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ABSTRACT

This is the teacher's edition of the Record Book for the unit "Crusty Problems" 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)

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Record Book

Crusty Problems

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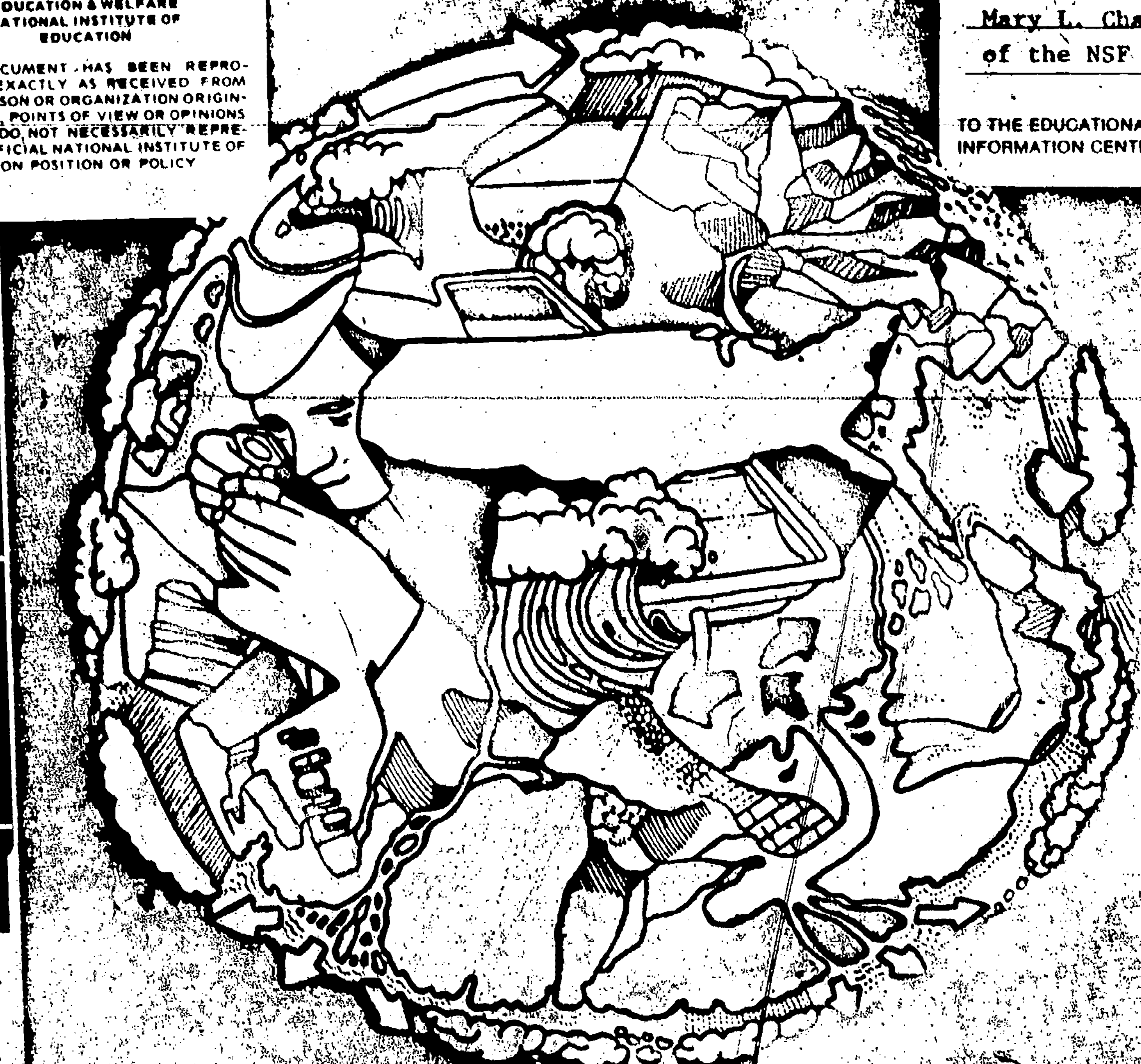

Probing the Natural World/3

INTERMEDIATE SCIENCE CURRICULUM STUDY

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ERIC

INTERMEDIATE SCIENCE CURRICULUM STUDY TEACHER'S EDITION

Record Book

Crusty Problems

Probing the Natural World / Level III

SILVER BURDETT
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
Test Resource Booklet

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
Record Book / with Teacher's Edition / Master Set of Equipment
Investigating Variation / with Teacher's Edition
Record Book / with Teacher's Edition / Master Set of Equipment
In Orbit / with Teacher's Edition,
Record Book / with Teacher's Edition / Master Set of Equipment
What's Up? / with Teacher's Edition
Record Book / with Teacher's Edition / Master Set of Equipment
Crusty Problems / with Teacher's Edition
Record Book / with Teacher's Edition / Master Set of Equipment
Winds and Weather / with Teacher's Edition
Record Book / with Teacher's Edition / Master Set of Equipment
Well-Being / with Teacher's Edition
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The genesis of some of the ISCS material stems from a summer writing conference in 1964. The participants were:

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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 — *The Directors*
February 1972 — INTERMEDIATE SCIENCE CURRICULUM STUDY

Contents

ERIC

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.

Additional questions I have thought about:

1. ________

2. ________

3. ________

4. ________

5. ________

☐ **1-1.** It is spherical with different-colored surfaces, a lot of water, and with white clouds covering large areas. The haze around it shows that it has an atmosphere. It seems to be magnetized because it affects the magnetic instruments.

☐ **1-2.** Solid areas of several different colors; large water areas; large areas of clouds; several large river channels (if close enough); shadows show mountains; thin halo shows an atmosphere.

☐ **1-3.** No

☐ **1-4.** Yes. Smoke; material being thrown out; evidence of material thrown out in the past.

Chapter 1
A First Look at Earth

1

ERIC

Activity 1-1. Use map on the next page.

☐ **1-5.** (Depends on student decision.)

☐ **1-6.** Supported the idea.

☐ **1-7.** a. Feb. 1, 1971; b. Turkey; c. 35 km; d. 37.2° N; e. 30.2° E.

☐ **1-8.** Latitude 15° N and longitude 120° W

☐ **1-9.** Ring around the Pacific Ocean; Malay Peninsula; South Sea Islands and Japan; line through North and South Atlantic Ocean; Mediteranean through to South Asia.

☐ **1-10.** They are in zones.

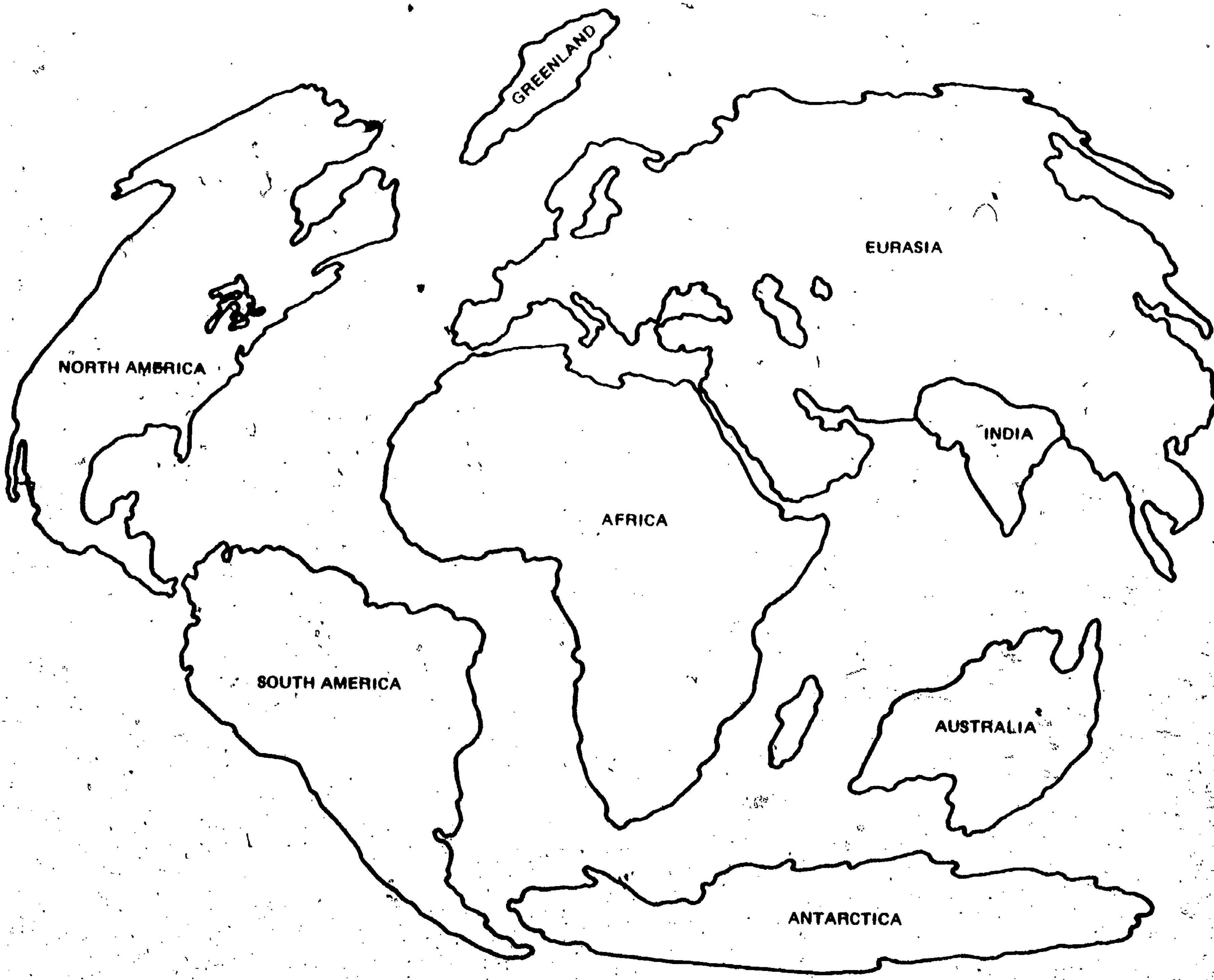
☐ **1-11.** Shallow—through the mid-Atlantic Ocean; moderate—western coast of South America; deep—South Sea Islands.

☐ **1-12.** Answers will vary. ("Don't know" may be a typical answer, but better students may come up with a connection between volcanic activity and earthquakes.)

☐ **1-13.** Yes (or partly)

☐ **1-14.** (Answers will vary; students may suggest the volcanic model.)

2


GREENLAND
NORTH AMERICA
EURASIA
INDIA
AFRICA
SOUTH AMERICA
AUSTRALIA
ANTARCTICA

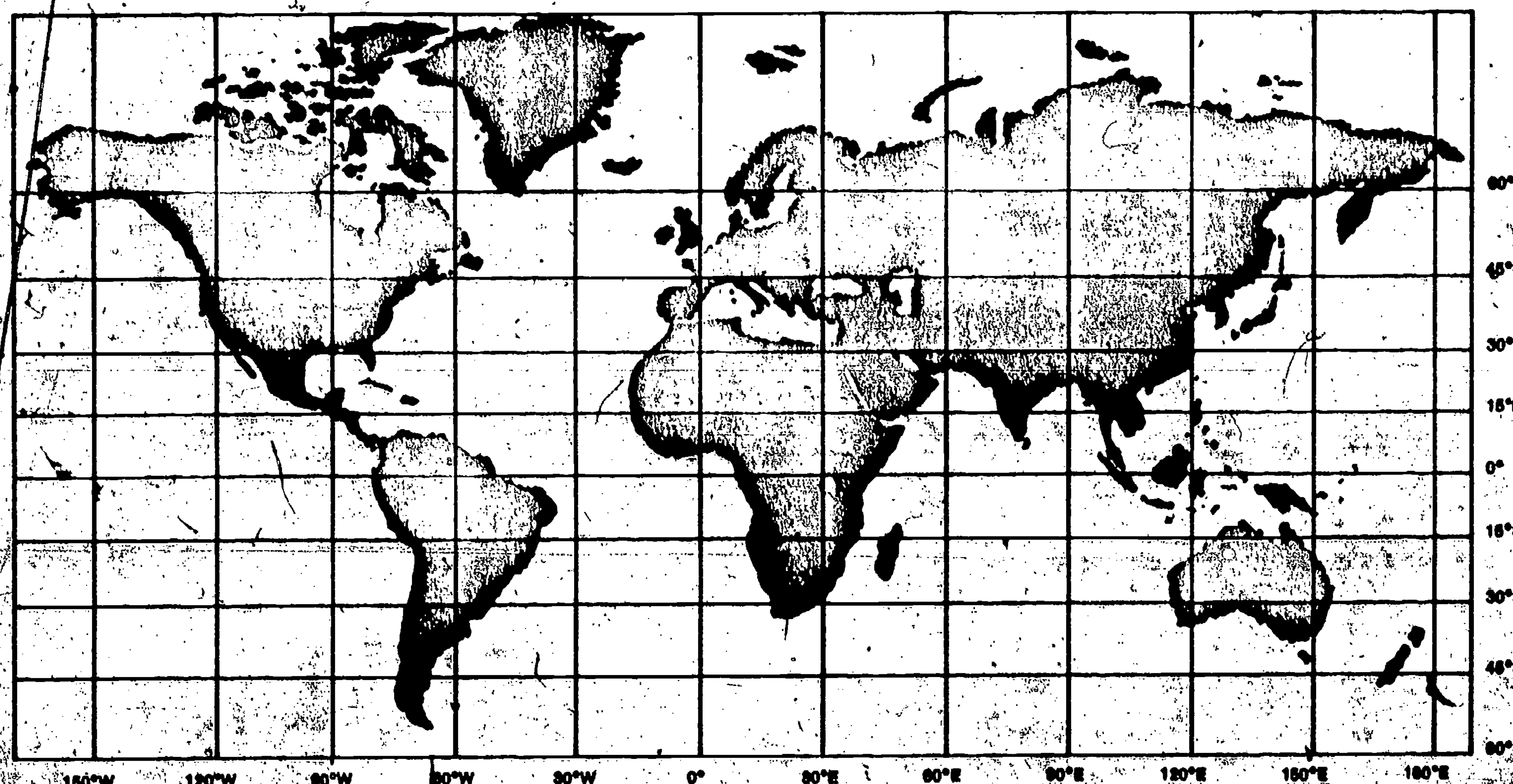
SELECTED DATA FOR DETERMINATION OF EPICENTERS

Day GMT	Origin Time GMT			Geographic Coordinates		Region and Comments	Depth KM	Magnitudes ERL	
	HR	MN	SEC	LAT	LONG			MB	MS
1	01	16	16.8	6.4 S	130.3 E	Banda Sea	133	5.8	
1	01	56	47.0	7.5 S	156.3 E	Solomon Islands	48	4.9	
1	05	40	06.2	22.1 S	170.1 E	Loyalty Islands Region	24		
1	05	53	34.9	21.7 N	143.0 E	Mariana Islands Region	310	4.0	
1	09	35	37.6	11.0 S	165.0 E	Santa Cruz Islands	N	4.4	
1	11	58	00.9*	15.4 S	173.1 W	Tonga Islands	17	5.0	
1	12	13	27.6	36.4 N	43.4 E	Iraq Felt at Mosul	16	5.1	
1	14	37	25.7	36.7 N	68.3 E	Hindu Kush Region	N	4.6	
1	15	42	27.0*	47.1 N	17.9 E	Hungary	N	4.0	
1	19	01	18.3	43.2 N	146.5 E	Kuril Islands Felt on Hokkaido.	56	4.7	
1	20	53	29.9*	0.8 S	120.4 E	Northern Celebes	124	4.9	
2	03	35	48.6	35.2 N	36.3 W	North Atlantic Ridge	N	4.7	
2	08	01	13.3	21.0 S	68.4 W	Chile-Bolivia Border Region	115 D	4.8	
2	09	18	32.5 P	34.2 N	117.5 W	Southern California 34°14.0' N., 117°31.2' W Preliminary Hypocenter and Mag. (3.2) by Pas.	10		
2	15	35	26.2*	28.0 N	111.8 W	Gulf of California	N	3.8	
3	04	05	53.8	35.1 N	27.8 E	Dodecanese Islands	34	4.7	
3	04	07	44.3	21.5 S	179.1 W	Fiji Islands Region	600 G	5.3	
3	04	26	22.1	41.3 N	79.3 E	Kirgiz-Sinkiang Border Region	17	4.9	
3	05	23	08.0*	30.1 S	75.4 E	Mid-Indian Rise	N		
3	08	10	05.2	8.4 S	111.3 E	Java	79	5.6	
3	15	40	59.7	23.9 S	66.6 W	Jujuy Province, Argentina	197	4.7	
3	17	18	19.2*	21.1 S	68.8 E	Mid-Indian Rise	N	4.6	
3	18	28	45.2*	36.2 N	141.1 E	Near East Coast of Honshu, Japan Felt (II JMA) in Eastern Honshu.	35	4.3	
4	09	25	56.9*	56.1 S	27.4 W	South Sandwich Islands Region	N	5.7	5.8
4	14	42	30.2	51.7 N	174.1 W	Andreanof Islands, Aleutian Is.	26	4.9	
4	18	33	18.0*	43.6 N	147.9 E	Kuril Islands	N	4.6	
4	22	15	55.4	20.6 S	69.0 W	Northern Chile	86	5.0	
4	22	51	28.9	6.9 S	155.5 E	Solomon Islands	62	5.0	
5	01	21	05.1	33.0 S	178.6 W	South of Kermadec Islands	N	5.1	
5	02	50	50.3	61.4 N	147.8 W	Southern Alaska	48	3.6	
5	16	52	47.6	41.8 N	32.5 E	Turkey	6	4.3	
6	13	28	26.9	51.2 N	179.2 W	Andreanof Islands, Aleutian Is.	34	4.1	
6	19	22	39.4	37.5 N	116.6 W	Southern Nevada	5 G	3.6	
7	05	35	15.6*	18.4 N	100.2 W	Guerrero, Mexico	88	4.2	
7	11	27	34.7*	23.5 N	44.8 W	North Atlantic Ridge	N	4.6	
8	05	54	12.4	19.1 N	68.0 W	North Atlantic Ocean	48	5.0	
8	07	17	05.0	41.1 S	72.6 W	Near Coast of Southern Chile Felt (III) at Valdivia.	90	4.4	
8	08	02	37.2*	0.9 S	78.5 W	Ecuador	28	4.1	
8	14	00	00.1A	37.1 N	116.1 W	Southern Nevada 37°06' 36.4" N., 116°03'05.1" W. Nevada Test Site. Miniata (AEC). Mag. 5 1/4 (BRK).	0	5.5	
8	14	39	56.8	19.1 N	64.4 W	Virgin Islands	N	4.6	
9	03	03	18.7	32.5 S	71.2 W	Near coast of Central Chile 83 killed, 447 injured, and widespread property damage in Central Chile. 1.2-meter Tsunami (Peak to Trough) at Valparaiso. Mag. 7.5 (PAS). 7.5 (BRK).	58	6.6	

EPICENTER DATA-(continued)

Day GMT	Origin Time GMT			Geographic Coordinates		Region and Comments	Depth KM	Magnitudes ERI	
	HR	MN	SEC	LAT	LONG			MB	MS
9	04	46	25.6	32.5 S	71.4 W	Near Coast of Central Chile	69	4.5	
9	09	52	50.4*	3.8 N	78.5 W	South of Panama	57	4.3	
9	12	27	24.5	20.5 S	178.1 W	Fiji Islands Region	550 G	5.1	
9	15	46	49.9*	53.0 S	22.9 E	South of Africa	N	4.6	
9	17	00	52.1*	8.2 S	148.2 E	East New Guinea Region	62		
9	17	11	55.5*	43.5 N	147.6 E	Kuril Islands	N	4.2	
10	00	26	35.3*	32.4 S	71.4 W	Near Coast of Central Chile	65	4.3	
10	17	22	37.2*	40.4 N	109.6 W	Utah	8	3.8	
11	05	30	53.9	0.9 S	13.3 W	North of Ascension Island	N	5.1	
11	11	43	13.2*	23.4 N	123.7 E	Southwestern Ryukyu Islands	34	4.8	
11	12	51	33.7*	8.2 N	38.0 W	Central Mid-Atlantic Ridge	N	4.5	
12	09	02	09.2	24.0 N	111.2 W	Baja California	N	4.8	
12	23	50	15.7*	19.6 N	63.0 W	Leeward Islands	N	4.2	
14	07	16	53.6*	5.8 S	153.2 E	New Ireland Region	N	4.9	
14	14	48	41.2	47.8 N	114.4 W	Montana	5 G		
14	15	40	48.6*	60.0 N	152.7 W	Southern Alaska	82	4.0	
14	15	51	58.1	32.9 S	72.1 W	Off Coast of Central Chile	62	4.8	
14	19	53	14.3	0.8 N	29.0 W	Central Mid-Atlantic Ridge	N	5.2	5.3
15	01	33	22.3	44.8 N	10.3 E	Northern Italy 2 killed. Damage at Parma. Felt throughout Northern Italy.	8	5.2	
15	05	36	11.6	60.1 N	153.3 W	Southern Alaska	150	4.4	
15	06	15	31.4	37.2 N	36.8 E	Turkey	N	4.6	
15	10	38	50.0P	34.2 N	117.5 W	Southern California 34°14.1' N., 117°27.7' W. Preliminary Hypocenter and MAG. (3.0) by PAS.	10		
15	10	57	02.4*	41.7 N	142.6 E	Hokkaido, Japan Region Felt at Urakawa (II JMA) and Hachinohe (I JMA).	57	4.1	
15	18	49	07.3	44.8 N	10.3 E	Northern Italy	19	4.0	
16	04	31	28.4*	59.3 N	154.2 W	Southern Alaska Mag. 3.5 ML (ERL).	N		
16	05	50	23.7	35.0 N	23.1 E	Crete	42	4.5	
16	21	40	23.1	16.7 N	96.1 W	Oaxaca, Mexico	14	5.2	
17	03	23	53.6	15.3 N	45.3 W	North Atlantic Ridge	N	4.6	
17	03	39	15.4	55.3 N	161.5 W	Alaska Peninsula	N	4.3	
17	05	32	42.9	7.0 N	94.7 E	Nicobar Islands Region	138 D	5.8	
17	15	00	55.4	26.5 N	93.2 E	Eastern India	49	5.3	5.1
17	17	56	13.9	4.0 S	80.8 W	Peru-Ecuador Border Region	35 G	4.8	
17	19	30	14.1E	49.8 N	114.8 W	British Columbia Strip Mine Explosion.	0		
17	20	10	21.5	21.5 S	68.2 W	Chile-Bolivia Border Region	123	5.4	
17	21	45	23.6	38.3 N	39.9 E	Turkey	N	4.5	
18	00	02	26.2*	34.0 N	45.2 E	Iran-Iraq Border Region	N	4.7	
18	16	18	22.8	45.7 N	26.3 E	Rumania	137	4.6	
18	19	16	41.7*	18.3 N	100.7 W	Guerrero, Mexico	110	4.7	
21	03	00	32.2*	1.2 S	14.9 W	North of Ascension Island	N	4.5	
21	09	14	26.1B	36.2 N	120.9 W	Central California 36°12.9' N., 120°52.7' W. Hypocenter and Mag. (3.3) by Brk.	8	4.2	
21	20	01	57.1*	30.9 N	41.6 W	North Atlantic Ridge	N	4.3	
22	06	29	49.0	31.1 N	41.6 W	North Atlantic Ridge	N	4.8	
25	15	31	11.4	41.3 N	29.5 W	Azores Islands Region	N	4.6	
23	15	44	27.4	47.8 N	114.3 W	Montana Felt at Kerr Dam. Mag. 3.5 Ml (ERL).	5 G		
24	20	24	30.6*	37.9 S	49.4 E	Atlantic-Indian Rise	N	5.0	

ERIC


60°N
45°N
30°N
15°N
0°
15°S
30°S
45°S
60°S
150°W
120°W
90°W
60°W
30°W
0°
30°E
60°E
90°E
120°E
150°E
180°E

RESOURCE 1.

☐ 1. The evidence seems to support the idea of continental drift. In order for glacial grooves to have formed in the direction they are now found, it would have been necessary for the glaciers to have moved from the oceans if the continents weren't together.

☐ 2. Something else besides glaciers made the grooves.

RESOURCE 2

☐ 1. Yes, they match by colors.

☐ 2. Some layers match; one doesn't.

☐ 3. The continents were once joined together (or the layers and fossils developed where they now are, and then the land sank in the middle, forming the ocean).

RESOURCE 4.

☐ 1. Shallow

☐ 2. Intermediate—70 to 299 km

☐ 3. Malay Peninsula, Japan, South Sea Islands

☐ 4. Yes (somewhat)

☐ 5. Yes

☐ 6. The spreading was about the same.

☐ 7. The age of the rocks should get greater as you go away from the ridge in either direction.

Chapter 2
The Mountains

☐**2-1.** Student accounts will vary, but they should say something about (1) the formation of the ripple marks, (2) the hardening of the ripple marks, and (3) the lifting and tilting of the ripple marks.

☐**2-2.** 20 to 30 degrees

Table 2-1

Sample Number or Color	Number of Components	Texture		Arrangement	
		Interlocking	Noninterlocking	Random	Oriented

☐**2-3.** **a.** The three types of rocks can be distinguished on the basis of texture. Igneous and metamorphic rocks have interlocking texture, whereas sedimentary rocks have noninterlocking texture. Some metamorphic rocks also have the minerals oriented in bands. Sedimentary rocks contain fossils, but igneous and metamorphic rocks do not. **b.** Igneous rocks form from the cooling of molten materials either within the crust or at the surface. Sedimentary rocks form from deposition of sediment (broken-up rocks) in the air or water, and then later are compacted by pressure and cemented together by chemical means. Metamorphic rocks are rocks that are changed by heat and pressure within the earth. **c.** All rocks are made of minerals. The predominant rock-forming minerals are quartz, feldspar, mica, hornblende, and calcite.

☐2-4. Rocks with interlocking texture were formed under conditions of extreme pressure and heat as either igneous or metamorphic rocks. Those that have a noninterlocking texture were formed by cementation as sedimentary rocks.

Table 2-2

Rock Number	Mineral	Type
05	mica, feldspar, quartz	metamorphic
06	mica, feldspar, quartz	igneous
08	plagioclase, feldspar, hornblende	igneous
12	calcite	metamorphic
13	quartz	sedimentary
17	calcite	sedimentary

☐2-5. Possibly all three kinds. The valley and ridges consist of sedimentary rock; intrusions of igneous rock occur along the Blue Ridge; some of the uplifted rock may have been changed to metamorphic.

☐2-6. (Answers will vary with locations.)

☐2-7. (Answers will vary with locations.)

☐2-8. (Answers will vary with locations.)

☐2-9. The ground appears to have cracked (faulted).

☐2-10. The west wall of the valley was uplifted.

☐2-11. The mountains were lifted up and tilted by faulting.

☐2-12. (Student answers will vary according to the model used.)

☐2-13. It is an igneous rock (rhyolite). The fine crystalline, glassy, frothy nature of the rock suggests that it was formed from molten rock at the surface of the earth.

☐2-14. The Mono craters were active volcanoes at one time. Since the rock is igneous, the material in the formations came from below the surface. It flowed out through openings, forming the cone-shaped mountains.

☐2-15. Yes. The shape of Mount St. Helens suggests the classic volcanic cone. Like the Mono craters, it was formed by the piling up of once molten materials on the surface of the earth. You would expect the rocks in it to be largely igneous.

☐2-16. The rocks (gray granite) are igneous, but they were formed deep beneath the surface. They cooled more slowly and under higher pressure than the igneous rocks that formed on the surface of the Mono craters.

☐2-17. Molten rock formed into a dome-shaped mass deep underground, and then slowly hardened. The material over and around the dome was softer than the dome itself and eroded away, leaving the dome exposed.

CHECKUP

1. The dark-colored rock is an intrusion of molten rock that filled a crack underground and then slowly hardened. It became visible because of a roadcut.

2. The sedimentary rock is older than the igneous rock. The molten rock forced its way through the crack in the sedimentary rock in forming the igneous intrusion.

☐ 2-18. The general process was folding of layers of rock caused by lateral pressure. The horizontal layers were wrinkled into a series of folds, which were then eroded.

☐ 2-19. (Answers will vary according to the model used. A model of either the collision of crustal plates or the "wrinkled apple" can explain the faulting and folding.)

☐ 2-20. The glacier exerts a force on the rock to remove chunks of it, carry the chunks some distance, and deposit them, thus changing the shapes of mountains.

☐ 2-21. More snow falls than melts. The snow compresses and forms ice. The ice moves down the mountain because of the force of gravity. The forces of weight and friction act on the mountains as the glaciers move, wearing them away.

☐ 2-22. U-shaped valleys are formed by the mass of ice, carrying rocks imbedded in it, scouring and carving out a wide, curved bed. Plucking of rock by ice at the head of a glacier deepens and widens a hole to make a bowl-shaped basin. This bowl-shaped basin may fill with water, forming a glacial lake. Tributary glaciers, flowing into the main glacier from the side, have less ice in them, and therefore scour at a slower rate. When the ice melts, the valley of a tributary glacier is left high above the main valley and is called a hanging valley.

RESOURCE 5

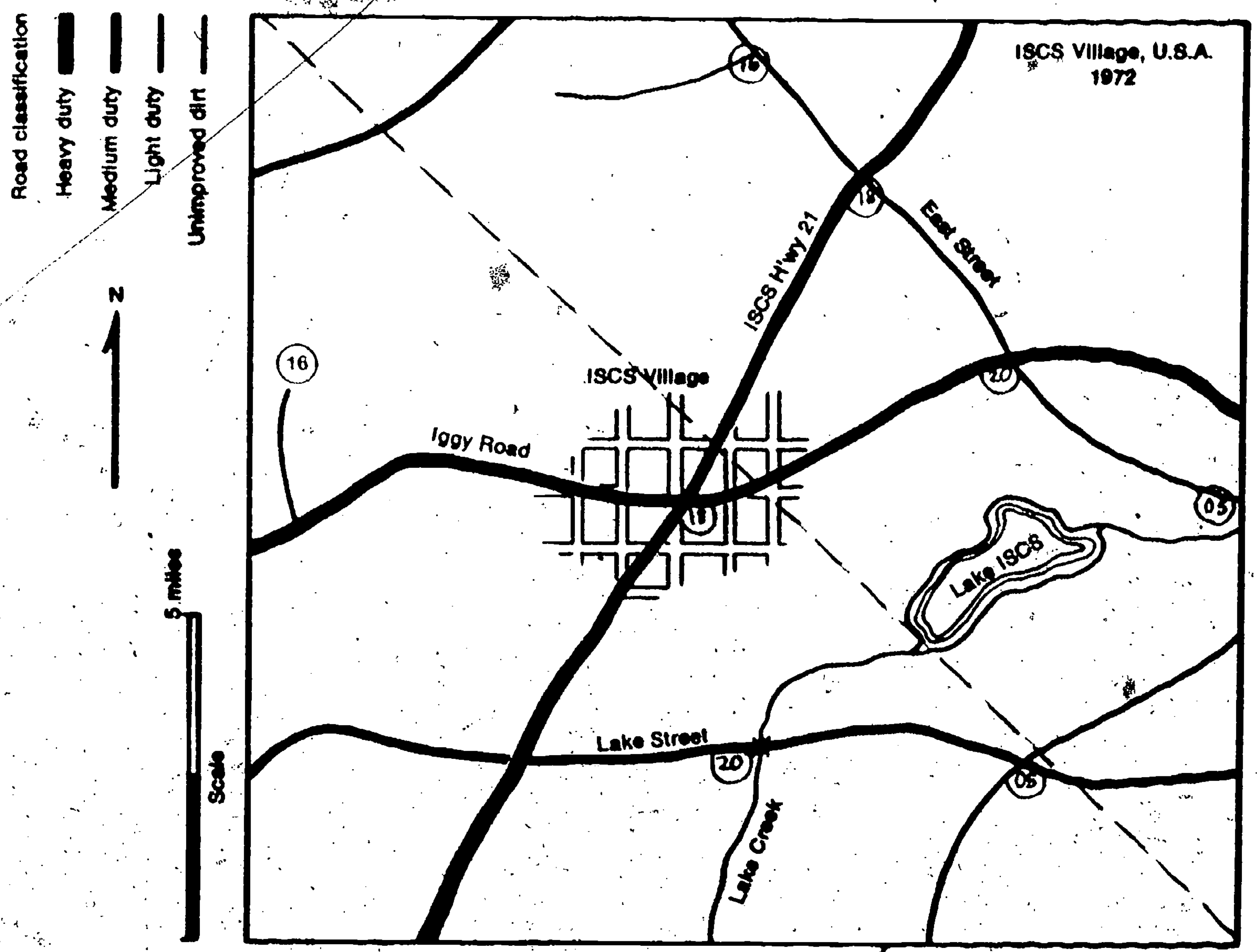
No.	Name	Prediction	Results of tests
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

RESOURCE 8

☐1. This is a control.

☐2. The sand was somewhat cemented together, and the color had changed in the two dishes to which the chemicals had been added. There was no change in the sand in the control dish.

RESOURCE 10



☐1. The rock types change from sedimentary (shale) to progressive forms of metamorphic (slate, schist, gneiss) as you go toward the lower right.

☐2. The size of the minerals will get larger as you progress downward to the right.

☐3. The arrangement of minerals will be toward more pronounced banding from 16 to 18 to 20 to 05.

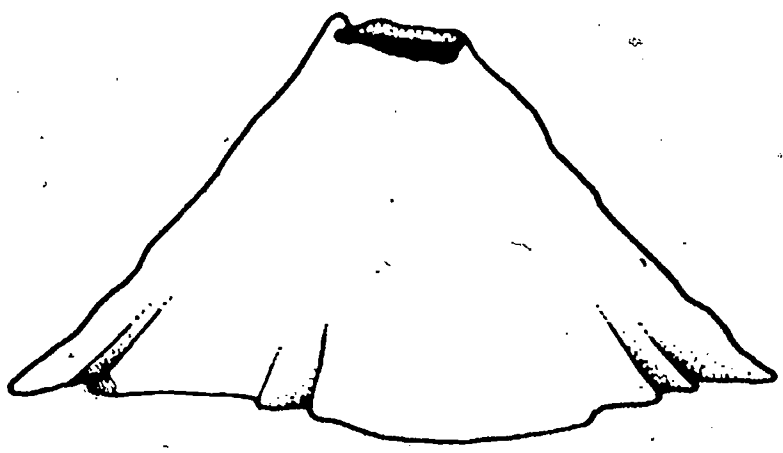
☐4. The lower right corner

RESOURCE 11

☐1. Harder than glass

☐2. Nonmetallic luster

RESOURCE 13



☐1. Yes (somewhat)

☐2. They were formed by volcanic action.

Chapter 3 The Midlands, A Pathway to the Sea

☐ **3-1.** The layered rock was formed under water. At some time in the past, water must have covered the land where it is now dry.

☐ **3-2.** A river has high kinetic energy when it is flowing rapidly; it has high potential energy when it is at a high elevation relative to its destination.

☐ **3-3.** The rivers begin in general in areas of high elevation (high potential energy) and of high precipitation. They need potential energy and water to get started.

☐ **3-4.** Factors that cause a river to flow swiftly: (1) rapid change of potential to kinetic energy; (2) smooth riverbed; (3) large source of water.

Factors that cause a river to slow down: (1) leveling off of riverbed (less rapid drop); (2) obstacles, obstructions, and roughness of bed; (3) loss of water by diversion, sinking in, etc.

Factors causing rivers to carry away rock and soil: (1) high kinetic energy; (2) looseness of soil; (3) hardness of rocks; (4) smoothness of riverbed.

☐ **3-5.** As the potential energy is changed to kinetic energy in the hills, the river moves faster. It picks up larger rocks and a larger load of rocks and soil. When it reaches the valley, it loses its kinetic energy in friction and slows down. It drops the larger rocks first and finally the smaller ones. Deposition is affected by rate of flow, size of particles, obstacles in stream bed, and changes in direction of flow.

☐3-8. (Predictions will depend on choices.)

Table 3-1

Feature	Your prediction	Results of Test	
		Accept prediction.	Reject prediction. Revise if rejected.
Waterfalls (Figs. 3-13 and 3-14)			
Gullies (Fig. 3-15)			
Meanders (Figs. 3-16, 3-17, and 3-18)			

Prediction 1. Hard rock on top of Niagara; mixed hard and soft on top, with hard underneath, at Yellowstone.

Labeled sketches:

Prediction 2. (1) Water flows toward bottom of page, and (2) gullies will deepen and lengthen upward on the page

Labeled sketch:

Prediction 3. Deposits of sand on inside of each curve. Water at that point will be moving slower than at a point across the river. The land will be eroded away in Figure 3-18.

☐**3-7.** The sand has moved from left to right. The left photograph was taken first.

RESOURCE 27

Table 1

	Slope (in cm)	Rate of Flow into Trough (in ml/sec)	Trough Bed	Speed (in cm/sec)
Trial 1	4	10	Normal	
Trial 2	8	10	Normal	
Trial 3	12	10	Normal	
Trial 4	4	20	Normal	
Trial 5	4	10	Gravel-covered	

RESOURCE 37

☐ 1. Sand on the side facing you moves up the slope, and drops on the far side.

☐ 2. The vegetation

☐ 3. Layers of sand (called dune bedding)

☐ 4. Water-deposited sand is in horizontal layers; wind-deposited sand is in tilted and curving layers.

☐ 5. Figure 5A. From left to right.

Chapter 4 The Shorelands

☐ 4-1. The change from Figure 4-3 to 4-4

☐ 4-2. Yes. The trees appear undamaged, so it is likely that the wave action of the water, rather than the wind, removed the cottage and the sand.

☐ 4-3. The low-energy waves move sand inward, building up the beach. The high-energy storm waves move sand outward, eroding the beach.

☐ 4-4. They erode the rock, expending the greater amount of their energy on the headlands. They then move with less energy into the pockets, depositing sand and forming beaches.

☐ 4-5. The rate of cave carving depends on the energy level of the waves, the range of the tidal cycles, seasonal differences in waves, and the hardness of the rock.

☐4-6. The friction of the water of the incoming wave on the bottom causes the wave to break.

☐4-7. Waves bend as they enter a bay because of diffraction. The wave hits the headlands of the bay first; the center part of the wave continues unimpeded.

Sketch of Prediction:

Waves approaching a shoreline at an angle bend because of refraction; the part arriving first is slowed up first and the wave front bends.

Sketch of Prediction:

32

☐4-8. The gravitational attraction of the moon and the sun on the earth causes outward bulging of the oceans. This daily tidal cycle exposes a narrow zone of coastline to varying water levels. The greater the difference between low and high tide, the greater amount of shore that will be subjected to wave action, and the more the relationship between ships and docks will be affected.

☐4-9. The flat area represents an old wave-cut bench. The sea level has dropped (or the land has been uplifted) and new cliffs have formed. The remains of old sea cliffs, stacks, and arches inland, and old wave-deposited sediments on the flat area (which resembles the tidal flat in Figure 4-14) are evidence for the change in sea level.

☐4-10. Most of the sand and silt was carried down by the river. However, ocean tides, currents, and wave action move sand and silt also. The material brought down by the river can be moved right or left depending on the prevailing winds and currents. They would probably have a broadening effect on the delta.

☐4-11. Waves strike the coast at an oblique angle. The wave action carries sand along the beach. Longshore currents also carry the sand. If there is a change in direction of the coastline inward so that a point, or headland, is formed, then waves will be bent, or refracted, around the point and lose enough energy to deposit sand. This sand builds up as a curved spit.

☐4-12. A glacier moved down from the mountains to scour out a wide, U-shaped valley. Alternatively, a fast-flowing river cut a V-shaped, deep river valley as it flowed down to the sea. With the melting of glacial ice, the sea level rose considerably, flooding both the glacial and the river valleys.

RESOURCE 41

Sketch of Prediction:

34

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 41.

List the numbers of all the resources you used for this chapter.

SELF-EVALUATION 1

☐**1-1.** This unit is about the earth's landscape. In the chapters that follow, you will be asked many questions about the earth's features, such as how they may have been formed and what they may look like in the future. Where will you get the information to help you answer the questions that were referred to as resource problems?

☐**1-2.** What observations have geologists used to support the idea that the continents might have been joined together in the past?

☐**1-3.** Indicate with a check mark those areas that have a large number of earthquakes.

______ western coast of the U.S.

______ eastern coast of the U.S.

______ the state you live in

———midway between North America and Europe

———eastern coast of South America

☐1-4. Which theory or model explains the pattern of earthquakes on the earth, sea-floor spreading or the contraction theory? Explain your answer.

☐1-5. Look at the combined drawing in your textbook of the three landscapes. (Page 9, Figure 1-4 in your textbook.) Which section, A, B, or C (see the left margin), contains features that are most like the landscape where you live?

SELF-EVALUATION 2

List the numbers of all the resources you used for this chapter.

☐2-1. What interpretations can you make from the following observations: The tilt of sedimentary rocks reported on the side of a mountain is 21°. Several fossils of animals that once lived in ocean water have been located within the rocks.

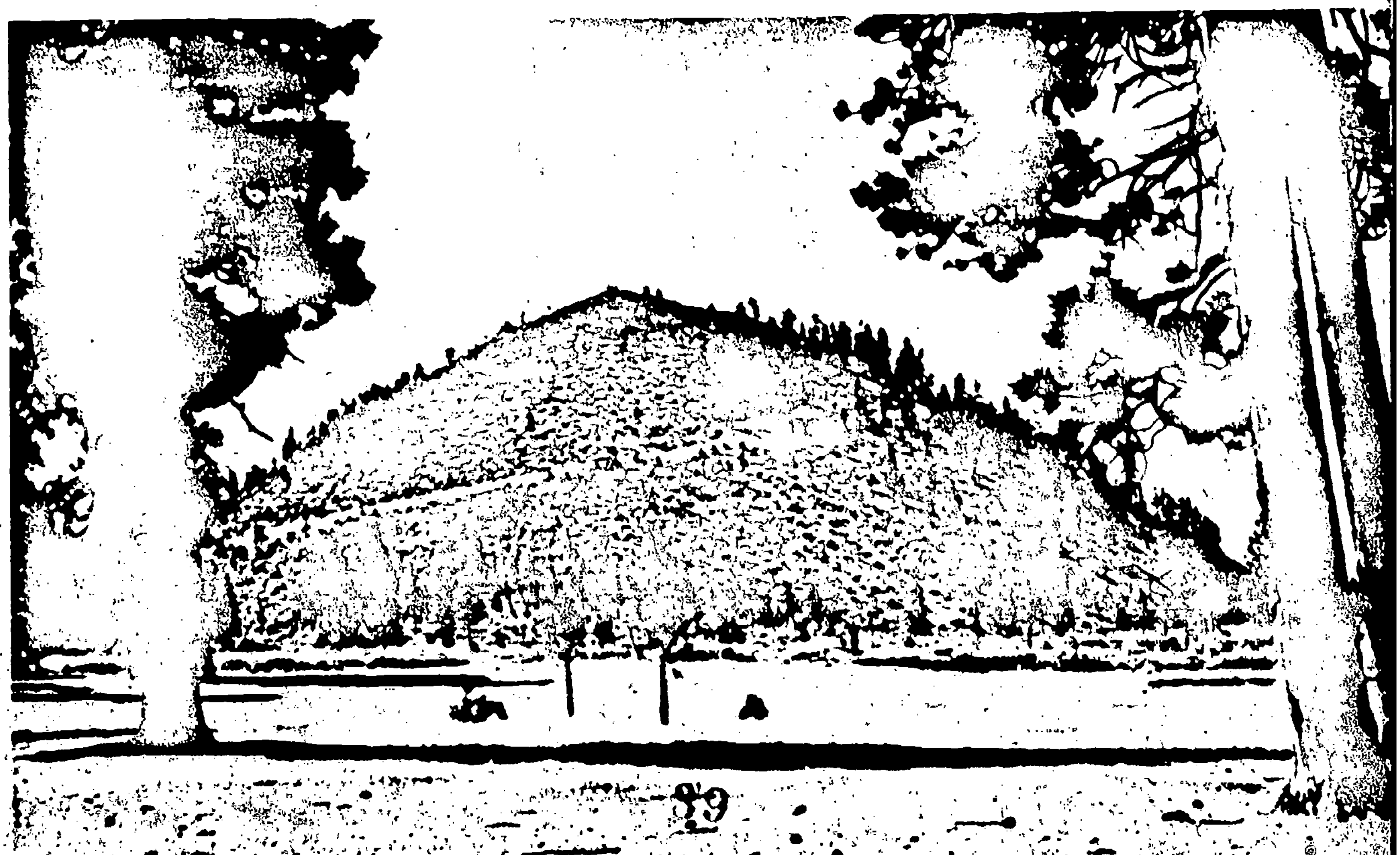
2-2. You should prepare in advance several bags, each containing 1 sample of pink granite (06) and 1 sample of red sandstone (19), 1 hand lens and 1 nail.

☐2-2. Obtain from your teacher the rock samples 06 and 19. Describe very carefully the appearance of each rock.

Do you think the rocks were formed in different ways? Explain your answer.

Identify at least one mineral in each rock.

☐**2-3.** Suppose you visited the mountain shown in the picture below to collect rocks. As you collected your rocks, suppose you found that most of them were one of three types—glassy, frothy, or fine-grained crystalline. Predict how the mountain was formed.



[ ]2-4. Describe the processes that probably formed the rock feature pictured below.

☐2-5. Describe how the mountains on the next page were probably formed.

☐2-6. Predict how the mountains shown in question 2-5 will look in the distant future.

☐2-7. Suppose the land around the Gulf of Mexico were uplifted in the future. Describe what you think the mountains would look like. What kind of rocks would you expect to find?

ERIC

SELF-EVALUATION 3

List the numbers of all the resources you used for this chapter.

☐ 3-1. What does the layered rock tell you about the history of the landscape shown in the picture below?

☐ 3-2. In this chapter you did several experiments with the stream table to find out some properties of rivers. Some factors you studied were the slope of a river, the volume of water, and the smoothness of the bed. How do changes in these factors affect the ability of a river to erode the landscape?

A

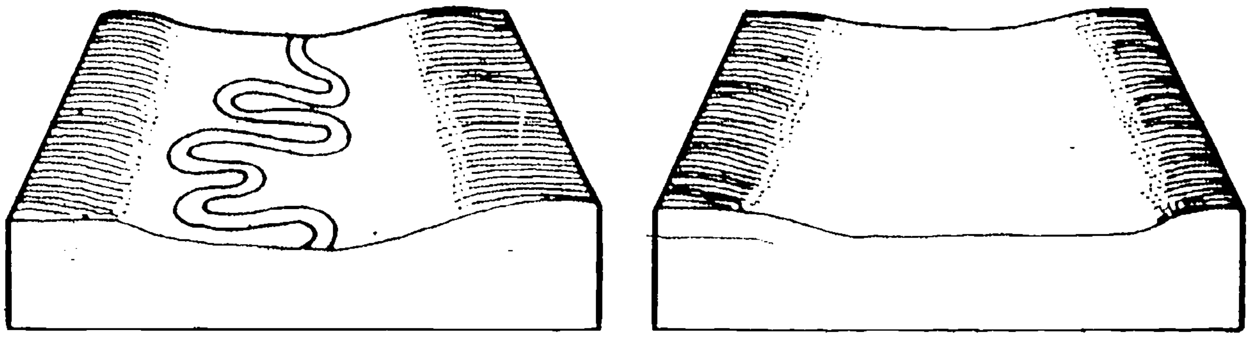
B

Questions 3-3 through 3-4 refer to Figures A and B above.

☐**3-3.** What are the major differences between the two streams in terms of potential energy? kinetic energy? erosive ability? rate of flow? size of particles carried in stream?

☐**3-4.** Predict what you think the landscape in each picture may look like in the future.

☐3-5. The figure below shows a river flowing toward the bottom of the page with a series of meandering bends. Make a sketch showing what you think will be the path of the river some time in the future. Explain your sketch.

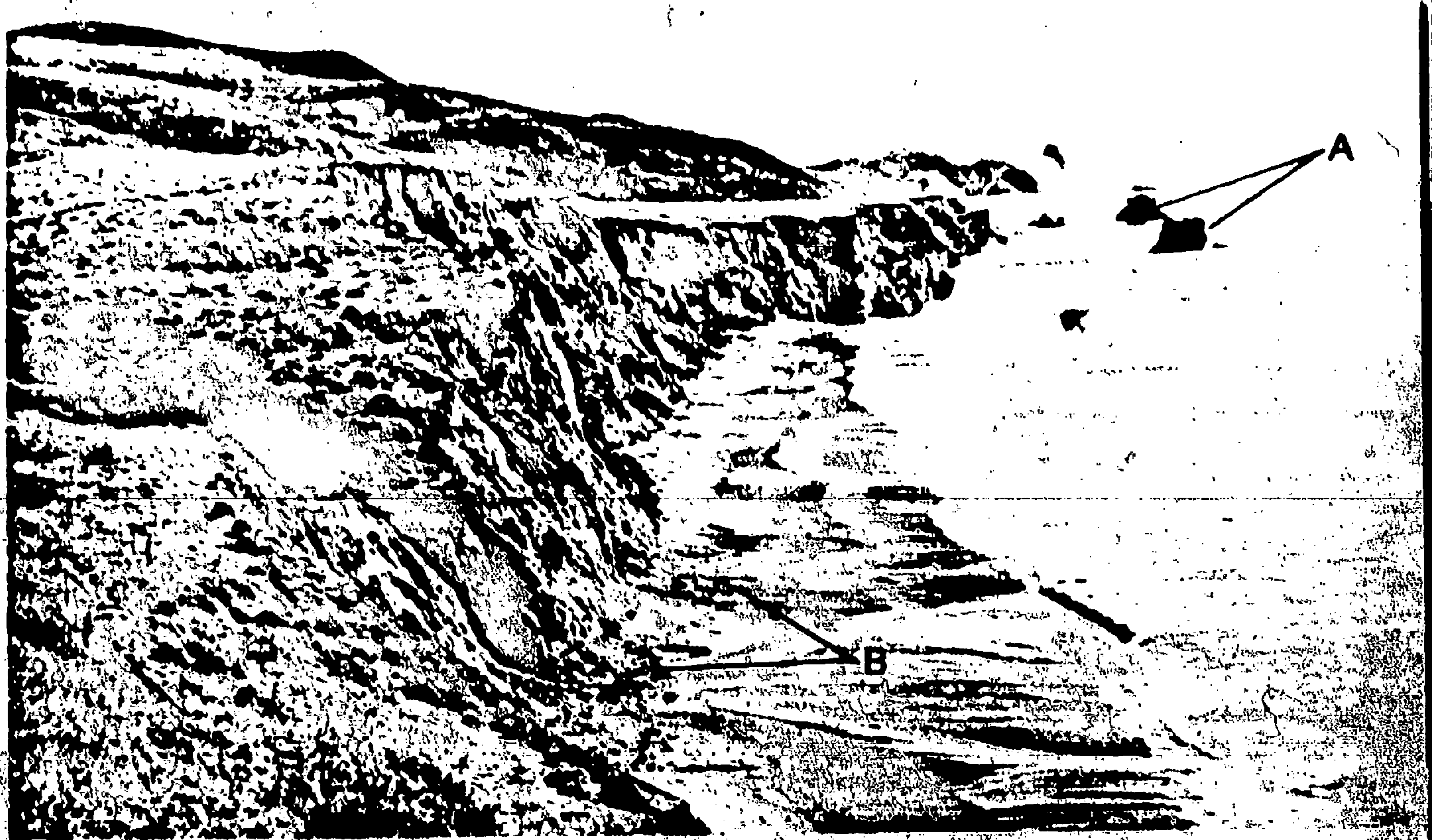


☐3-6. Some of the most fertile farmland in the United States is now on the bottom of the Gulf of Mexico near the mouth of the Mississippi. Where did it come from? How did it get where it is?

SELF-EVALUATION 4

List the numbers of all the resources you used for this chapter.

☐4.1. The following statements were made by an ISCS student about the landscape shown on the next page. Place a check mark (✓) next to each statement that you agree with. For those that you disagree with, state your reasons.



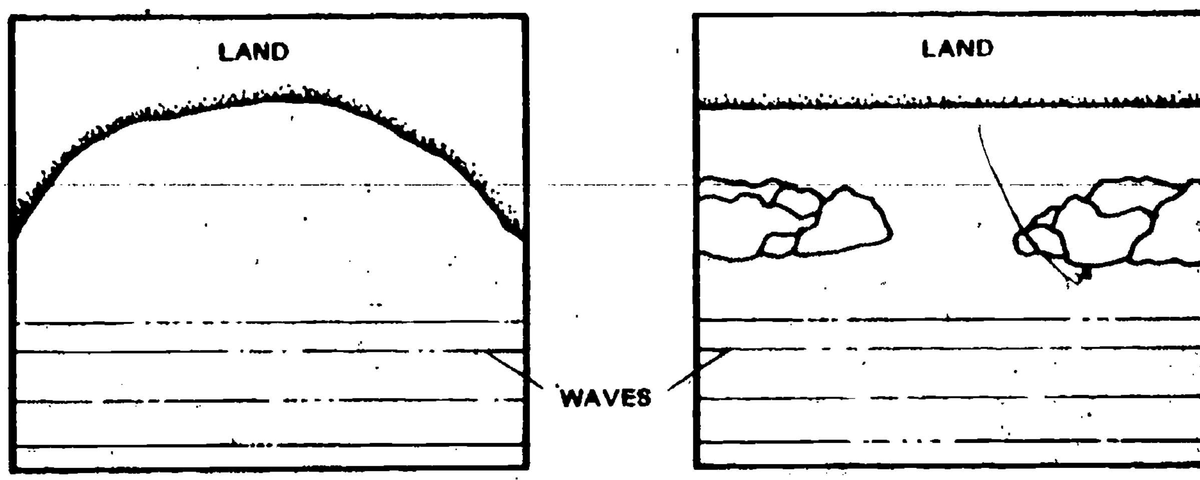
____a. There does not appear to be any evidence of uplift in this area.

____b. The rock outcrops at A are probably more resistant rock than the rock on the shore.

____c. The waves break because of interference or friction with the sea bottom.

____d. The debris that has accumulated at the bottom of the cliff B is evidence of storm activity.

☐4-2. For each diagram below, sketch a pattern that you believe describes the waves as they approach the shore.

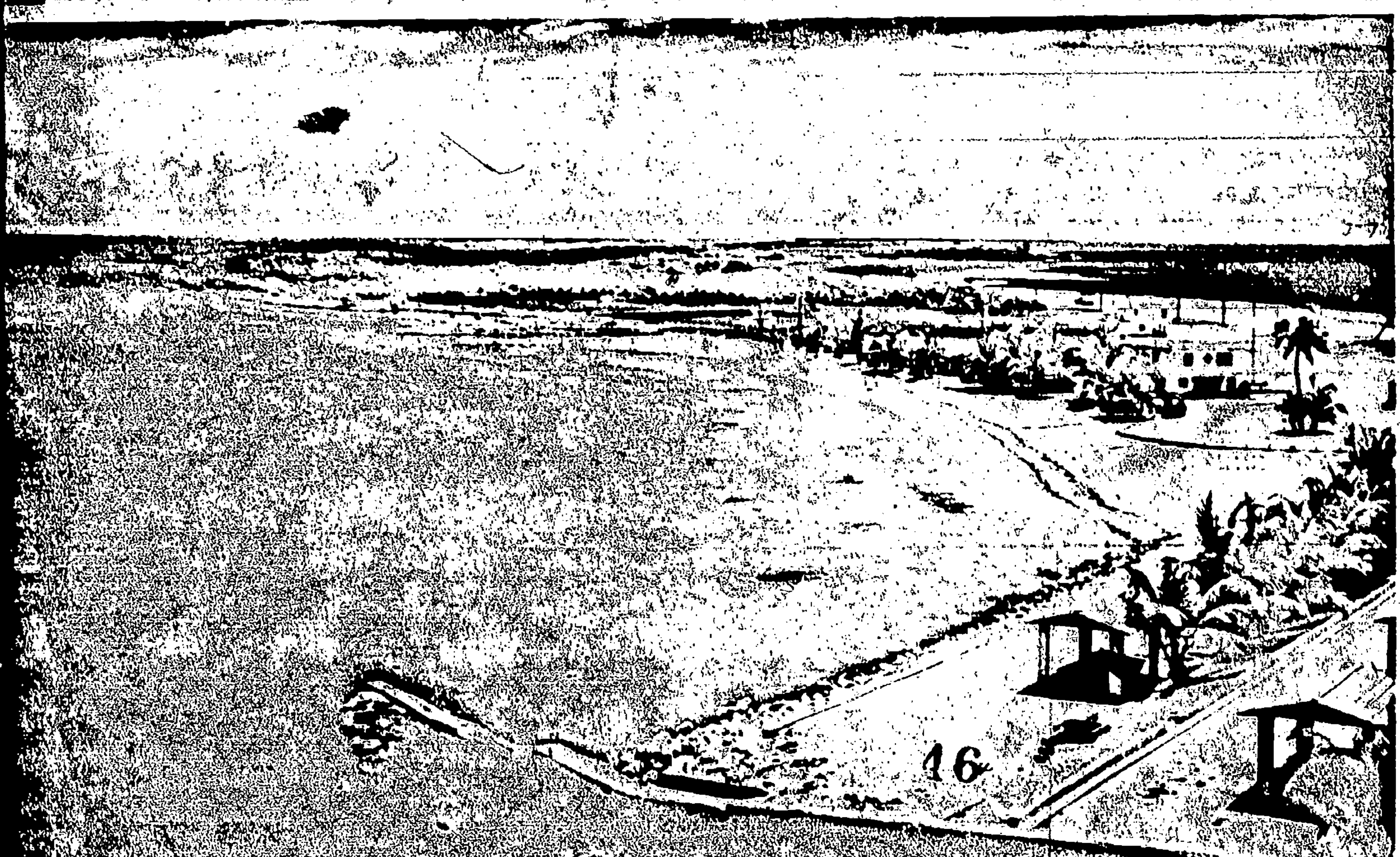


A B

☐4.3. Use the picture below to answer the following questions.
Do you think the beach house is in a good location? Why?

____

____



Was this picture taken at low, or high, tide? Explain your answer.

____

____

Do you think there are many sandbars in this area? Explain your answer.

____

____

☐4-4. Predict what would happen to the New Orleans harbor (below) if the area were not continuously dredged.

____

____

☐4-5. Place the letter D next to those features that are formed by deposition of earth material, and the letter E for those formed by the erosion of earth material.

____sandbar ____spit

____sea cave ____sea cliff ____beach

SELF EVALUATION ANSWER KEY

SELF-EVALUATION 1

1-1. Resources have been provided to help you answer the questions that are raised in each of the chapters of this unit. When you meet a resource question, you will be referred to a cluster of resources located at the end of the chapter. It is your responsibility to select and do the resource or resources that seem most appropriate. In some cases you will only have to do one or two resources to answer a resource problem, while in other cases you may have to use all the resources in a cluster. There are other places you might go for information—to your library, films, or even your community itself.

1-2. The observations that have been used to support continental drift are varied. They include the location of glacial features, such as grooves in rock and deposits of glacial till, on continents separated by oceans. This has led to the inference that these features could only exist if the continents were together during an ancient ice age. Another line of evidence you might have mentioned is the location of similar sequences of rocks on the Southern Hemisphere continents. See Resources 1 and 2 if you had trouble.

1-3. The following places would have large numbers of earthquakes: western coast of U.S. and midway between North America and Europe (mid-ocean ridge). If you live in a western state, you might have said the state you live in. The answers to this question are based on Activity 1-3, where you plotted the locations of a large number of earthquakes. Check your completed map of earthquakes, or look at the map on page 20 of *Crusty Problems.*

1-4. Sea-floor spreading seems to account for the pattern of earthquakes. According to the theory, new crust is forming at the mid-ocean ridges and spreading away from these areas. Crust is pulled back into the crust at deep-sea trenches. Thus, earthquakes should occur where the action is. In this case the action is along the mid-ocean ridges, the western edges of continents of North America and South America, across central Europe into Turkey and across to India. Thus, you should have noted that there are belts of earthquakes indicating the places where crustal plates are spreading apart or coming together. Review Resources 3 and 4 if you had trouble.

1-5. Your answer to this question depends on where you live. You may live in a mountain region, or you may live in the midlands. You may even live near the seashore. You can ask your teacher to check your answer. More than likely, you will recognize the kind of landscape of the nearby countryside even if you live in a city.

SELF-EVALUATION 2

2-1. You might have some of the following interpretations. Sedimentary rocks with a tilt of 21° have been uplifted from their original position. The fact that fossils of sea animals are found in a mountain might have led you to say that the land was uplifted from the sea (or sea level went down). Review pages 27-30 if you missed this.

2-2. Rock sample 06, which is a pink granite, is composed of more than one component or mineral. It contains a black mineral, a pink mineral, and an off-white mineral. The minerals (hornblende, feldspar, and quartz respectively) have an interlocking texture and are randomly arranged in the rock. Sample 19 is a sandstone. The rock is red in color, and if you examined it under a hand lens you probably noted that it appears to be composed of one mineral. It is noninterlocking. See pages 31-32 if you had trouble describing the rocks.

You should have concluded from your observations that the rocks were formed in different ways. Sample 06 was probably formed by the cooling of a hot molten material beneath the crust. The sandstone was probably formed from the accumulation of quartz grains in water, which were later cemented together. If you had trouble making interpretation, see Resources 6, 7, and 8. If you could not identify the mineral, check Resource 11.

2-3. The evidence suggests that the mountain is volcanic. If you look at the picture, you will see the mountain is cone-shaped, which is typical of volcanoes. The rocks described are igneous, which indicates that they are formed from molten material. See the section on Mono craters on pages 37-39, and check Resource 13.

2-4. The rock was apparently a flat-lying sedimentary rock that became folded because of pressures squeezing in from the sides. A model used to interpret folding is described in Resource 18.

2-5. The mountains pictured are wedge-shaped. One explanation for the formation of wedge-shaped mountains is slippage along a fault or an uplift. Whatever description you gave to help explain the shape of the mountains and their uplift is okay as long as it provides for the steep wedge-shape of the mountains. If you would like some help on this, see pages 35-37 and Resource 17.

2-6. Today, the mountains in the picture are steep and jagged. In the distant future, they may look quite different. They may be very smooth. It is also possible that folding may occur. As time passes, vegetation may increase on the mountains. These are only a few of the many predictions you could have made. It is important for you to include in your prediction the idea that in the distant future these mountains may look very different than they do today.

2-7. If the land around the Gulf of Mexico were uplifted in the future, the mountains would very likely be composed of ripple-marked, tilted rock. The area would probably have a great deal of sedimentary rock with impressions of small sea creatures and many shells. It is not likely that this event will happen in your lifetime or even in the next few hundred years. However, you might like to think about it. Since a tremendous amount of soil and silt is being dumped into the Gulf of Mexico from the surrounding rivers that empty into it, it is quite possible that this could happen someday.

SELF-EVALUATION 3

3-1. The rock, because of its horizontal layers, is apparently sedimentary. It was probably formed when sediments were deposited underwater. These sediments could have hardened into rocks by chemical action. Thus, the cliff here was probably underwater a long time ago. See Resources 7, 8, and 9 in Chapter 2 for information about how this area may have been formed.

3-2. The greater the kinetic energy of a stream, the greater its erosive ability. Increasing the slope of a stream makes the water flow faster. Streams with high slopes should erode more material than those with gentle slopes. The more water in a stream, the greater its capacity to carry material away. You should have noted that the smoothness of the bed affects the velocity. Increased smoothness increases the velocity. If you need to review these ideas, see Resource Cluster B in Chapter 3.

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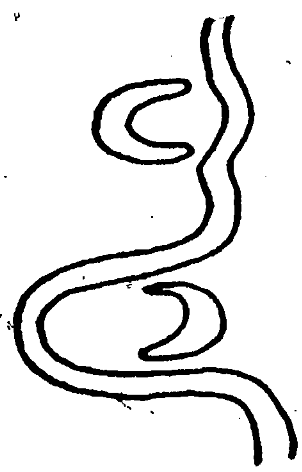
3-3. The stream in picture A is a meandering stream flowing along relatively flat ground. The stream in picture B is obviously a mountain stream, falling down a sloped area. The two streams are quite different. One is moving relatively slowly, twisting and winding, while the other is moving very rapidly. They are alike in that they are both composed of moving water and both streams have energy. With reference to each variable you may have included the following: You may have said that the stream in picture B has more kinetic energy and the stream in picture A has more potential energy if you assumed that it was at a high elevation. There is another way you could look at energy in these situations. You could consider that because of its height, the mountain stream also has potential energy. As the water plunges down the mountain, its potential energy decreases. When you talk about kinetic and potential energy, everything depends on your point of view.

See pages 103 and 104 for more information about energy. For the meandering stream in A, the outer bank of the river is being eroded by faster water, which has more kinetic energy. For the mountain stream in B, most erosion is probably taking place as the water hits in the lowest part of the picture. See Resources 28 and 36 for erosive ability. The rate of flow is probably greater in river B than in A. The size of the particles being carried in A are probably smaller (mud and silt size) whereas, because of the higher velocity, large particles can be carried in B. See Resources 27 and 28.

3-4. In the future river A may change its course many times. As it changes its course, it may leave behind small lakes and islands. It is possible that the river may even disappear, leaving behind a dry channel. It may even increase in size, covering a much larger area. In the distant future, a huge waterfall may be formed in the landscape shown in picture B, or there may be a series of waterfalls, one after the other. There's also a possibility that a large gorge may be carved out of the rock. See Resource 36 for river A, and 33 for river B.

3-5. Your sketch should show the continued erosion of the outer bends of the stream. This would cause cutoffs or oxbows to occur. One possible path is shown here:

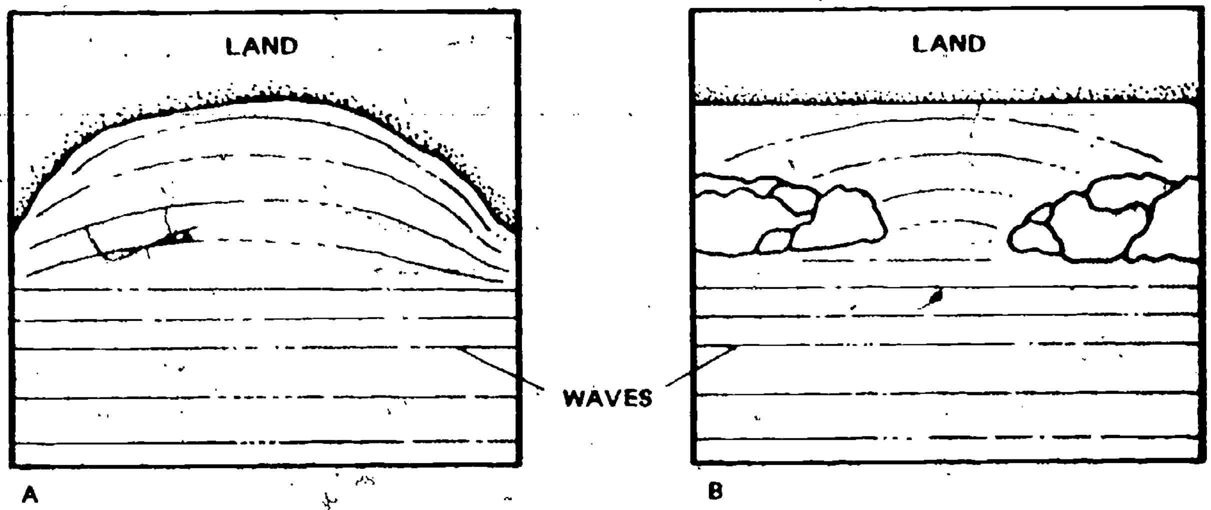


3-6. The Mississippi River drains a large portion of the midlands of the United States. If you look at the map in Resource 25, you will see that the Mississippi flows many, many miles through the midlands. Its origin is about Bemidji, Minnesota, from whence it flows south into the Gulf of Mexico. The area through which the Mississippi flows contains some of the most fertile farmland in the United States. As the river flows and tributaries join with the Mississippi, the water carries away the soil from these farmlands. Eventually, this soil is dumped in the Gulf of Mexico. If you ever visit the harbor at New Orleans, you will see huge pumps that work continuously to remove the sand from the bottom of the harbor in order to keep the channel open.

SELF-EVALUATION 4

4-1. You should have checked (agreed) items **b, c,** and **d.** If you did not agree with these, check Resource 38 for **b,** 39 for **c,** and Activities 4-1 through 4-3 for **d.** You may not have checked **a,** since there is evidence of a former beach or bench at a higher elevation. The flat surface in the upper center of the photograph well above the current beach might have been lifted to that elevation. Of course, you might have said that ocean level went down, and you could also be right.

4-2. The wave patterns might have looked like these:



Check Resource 40. For your information A is an example of waves bending because of refraction, and B because of diffraction.

4-3. If you studied the picture carefully, you probably came to the conclusion that this coastline does not receive violent wave action except perhaps during a storm. The beach house is sitting relatively unprotected. However, if you look closely at the trees, you will notice that they do not seem to be bent in any one direction, indicating that this area does not receive long periods of strong winds from a single direction. Probably the beach house is in a good location except, of course, in the event of a hurricane. You should have come to the conclusion that the picture was taken at low tide. (You can see a double row of seaweed and trash deposited along the beach as the tide went out.) Whether or not there are sandbars in this area is a more difficult question. You really have to study the picture very carefully. If you do, you will see a jetty in the foreground. This was built to prevent the transport of sand. If you visited this area, you would find that there are many sandbars, and sand could be transported up the coast. But the jetty has been built purposely to interrupt the wave action that transports this sand. Check Resource 46 for further information.

4-4. If you have studied the chapter on the midlands, you already know that tons of sand and silt are carried by the Mississippi River as it flows into the Gulf of Mexico. As the Mississippi River enters the Gulf, it slows down and drops some of its load. If the harbor were not continuously dredged, it would soon disappear, because the sand would pile up higher and higher.

4-5. You should have placed D for depositional features and E for erosional features as shown below. You can find further information on each feature by referring to the resources or pages listed next to each feature.

__D__ sandbar—Resource 46

__E__ sea cave—Page 161, and Resource 38

__D__ spit—Resource 46

__E__ sea cliff—Resource 38

__D__ beach—Pages 157–160

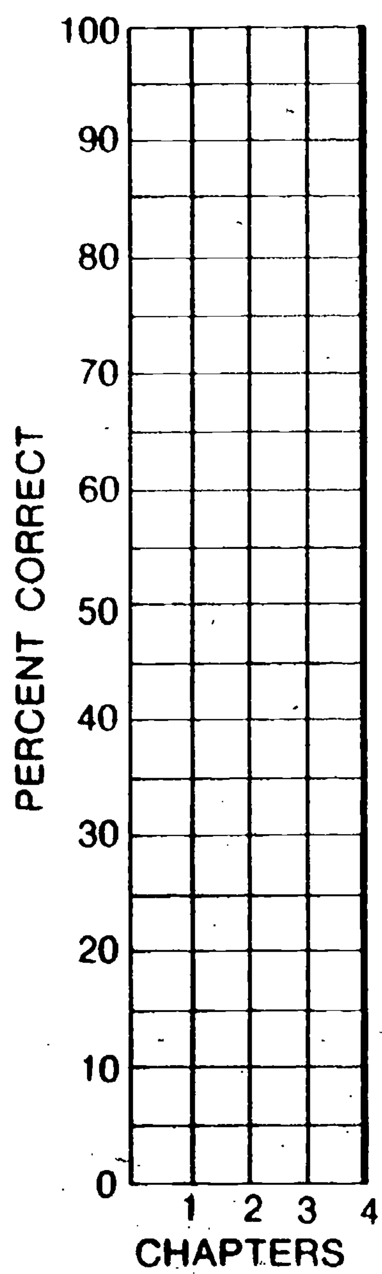
My Progress

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

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