



Sketch 1 Sketch 2 Sketch 3

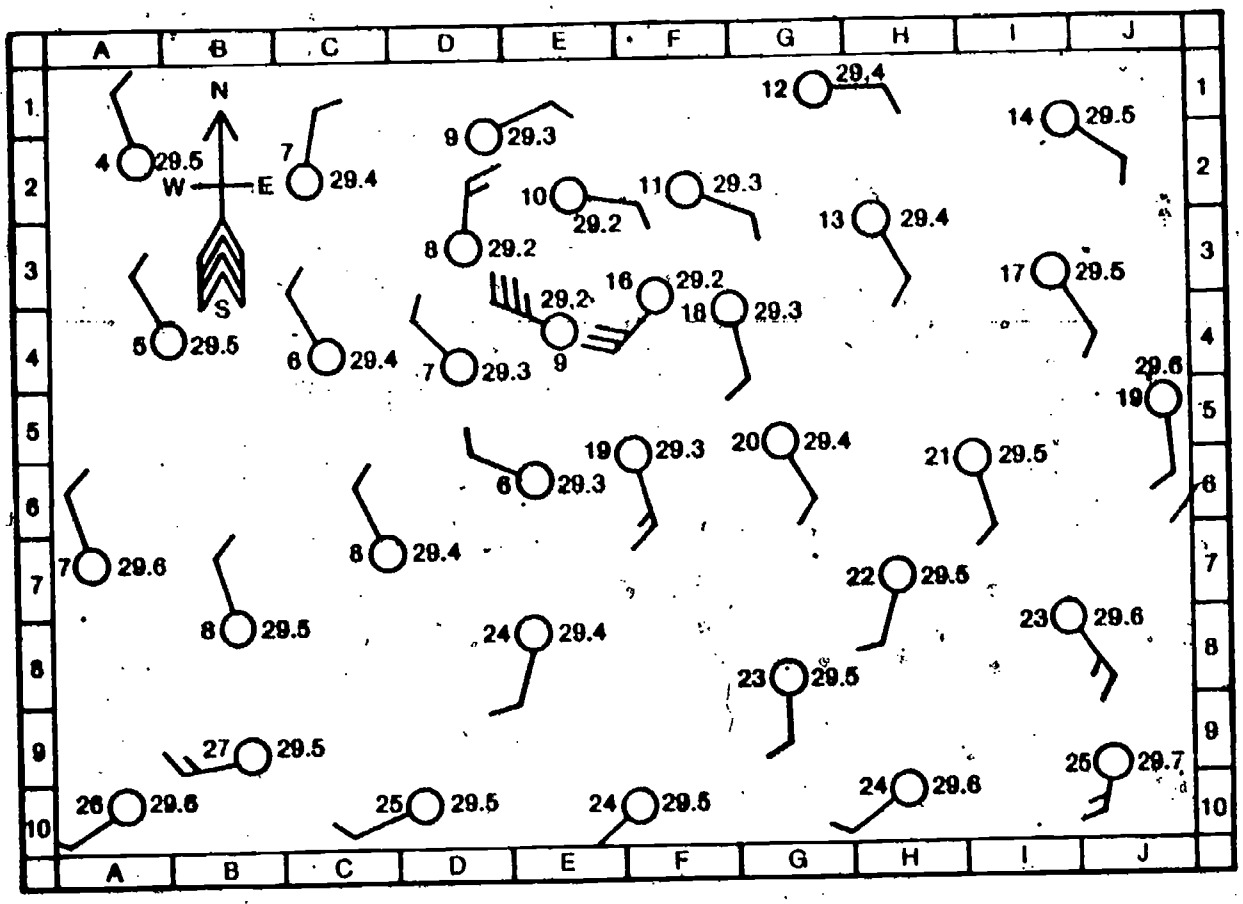
B. Explain your answer to part **A**.

☐**5-4.** In the winter, snow may lie on the ground for months at a time. As long as it stays cold, and the snow is in an undisturbed place, the snow remains very white. When it starts to melt, it begins to look dirty. Explain why this occurs.

If you did any excursions for this chapter, write their numbers here.

_____

☐**6-1.** Use the map below to answer the questions that follow.



A. Using the border symbols and a straightedge, describe the following locations by letter and number.

a. ____Highest wind velocity **c.** ____Highest barometric pressure

b. ____Lowest temperature **d.** ____Highest temperature

B. Draw in the isobars (lines of equal pressure).
C. Shade in the areas that you would expect to have heavy cloud cover.
D. Explain why you shaded the areas you did for part **C.**

_____

_____

_____

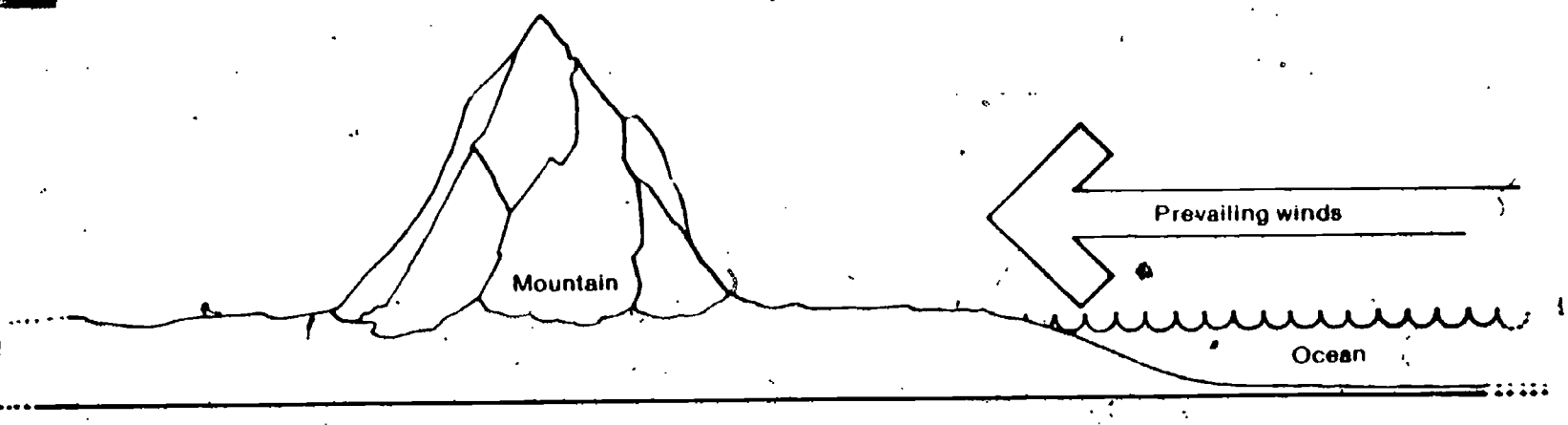
E. Is the region E3 a high- or a low-pressure area?

_____

☐**6-2.** What is the direction of air motion around a low-pressure area?

_____

☐**6-3.** Use the diagram below to answer the questions that follow.



A. Shade in the area on the diagram where you would expect the clouds to form.
B. Label the area on the diagram that receives the most rainfall as WET.
C. Label the area on the diagram that receives the least rainfall as DRY.

☐**6-4.** What are four things to look for on a weather map when predicting where clouds will form?

a. _____

b. _____

c. _____

d. _____

SELF EVALUATION

If you did any excursions for this chapter, write their numbers here.

_____

☐**7-1.** Large weather disturbances move slowly across the North American continent. What is the general direction of motion?

_____

☐**7-2.** Suppose a low-pressure area is approaching the part of the country where you live.

A. What changes would you expect in the amount of cloud cover as it approaches?

_____

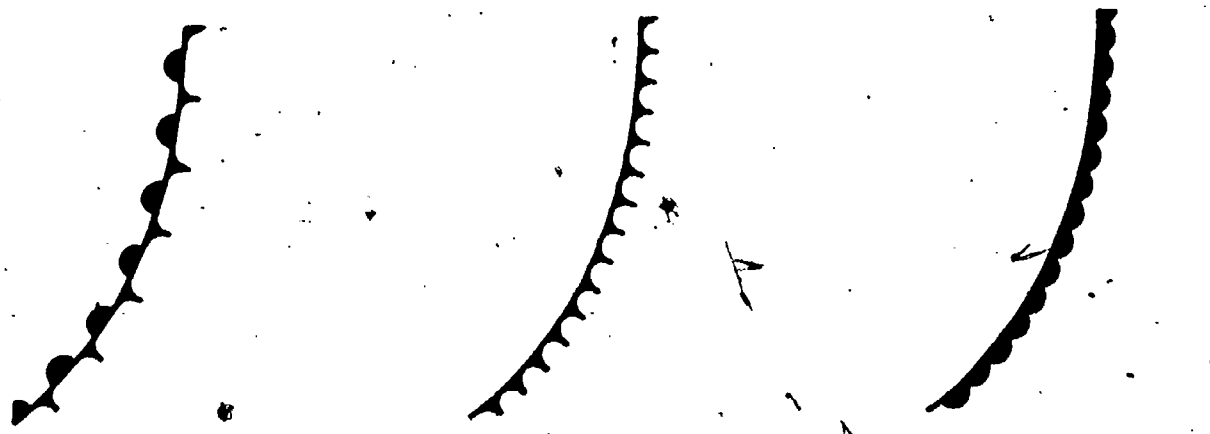
B. What changes would you expect in the barometric pressure reading?

_____

C. What changes in the wind direction would you expect as the system passes?

_____

☐**7-3.** Label the three front symbols shown below with their correct names (cold, warm, or stationary).



a. _____ b. _____ c. _____

☐**7-4.** The weather forecast for today reads: sunny and hot today with the chance of local thunderstorms in the late afternoon or early evening. Explain what causes these local storms.

_____

_____

_____

☐**7-5.** Yesterday an ISCS student noticed some cirrus clouds in the sky. Today he noticed that the barometer had fallen slightly, the wind had shifted so that it was blowing from the southeast, and there was a heavy layer of cumulus clouds overhead.

A. Predict whether the temperature will increase, decrease, or remain the same over the next day or so.

_____

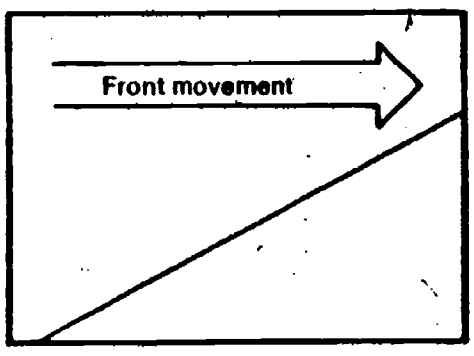
B. Predict whether the rain that is coming will last for just a few hours or for at least a day.

_____

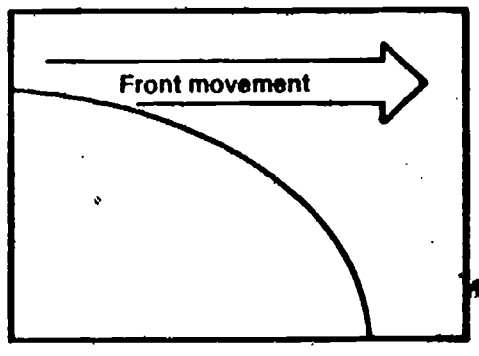
C. What will be the approximate wind direction once the rain has passed?

_____

☐**7-6.** Generally there is a difference in the shape of fronts. Label the fronts shown as warm or cold.



a. _____



b. _____

☐**7-7.** On the basis of your last few days weather watch, predict what tomorrow's weather will be like.

_____

_____

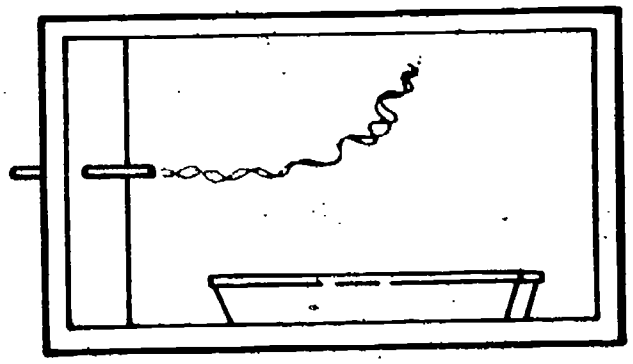
_____

_____

SELF-EVALUATION ANSWER KEY

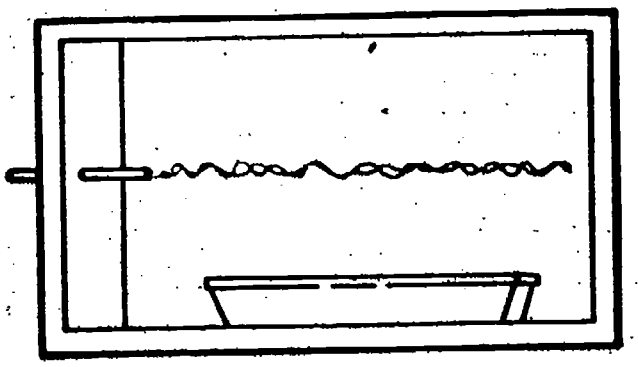
SELF EVALUATION 1

1-1. A.



B. Your answer should indicate that the smoke will rise because of the fact that the water is warmer than the surrounding air. This causes an updraft above the water surface. If you had difficulty with this, you should try Activities 1-2 to 1-5 again.

C.

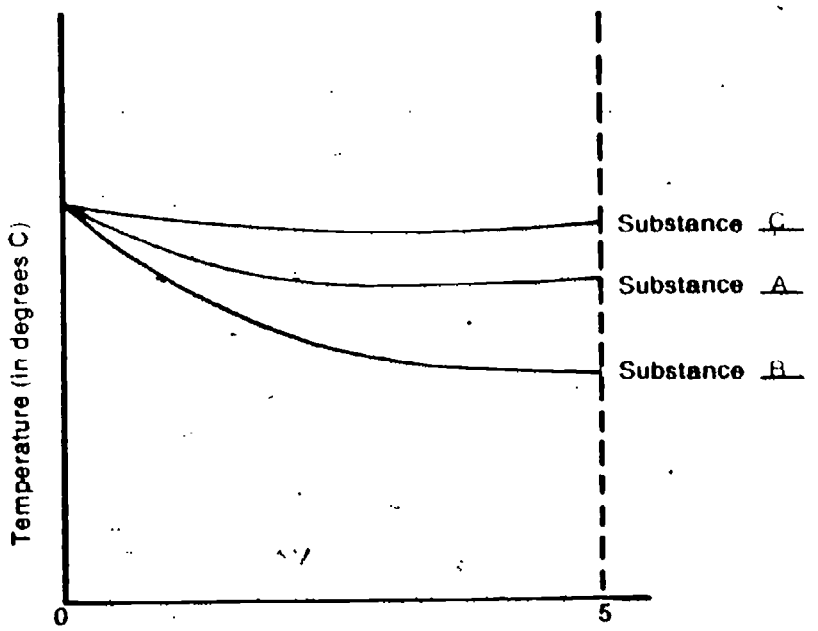


D. Your answer should have indicated that since the water and the air are at the same temperature, there will not be an updraft or a downdraft. The smoke will then travel straight across the box. You may want to try this for yourself.

1-2. A. The balance will tip so that bag B is lower than bag A.

B. The particles of air in the cold beaker are moving slower than the particles of air in the room. The particles are then closer together. When this cold air is poured into bag B, there will be more air particles in B than in A. Since each particle has weight, the weight of particles in bag B is greater than the weight of those in bag A. This means that the balance will tip down on the side that has bag B. If you had difficulty answering this question, you should reread pages 5 and 6. You might want to use this as part of a magic show at home.

1-3. You should have labeled the graph as shown below.



While doing Activities 1-8 to 1-11, you should have noticed that those substances that warm up most rapidly also cool down rapidly. Check your graph (Figure 1-4) in your Record Book if you forgot about this.

1-4. A. Areas A and C

B. You should have indicated that the highway and the plowed field warm up rapidly in the sun. Since the surface is warm, the air above it is heated. This warm air tends to rise.

C. Areas B and D

D. The forest and the pond will not warm up as rapidly on a sunny day. As a result, the air above them is cooler and tends to move downward.

If you had trouble with these questions, look over your observations from the observation box activities and pages 11 to 13 again.

SELF EVALUATION 2

2-1. A. There is a southeast wind blowing. Remember that the wind direction is the direction *from* which the wind is blowing.

B. The wind speed is about 18 or 19 mph.

C. The wind speed is about 29 km/hr. If you had difficulty with this, you should work through Excursion 2-3 again.

2-2. A. These clouds are cirrus clouds. Note their thin, wispy appearance.

B. These are cumulus clouds. Note their tall, billowy shapes and flat bottoms. If you had difficulty in identifying either of these cloud shapes, you should take another look at page 18 and work through Excursion 2-2.

C. The sky is about 25% overcast, so the symbol is ◔.

D. Here the sky is about 50% overcast, so the symbol is ◑.

2-3. About 3.8 centimeters of rain fell. If you had difficulty with this question, you should take another look at Excursion 2-3.

SELF EVALUATION 3

3-1. A. Graph 3.

B. As you get farther from the earth's surface, the air usually becomes cooler (about 2°C/1,000 ft). Sometimes, under unusual circumstances, the temperature stays constant or even rises as you go higher. This unusual distribution of air is called a thermal inversion. During an inversion, smoke and exhaust fumes do not rise and mix with the rest of the air but stay near the ground. This can cause very severe smog that may endanger the lives of people who have respiratory diseases such as pneumonia or asthma.

3-2. A. The pressure will increase.

B. The pressure is the weight of substance above an object. The greater the depth in the ocean, the greater the weight of the material in the column above an object. Thus, the pressure increases. If you had difficulty answering this question, read pages 24 and 25 again and work through Excursion 3-1.

3-3. A. The pressure has increased.

B. The rubber diaphram has been pushed inward. This indicates that the air outside has pushed it in and compressed the air inside. If you had problems with this question, reread pages 26 and 27.

3-4. A. The pressure will have increased.

B. While driving, the tires get very hot and this increases the pressure inside. This is similar to what you did in Activity 3-9 when you warmed up your barometer. In case you actually try measuring the pressure in the car tires, here is a safety tip. Do not let air out of the tires to reduce the pressure to what it was in the morning. If you do, the increased flexing of the tire may heat it enough so that it will catch fire or blow out, causing a serious accident. For tire safety, check the air pressure when the tires cool and keep the pressure up to what the manufacturer recommends.

3-5. The answer is **a**. It will be greater, since the weight of air above the barometer will be greater. If you want to try this yourself, you need a fairly tall building. The pressure should change about 0.10 inch of mercury for every 7 to 10 stories change in height.

SELF EVALUATION 4

4-1. Your answer should have included these ideas: The window glass is cold and this cools down the inside air near the window below the dew point. Moisture then condenses on the inside of the window. If the glass is cold enough, the moisture will freeze and produce frost on the inside of the window. If you did not include these ideas in your answer you should reread pages 37 to 40.

4-2. The relative humidity would be about 56%. If you did not get this answer, you should reread page 41.

4-3. Check your answer with two or three other students who are at the same place in the book. If your answer does not agree with theirs or if you forgot how to find the relative humidity, read page 43 and try again.

4-4. A. The relative humidity is about 49%. Reread page 43 if you did not get this answer.

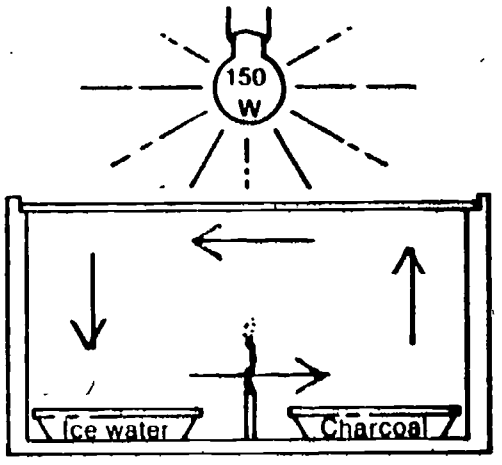
B. The dew point is 13°C. You should study pages 45 and 46 again and do Excursion 4-1 if you had difficulty with this question.

4-5. The relative humidity at the dew point is 100%. If you had difficulty answering this question, reread pages 40 and 41.

4-6. As you know, you need both solid particles and rising moist air to produce clouds. If one of the two is missing, you will produce few clouds. If the new plant gives off a lot of solid particles, it may cause a great deal more cloud formation and upset the local climate patterns. Check pages 48 and 49 if you missed this.

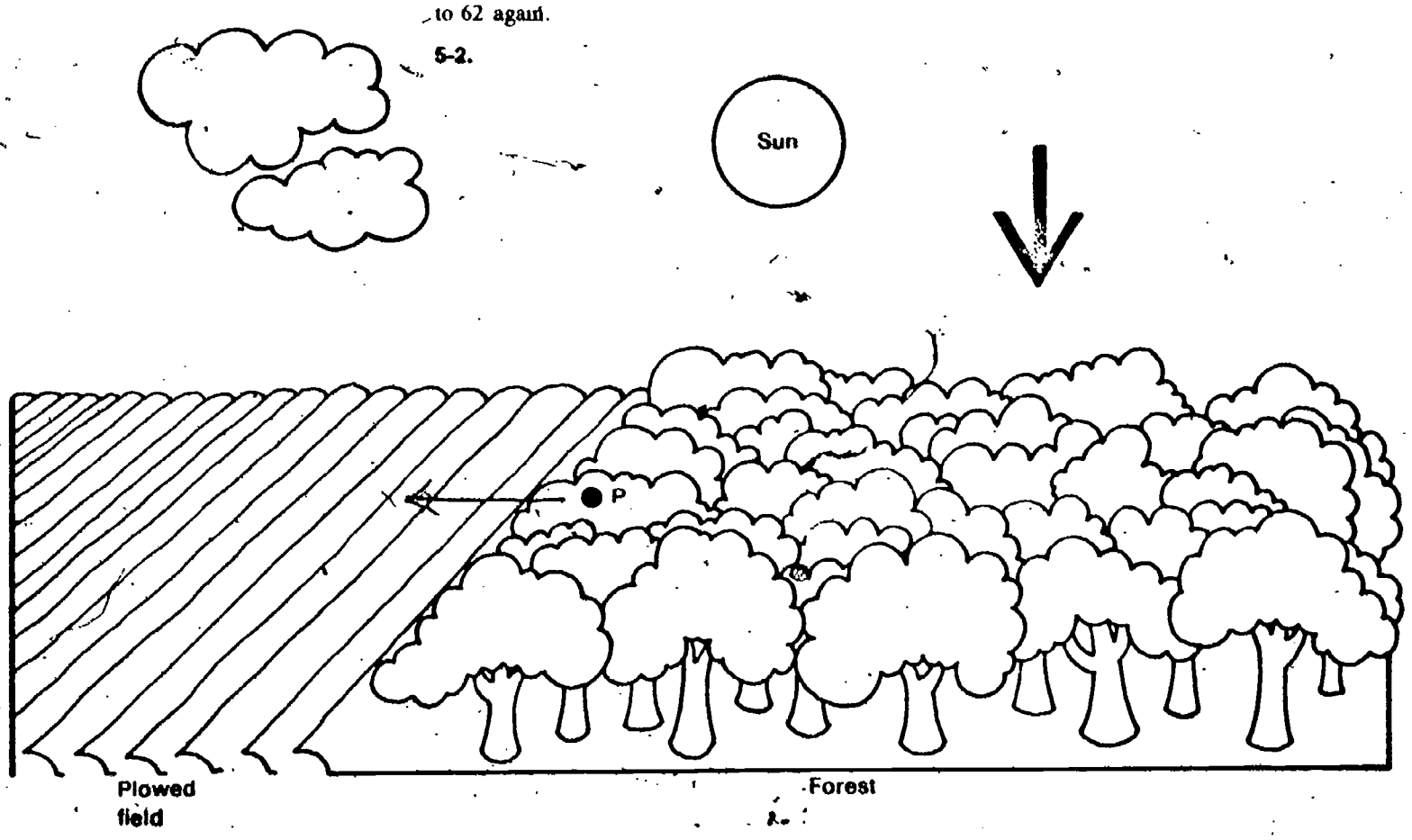
SELF EVALUATION 5

5-1.



If you had difficulty deciding about the directions, you should look over pages 8 to 11 and 59 to 62 again.

5-2.



A. The wind is from the cooler forest toward the warmer plowed field, as shown on page 50
B. The warm air over the plowed field will rise. You would expect this rising warm air to form clouds over the warmer surface, as indicated above
C. The air above the forest will be cooler, so it will tend to be moving downward. Look at pages 61 through 63 again if you missed any of these questions.

S-3. A. You would expect the balloon to appear as in sketch 2.

B. As you go higher above the earth's surface, the pressure will decrease. This means that the balloon will swell outward much as the top of your atmospheric pressure measurer did when the air pressure decreased.

S-4. This question is a bit tricky, so you may have had to think about it for a while. You know that solid particles are necessary for clouds to form. These particles are trapped inside the snowflakes or raindrops that fall. When the snow begins to melt, the water runs away or evaporates, leaving these particles on the surface of the snow. This layer of fine particles gives melting snow its gray appearance. If you live where snow falls, you may want to try melting some snow and looking at these tiny particles. Of course, some of the particles may have settled out of the air onto the snow surface. See page 54.

SELF EVALUATION 6

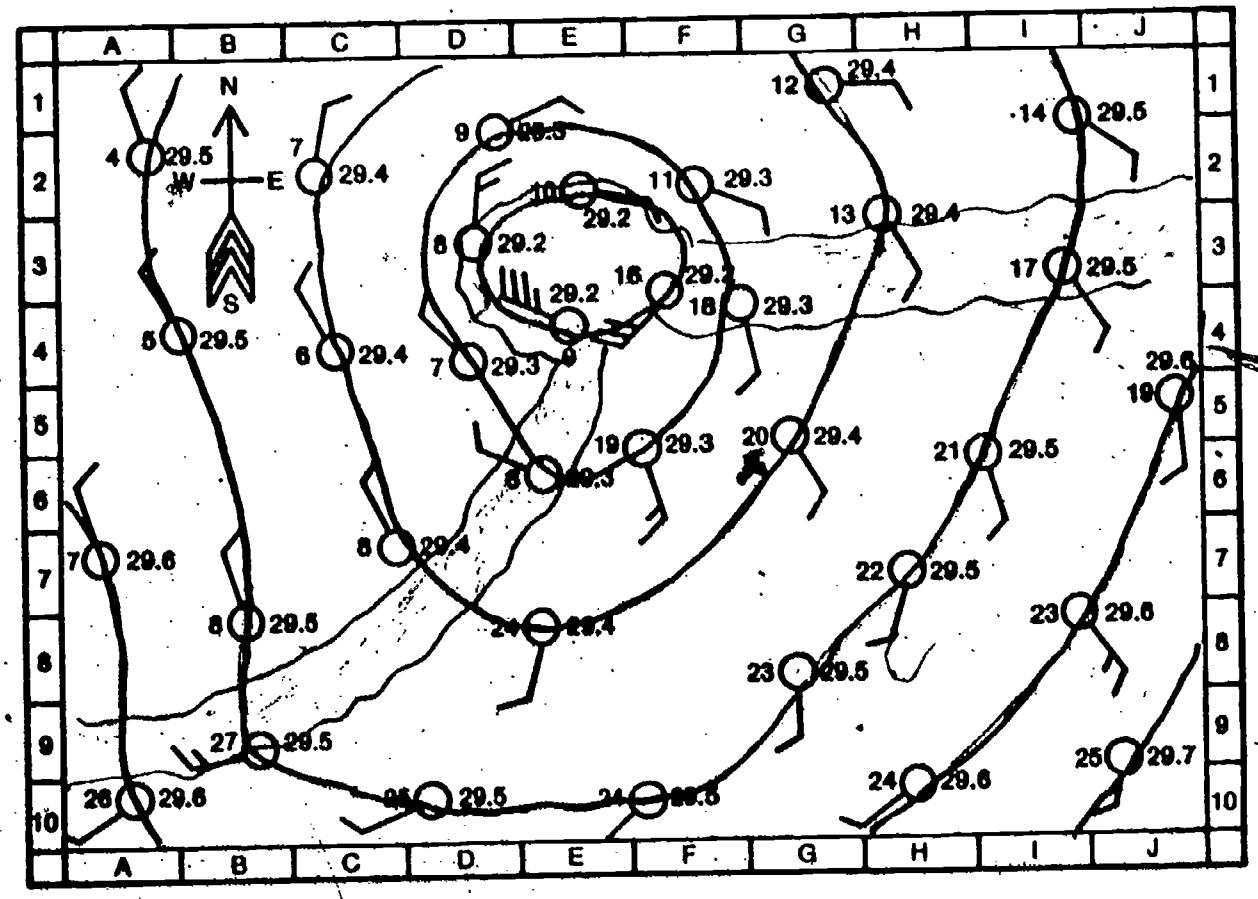
6-1. A. a. E-4

b. A-2

c. J-10

d. B-9

B and C. —see the map below.

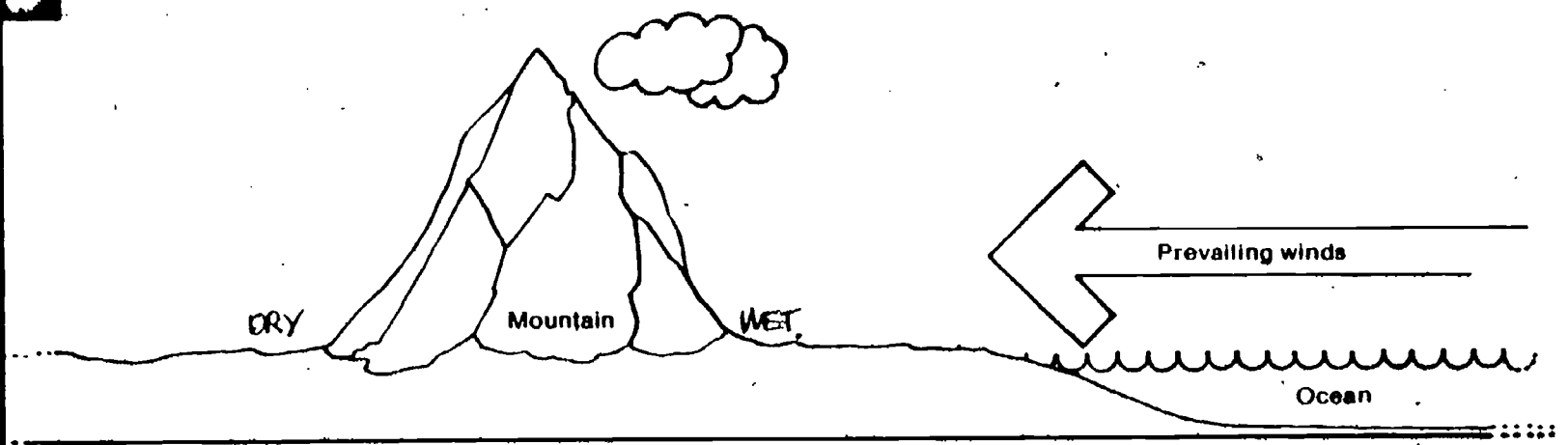


D. The cloud is due to two different factors. The cloudbank around E3 is due to the low-pressure area there. The long banks of clouds from E3 to A9 and from E3 to J2 are due to lines of sharp temperature difference (fronts). If you had trouble deciding where and why the clouds will form, reread pages 65 to 75.

E. The region is a low-pressure area. You can tell this from the barometer readings at various weather stations in this area.

6-2. North of the equator, the air moves around a low-pressure area counterclockwise. Reread pages 73 to 75 if you did not remember the direction. You may be interested to know that south of the equator the air moves clockwise around a low-pressure area. Check with your teacher for some other books on meteorology if you would like to find out more about this.

6-3.



A. The clouds will form where the moist air is pushed up over the mountain. The rising air cools and once it reaches the dew point, clouds will form.

B. The side of the mountains nearest the ocean will receive the most rainfall. Here is where the air is being cooled and the clouds form.

C. On the side of the mountains away from the oceans, it is usually very dry. The air becomes warmer as it comes down the side of the mountain. If the air warms up and the amount of moisture it contains stays the same, its relative humidity decreases. See pages 77 through 79 if you had trouble with these.

6-4. Some things to look for are these:

a. Low-pressure areas
b. Lines of sharp temperature difference
c. Mountains
d. Large bodies of water and their coastal areas
e. Areas where there is uneven surface heating

SELF EVALUATION 7

7-1. The general direction of motion of air masses is easterly. If you did not remember this, take another look at the weather maps on pages 83 through 86.

7-2. A. As the low-pressure area approaches, the sky would cloud over.

B. The barometric pressure reading would decrease.

C. The wind would be generally from the south before the low-pressure area arrived. As it passes, the wind would shift rapidly so that it is coming from the north. If you had difficulty answering these questions, look closely at the weather in Syracuse, New York, as the low-pressure area approaches. See pages 83 through 86.

7-3. **a.** stationary front
b. cold front
c. warm front

7-4. Small local storms in the afternoon are usually caused by uneven heating of the earth's surface.

7-5. The type of clouds that he saw indicates that a warm front is approaching.
A. The warm front will bring warmer temperatures over the next few days.
B. The rain when it comes will last for at least a day. This is because a warm front has such a gradual slope. (See pages 89 through 93.)
C. As the front passes, the wind will most likely shift around so that it is blowing from the north or west. You can see this on the weather maps on pages 83 through 86. Pay particular attention to the warm front that passes through Fargo.

7-6. **a.** warm front
b. cold front
If you had difficulty recognizing the shape of the fronts, take another look at page 89.

7-7. Compare your prediction with that of other students and the official weather forecast for your area. The only way to check your answer is to wait until tomorrow. Good luck!

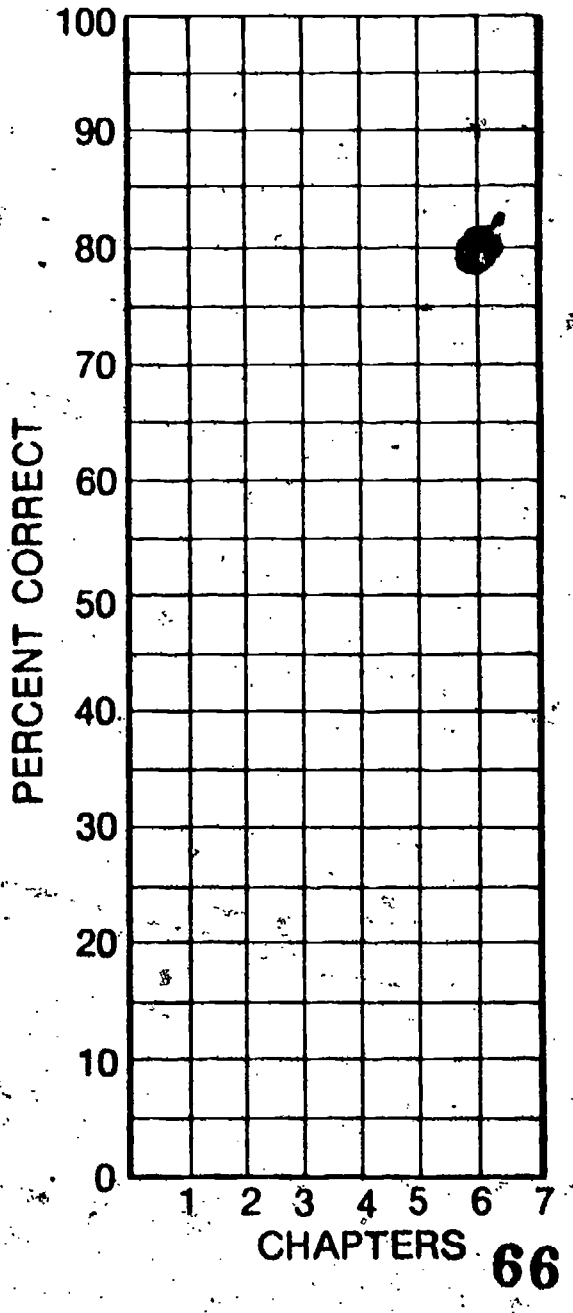
My Progress

Keep track of your progress in the course by plotting the percent correct for each Self Evaluation as you complete it.

$$\text{Percent correct} = \frac{\text{Number correct}}{\text{Number of questions}} \times 100$$

To find how you are doing, draw lines connecting these points. After you've tested yourself on all chapters, you may want to draw a best-fit line. But in the meantime, unless you always get the same percent correct, your graph will look like a series of mountain peaks.

RECORD OF MY PROGRESS



PICTURE CREDITS

36 United States Weather Bureau

36 U.S. Forest Service