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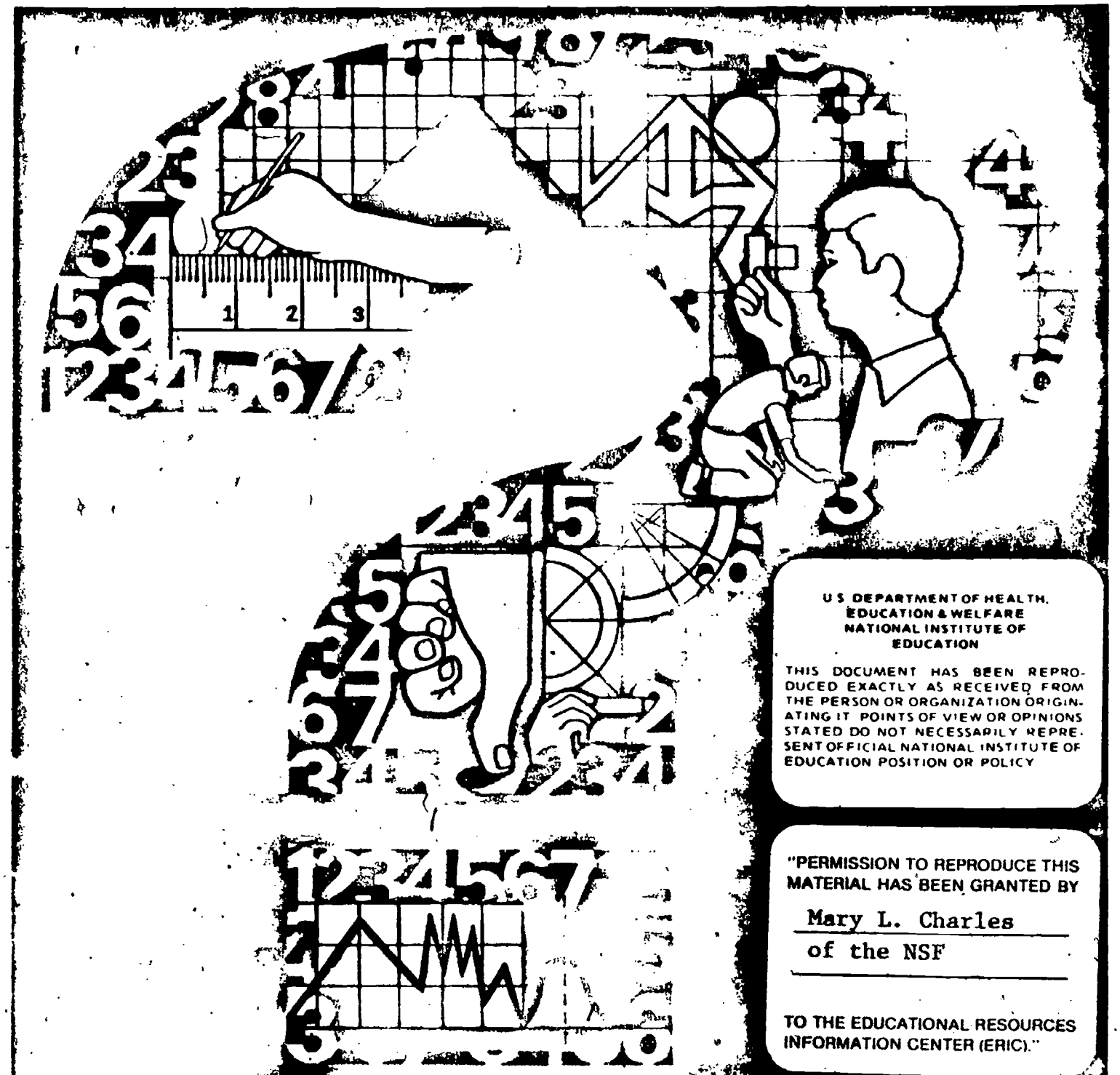
ABSTRACT

This is the student's edition of the Record Book which accompanies the unit "Investigating Variation" of the Intermediate Science Curriculum Study (ISCS) for level III students (grade 9). Space is provided for answers to the questions from the student text as well as for the optional excursions and the self evaluation. An introductory note to the student explains how to use the book. (SA)

Record Book

Investigating Variation



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INTERMEDIATE SCIENCE CURRICULUM STUDY

Record Book

Investigating Variation

Probing the Natural World / Level III

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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

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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
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.

☐1-1. _____

_____

_____

Chapter 1
The Road Ahead

Activity 1-1.

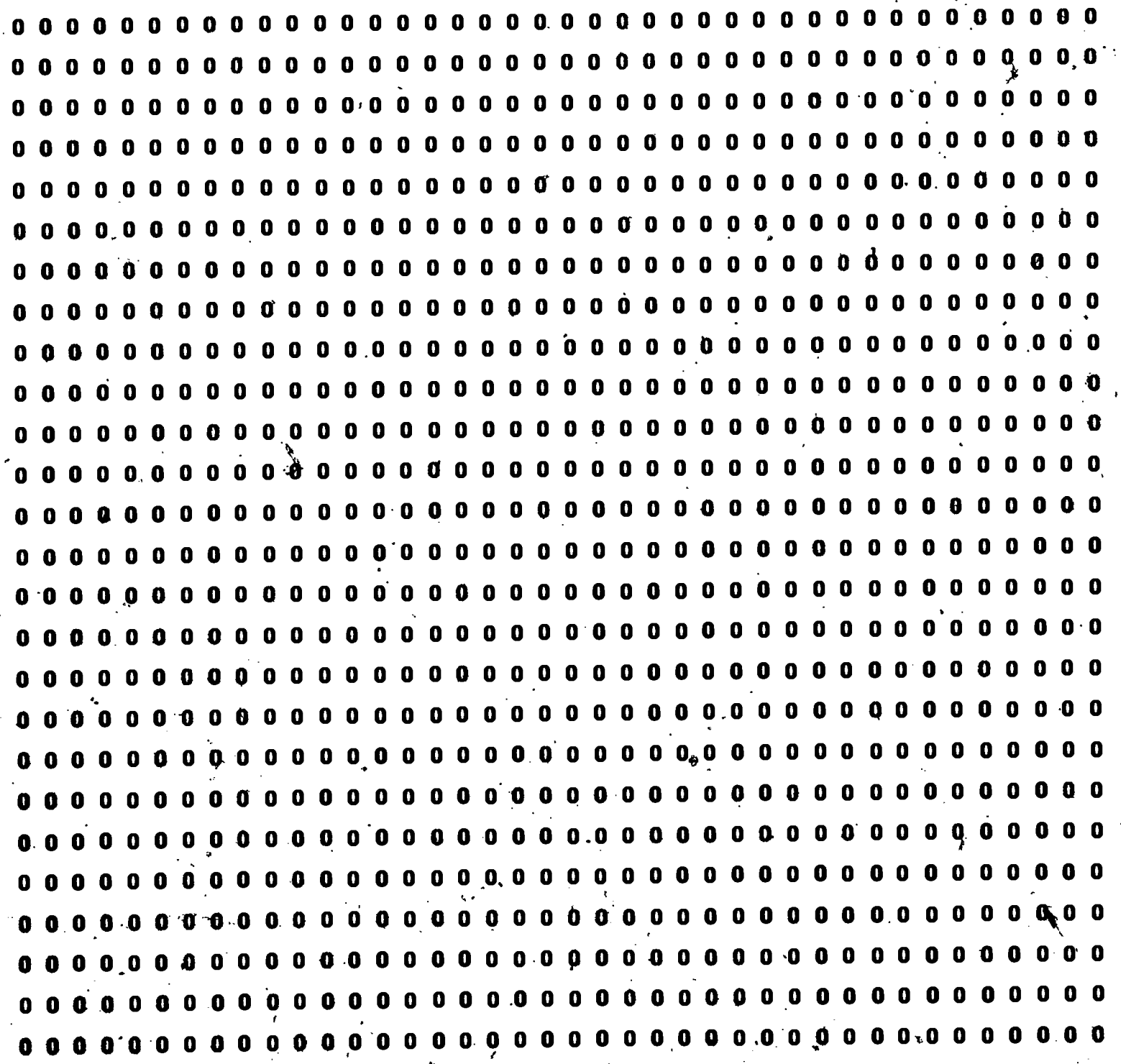


Table 1-1

	Number of Zeros Crossed Out	Handedness
Partner	Right	
	Left	
Self	Right	
	Left	

☐**1-2.** _____

_____

☐**1-3.** _____

_____

_____

Table 1-2

Name	Handedness Measure
Self	
Partner	
1.	
2.	
3.	
4.	
5.	

6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	

☐1-4. _____

☐1-5. _____

_____

_____

_____

☐1-6. _____

☐1-7. _____

☐1-8. _____

☐1-9. _____

Table 1-3

Subject	Going-out Reading	Going-in Reading
Partner		
Self		
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		

☐ 1-10. _____

_____

☐ 1-11. _____

_____

☐ 1-12. _____

☐ 1-13. _____

Chapter 2 Tallies and Tables

☐ 2-1. _____

Table 2-1

Eyedness	Tallies (checks)	Totals
Right		
Left		

Problem Break 2-1

My plan for measuring right- or left-eyedness:

_____

_____

_____

_____

_____

_____

Teacher Check _____

Data:

Observations:

☐2-2. (Answers will vary.)

Table 2-2

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Average
Self							
Partner							

Table 2-3

Average Grabbiness Measures	Tally	Totals
25–34		
35–44		
45–54		

55–64		
65–74		
75–84		
85–94		
95—		

Problem Break 2-2

Question: Do you react faster (or slower) to a sudden sound or touch than you do to a visual (sight) stimulus?

Procedure:

Data:

Conclusion:

☐2-3. _____

_____

_____

☐2-4. _____

_____

_____

☐2-5. _____

☐2-6. _____

_____

_____

☐2-7. _____

☐2-8. _____

☐2-9. 1. _____

_____

_____

_____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

Figure 2-3

Teacher Check _____

☐**2-10.** Data table:

Table 2-4

Teacher Check _____

☐2-11. _____

☐2-12. _____

☐2-13. _____

Problem Break 2-3

Questions:
1. Is there any correlation between sex and reaction time in students of your age?
2. Is there any correlation between handedness and eyedness in girls of your age?

Question 1:

Actual Grabbiness scores for boys and girls

Boy	Girl

Actual Grabbiness scores continued

Boy	Girl
Totals	
Average	

Question 2:

Girls: Handedness	Eyedness	
	RE	LE
RH		
LH		

Teacher Check _____

☐3-1. _____

_____

_____

☐3-2. _____

_____

_____

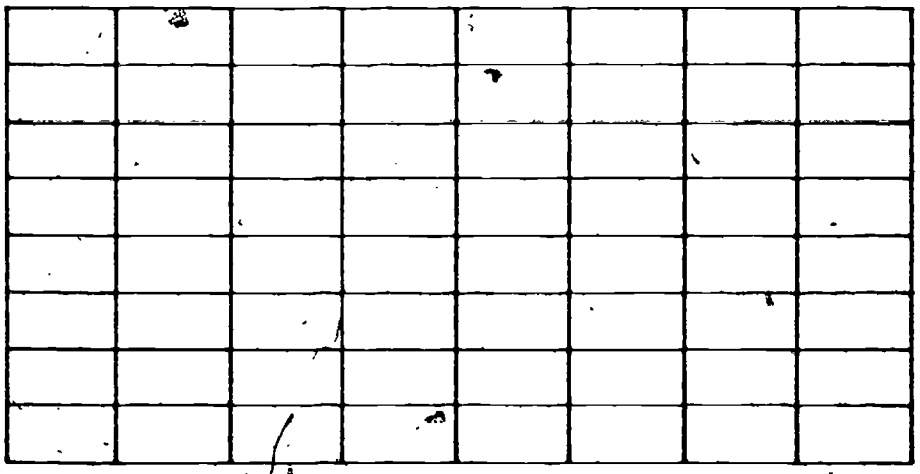
☐3-3. _____

_____

☐3-4. _____

☐3-5. _____

Figure 3-2



Teacher Check _____

☐ 3-6. _____

☐ 3-7. _____

_____

☐ 3-8. _____

☐ 3-9. _____

_____

☐ 3-10. _____

☐3-11. _____

_____

_____

☐3-12. _____

☐3-13. _____

☐3-14. _____

☐3-15. _____

☐3-16. _____

☐3-17. _____

☐4-1. _____

_____

☐4-2. _____

☐4-3. _____

☐4-4. _____

_____

☐4-5. _____

_____

☐4-6. _____

☐4-7. _____

Chapter 4
How Do You Measure Up?

Table 4-2

Student	Trial 1	Trial 2	Trial 3	Average
Self	____°	____°	____°	____°
Student 1	____°	____°	____°	____°
Student 2	____°	____°	____°	____°
Student 3	____°	____°	____°	____°
Student 4	____°	____°	____°	____°
Student 5	____°	____°	____°	____°
Student 6	____°	____°	____°	____°
Student 7	____°	____°	____°	____°
Student 8	____°	____°	____°	____°
Student 9	____°	____°	____°	____°
Student 10	____°	____°	____°	____°

☐**4-8.** _____

☐**4-9.** _____

☐**4-10.** _____

Problem Break 4-1

Procedure for measuring vertical field of vision:

Data:

Conclusions:

☐4-11. _____

☐4-12. _____

Table 4-3

Area Tested	Distance (cm) Between Points When They Are Felt as One					
	Trial 1		Trial 2		Average	
	Self	Partner	Self	Partner	Self	Partner
Back of forearm						
Back of neck						
Palm of hand						
Back of hand						
Sole of foot						

Table 4-4

Area Tested	Self	Classmates									
		1	2	3	4	5	6	7	8	9	10
Back of forearm											
Back of neck											
Palm of hand											
Back of hand											
Sole of foot											

Histogram of Data in Table 4-4

☐4-13.

Table 4-5

	Range	Mean	Mode
Back of forearm	____cm to ____cm	____cm	____cm
Back of neck	____cm to ____cm	____cm	____cm
Palm of hand	____cm to ____cm	____cm	____cm
Back of hand	____cm to ____cm	____cm	____cm
Sole of foot	____cm to ____cm	____cm	____cm

☐4-14. _____

☐4-15. _____

☐4-16. _____

Table 4-6

BLIND SPOT DISTANCE FOR EACH EYE

	Right	Left
Disappearing distance		
Reappearing distance		
Total blind distance (TBD) (disappearing minus reappearing)		

☐4-17. _____

☐ **4-18.** _____

☐ **4-19.** _____

☐ **4-20.** _____

_____

_____

_____

Activity 4-17

My plan for deciding how much my partner's guesses were off in direction and distance:

☐4-21. _____

_____

☐4-22. _____

Problem Break 4-2

My plan for measuring judgment of one-minute interval:

Data for myself, partner, and classmates:

☐ **4-23.** _____

☐ **4-24.** _____

☐ **4-25.** _____

Chapter 5 Personalizing the Population

Be sure to identify each problem break by number. Describe your plan, show all data, and give your conclusions.

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Excursions

Excursion 1-1
Measuring—Mostly in Metric

☐1. _____

☐2. _____

☐3. _____

☐4. _____

☐5. _____

☐6. _____

☐7. _____

☐8. A and E 15.7 mm

_____

A and F 16.8 cm

A and G 18.4 cm

CHECKUP

A and H ____ mm

A and J ____ cm

A and K ____ cm

A and L ____ cm

Excursion 2-1
On the Average

☐1. _____

_____

_____

Table 1

Index finger	_____ cm
Middle finger	_____ cm
Ring finger	_____ cm
Pinky	_____ cm

☐2. _____

☐3. _____

☐4. _____

Table 4

HEIGHTS OF NINTH-GRADE STUDENTS

Original Measurement (cm)	Rounded-off Measurement (cm)	Number of Rule Applied
180.4		
172.6		
174.7		
176.5		
181.5		
180.2		

179.8			
180.3			
182.9			
176.4			
173.6			
179.2			
161.1			
169.9			

Teacher Check _____

☐1.

Table 4

		Eyedness		
		RE.	LE	Total
Handedness	RH	75	14	
	LH	26	12	
	Total			

Excursion 2-2 Contingency Tables

☐2. _____

☐3. _____

☐4. _____

☐5. _____

_____

_____

_____

☐6. _____

☐7. _____

☐8. _____

☐9. _____

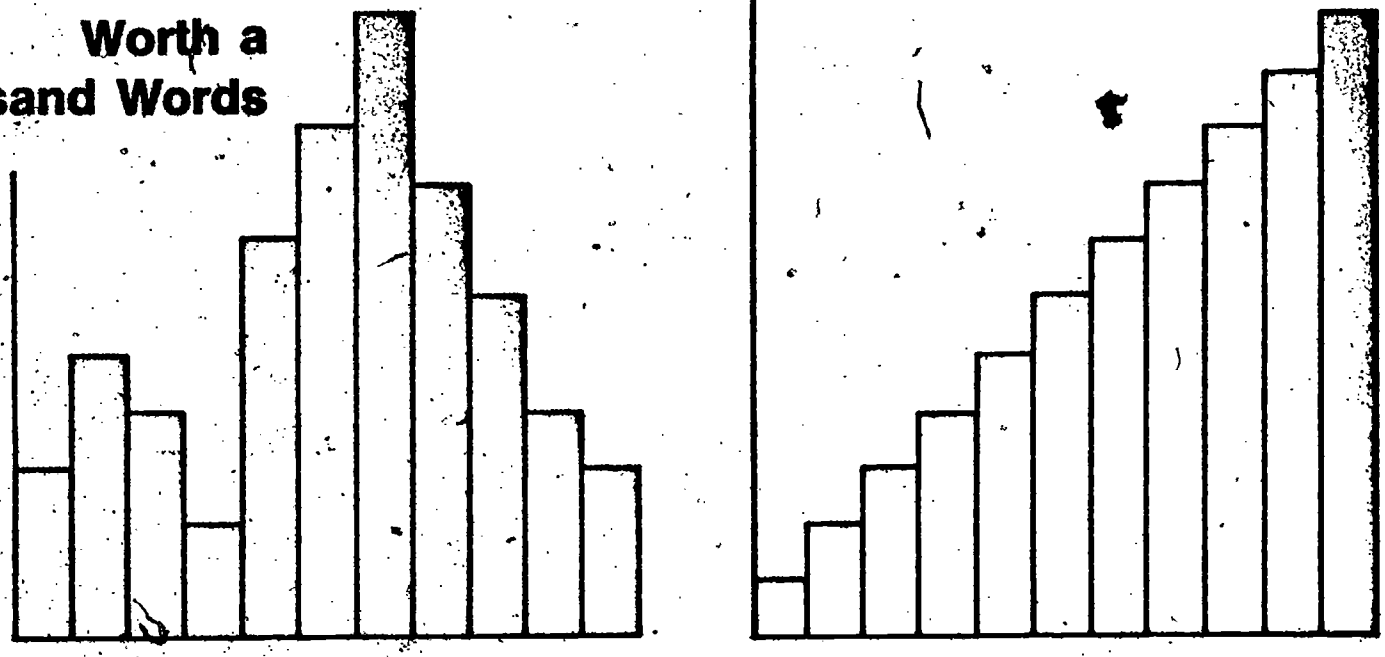
_____

_____

_____

Excursion 3-1 Worth a Thousand Words

☐1. Figure 4



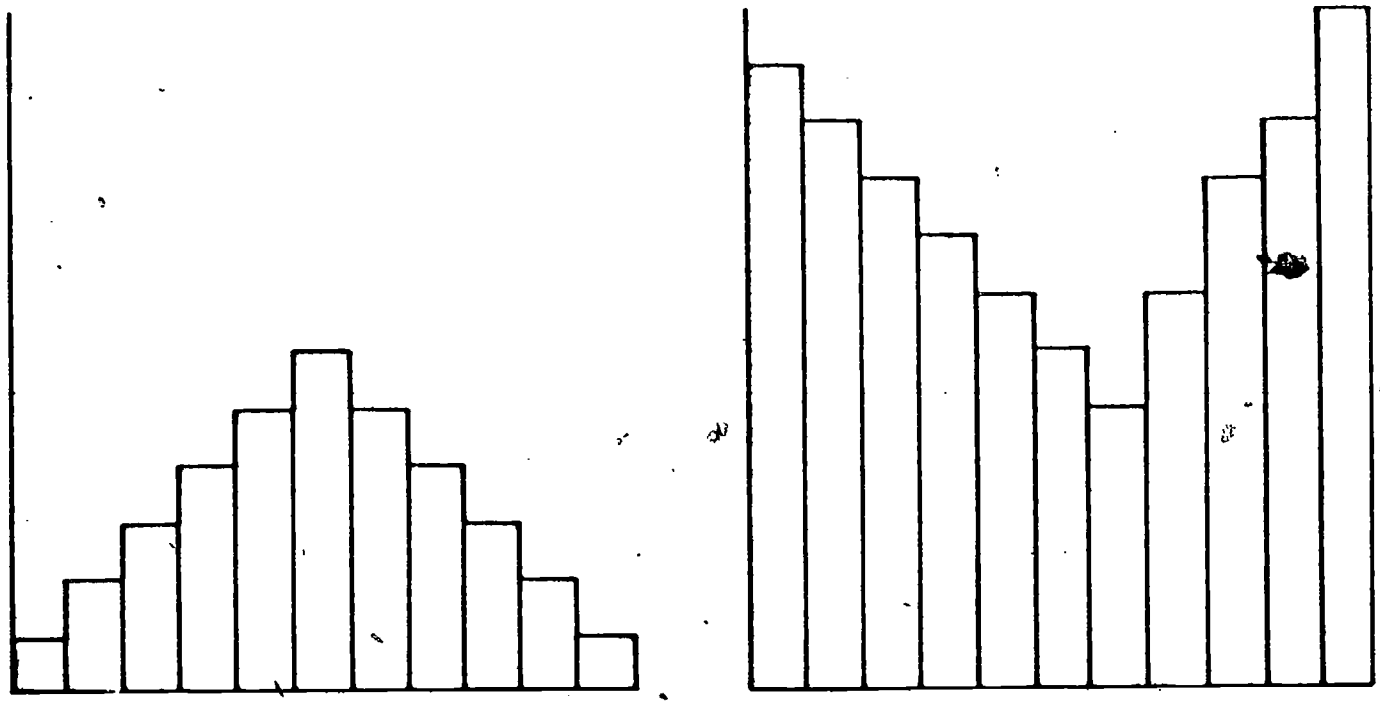


Figure 5

Excursion 4-1
Angles and Protractors

☐1. _____

_____

☐2. _____

☐3. _____

☐4. _____

Table 1

Figure 8	Angle Size
a	
b	
c	
d	
e	

☐5. Construct a 65° angle.

☐**6.** Construct angles of 72°, 30°, 115°.

Table 1

Eye(s)	DISTANCE BETWEEN A AND B (in cm)		
	Trial 1	Trial 2	Average
Right only			
Left only			
Both eyes			

☐1. _____

_____

_____

_____

☐2. _____

_____

☐3. _____

_____

Additional Experiments

Excursion 4-3
No Two Alike

☐1. _____

Table 1

	PRINT PATTERN FOR EACH FINGER				
	Thumb	1	2	3	4
Right hand					
Left hand					

☐2. _____

☐3. _____

☐4. _____

_____

Excursion 5-1 Sampling Populations

☐1. _____

_____

_____

_____

_____

☐2. _____

_____

_____

_____

_____

☐3. _____

☐4. _____

_____

☐5. _____

_____

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 page 54 of this booklet, there is a grid, which you can use to keep a record of your own progress.

Circle the excursion for this chapter if you completed it.

SELF-EVALUATION 1

1-1

☐**1-1.** What is meant by an operational definition?

☐**1-2.** Suppose you were interested in measuring the variability of heart rate (pulse rate) among the students in your class. Give an operational definition of heart rate.

☐**1-3.** Measure the lengths of the lines below to the nearest millimeter.

a. _____

b. _____

c. _____

SELF-EVALUATION 2 Circle any of the excursions for this chapter that you completed.
2-1; 2-2

☐**2-1.** Calculate the average of the numbers given below.

a. 24.6 21.9 31.8 _____

b. 1.8 1.4 2.3 1.4 2.1 _____

☐**2-2. a.** What is meant by an either-or variation? _____

_____

_____

b. What is meant by a continuous variation? _____

_____

_____

☐**2-3.** In this chapter, you have been making data tables. Why do we bother making tables of the data? _____

_____

_____

☐**2-4.** Indicate whether the following are either-or variations or continuous variations.

a. large or small _____

b. odd or even _____

c. dead or alive _____

d. fast or slow _____

☐**2-5.** Susan wanted to see if there was some relationship between the handedness of the students in her class and whether they were boys or girls. The data she collected is on the next page.

Susan—girl—left	Debbie—girl—right
Mike—boy—right	Wesley—boy—left
Henry—boy—right	Everet—boy—right
Jane—girl—right	Maria—girl—right
Martha—girl—right	Patrick—boy—right
Bill—boy—right	Isabel—girl—left
Larry—boy—right	Eric—boy—right
John—boy—left	Jim—boy—right

a. Draw and fill in a data table that would allow you to see any patterns more clearly.

b. How many girls are right-handed?_____

c. Is there any relationship between sex and handedness in this class?_____

d. Explain your answer to c._____

_____

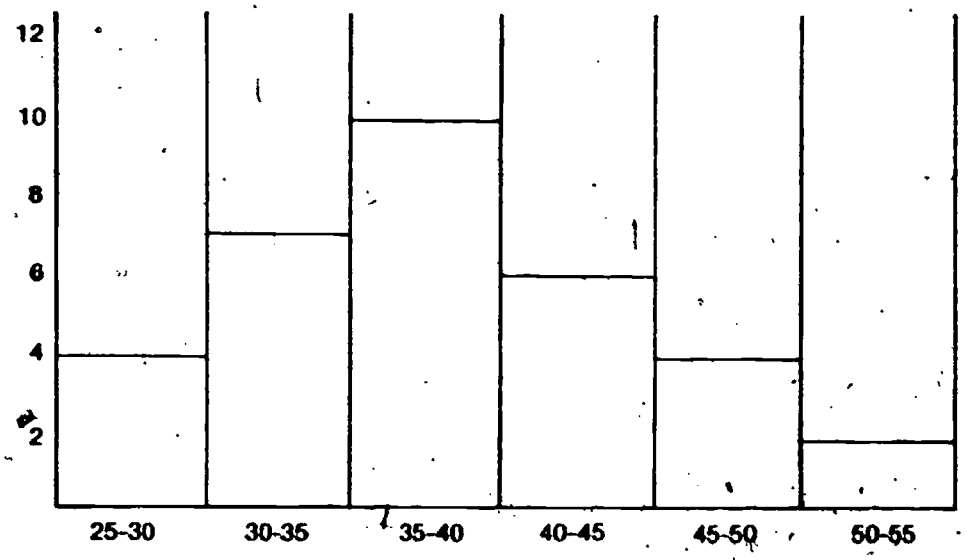
_____

Circle any of the excursions for this chapter that you completed. **SELF-EVALUATION 3**

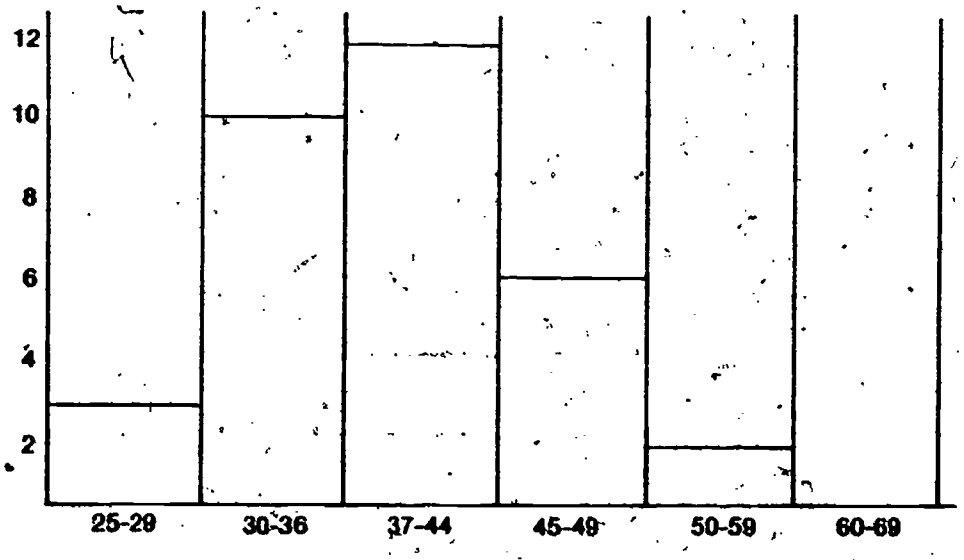
3-1

☐**3-1.** George and Susan were having trouble with histograms, so their teacher gave them a set of data and asked them to try another one. They set to work and soon produced the histograms shown below.

George's Histogram



Susan's Histogram



When they took their histograms to their teacher, he said that they still were not quite right. Can you help them find their mistakes?

a. What mistake did George make?

_____

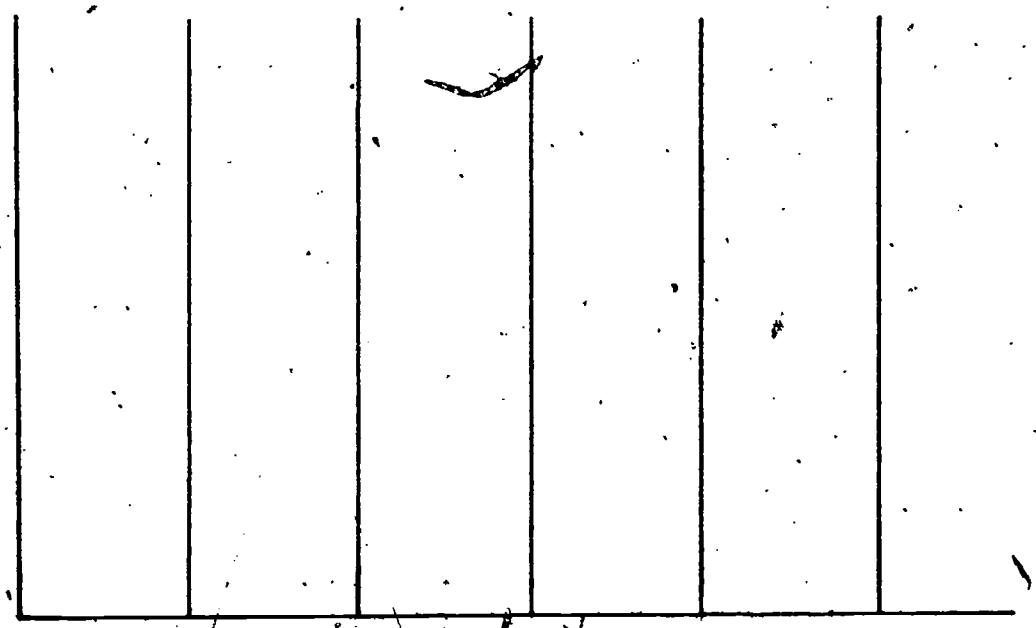
_____

b. What mistake did Susan make?

☐**3-2.** Nancy helps the school librarian. She wondered whether there was any variability in the number of times a book was read during a year. She picked out forty books and looked to see how many times each one had been signed out in the last year. Use her data to answer the questions that follow.

Book	Times Out	Book	Times Out	Book	Times Out	Book	Times Out
1	3	11	12	21	1	31	13
2	7	12	0	22	21	32	10
3	13	13	7	23	7	33	15
4	0	14	5	24	16	34	0
5	15	15	2	25	11	35	18
6	10	16	8	26	24	36	7
7	3	17	14	27	13	37	11
8	2	18	0	28	10	38	14
9	11	19	18	29	20	39	9
10	7	20	10	30	6	40	5

a. Group the data into five groups and plot the data on the histogram given below.



b. What is the range of the data?_____

c. What is the mode?_____

d. What is the mean?_____

e. If a book is signed out 8 times a year, is it above, or below, the mode?_____

f. Is the book that is signed out 8 times a year above, or below, the mean?_____

SELF-EVALUATION 4 Circle any of the excursions for this chapter that you completed.
4-1; 4-2; 4-3

☐**4-1.** In your investigations of human variation, you have used several trials for each measurement. Why was one trial not enough?_____

☐**4-2.** When you investigated the sense of touch, you had the person you were testing close his eyes. Why?_____

☐**4-3.** Design an investigation that would allow you to test whether a person has the same angle of vision in his left eye as in his right eye. Include the data table you would use to record the data.

Data Table

☐**4-4.** One of the girls in the class asked all the boys whether they had ever built a model airplane. She found that 3 boys had and 12 boys had not.

a. With this data, can you predict whether Henry, one of the boys in your class, has built a model airplane or not?

b. Explain your answer to a. _____

SELF-EVALUATION 5 Circle the excursion for this chapter if you completed it.

5-1

☐**5-1.** When people take a poll or opinion survey, they generally try to take a random sample of the group they are interested in. For example, they may take every tenth name in an alphabetic list of the people in the group. Why is it important to have a "random" sample?

☐**5-2.** The science club in a school was trying to raise some money to go on a special field trip to a science museum in a nearby city. They came up with the idea of renting a feature-length science film and charging twenty cents admission. To see whether enough students would come out to see the film, they asked Bob and Pat to make a survey of the students to see how many would want to come. Late that afternoon, they reported back. Bob said that 75% of the students he talked to would come. Pat said that only 20% of the students she talked to would come. How would you account for these different responses?

SELF-EVALUATION ANSWER KEY

SELF-EVALUATION 1

1-1. You should have included two ideas in your answer. An operational definition should tell you how to determine if a thing is present or not and how to measure how much of it is present. Read over text pages 6 and 7 if you had difficulties with this question.

1-2. Any one of several answers could be correct. You should have included a method of detecting the heart beat, such as using a stethoscope or feeling the pulse in the person's wrist. To measure the rate of the pulse, you must also have mentioned a means of counting the number of beats over a period of time—perhaps 30 seconds or 60 seconds. You should also have included the conditions under which the measurement is to be made. For example, the person sits still in a chair for five minutes before you measure his heart rate.

1-3. **a.** 16 mm
b. 71 mm
c. 46 mm
If you missed any of these measurements, you should review **Excursion 1-1**.

SELF-EVALUATION 2

2-1. **a.** 26.1
b. 1.8
If you missed either of these answers, you should take another look at **Excursion 2-1.**

2-2. **a.** An either-or variation is one that appears in one form or the other with no gradations in between.
b. A continuous variation is one that can take on many different values. If you had problems with either answer, you should reread pages 20 and 21.

2-3. Data tables serve to organize the data so that it is easier to see relationships. Reread pages 21 to 23 if you had difficulties with this question.

2-4. **a.** continuous
b. either-or
c. either-or
d. continuous
You should reread pages 20 and 21 if you had difficulty deciding which were continuous and which were either-or variations.

2-5. a. Your data table should be similar to the one shown below. If it is much different, you should take another look at pages 22 and 23 of the text.

	HANDEDNESS	
	LEFT	RIGHT
Boy	2	8
Girl	2	4

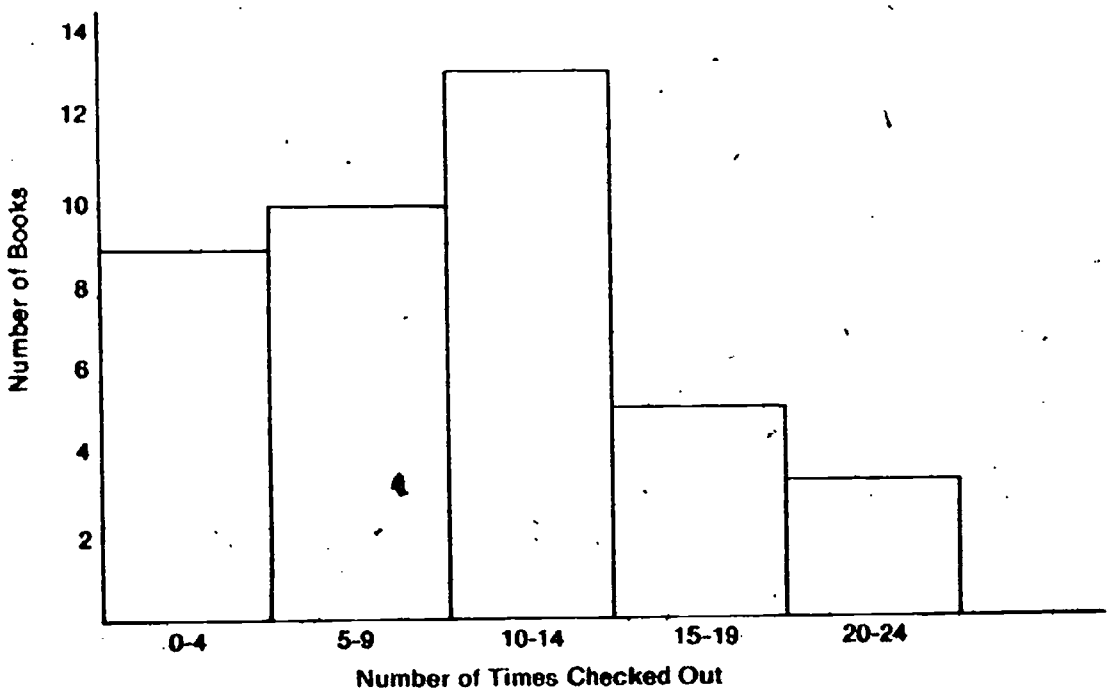
b. Four girls are right-handed.
c. Yes
d. A larger fraction of the girls than of the boys are left-handed.

SELF-EVALUATION 3

3-1. a. George's histogram has overlapping groups. If he has a value of 40, he is not sure of whether it goes in the 35–40 group or the 40–45 group.

b. Susan's histogram has groups that are unequal in size. Her 30–36 groups is not as wide as her 50–59 group.

3-2. a. Your histogram should be similar to the one shown below. Check over **Excursion 3-1** if it is much different.



b. 24. The smallest number is 0 and the largest is 24.

c. 7. Five books circulated seven times a year. (Reread pages 28 and 29 if you had problems finding the mode.

d. 9.45 check-outs/year. See **Excursion 2-1** if you had difficulty with this.

e. It is above the mode.

f. It is below the mean.

SELF-EVALUATION 4

4-1. In most investigations, several trials are used to increase the accuracy of the result. When several trials are used, the errors in measurement tend to cancel out.

4-2. Perhaps the most important reason was so that the person could not see whether you were touching him with one toothpick or two. If he can see the two points touching him, he will seem to be able to feel two points no matter what their separation. You may want to investigate this further.

4-3. You may have used a setup similar to the one you used for the angle of vision measurement in Activities 4-2 to 4-9. You should have stated that the person should cover one eye and then the other when making the measurements, and that several trials should be used for each measurement. Your data table should look similar to the one shown below.

	Angle of Vision Left Eye				Angle of Vision Right Eye			
Student	Trial 1	Trial 2	Trial 3	Avg.	Trial 1	Trial 2	Trial 3	Avg.

If you had difficulty designing the investigation, you should check over pages 37 to 40.

4-4. a. No, you cannot tell for sure whether Henry has built a model airplane or not.

b. Once you have grouped the data, it is impossible to be certain about any one individual. You can, however, make an educated guess and say that Henry has not built a model airplane, since most of the boys in the class have not built a model airplane. Remember, though, that this is only a good guess and not a certainty.

SELF-EVALUATION 5

5-1. If a sample is not chosen at random, your results may not represent the actual feelings of the group. In other words, you may have a biased sample. For example, you might want to find out how many books a student in your school reads each month. If you went to the library during a spare period and asked the students there how many books they have read during the last month, you would get a much different result than if you asked the same number of students in the cafeteria during lunch. Take another look at **Excursion 5-1** if you had difficulty with this question.

5-2. There are two things that could have gone wrong. One of the samples may have been biased, or they may not have asked the same questions. Bob may have raved about the interesting film and told everyone that admission was only twenty cents, while Pat may have made the movie sound less interesting and not really worth paying twenty cents to see. If you don't think that the questions and the tone of voice make a difference in how people answer, try one of your investigations from this chapter with different sets of questions.

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 may go up and down like a series of mountain peaks.

RECORD OF MY PROGRESS