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Alternative Formats for Testing: Changing a History of Failure

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Running head: ALTERNATIVE TEST FORMATS

Abstract

Many students experience difficulty taking traditional teacher-made tests and often score below their ability. A survey of student preference among three tests types (traditional, modified-choice, and oral/checklist) indicated that a majority would prefer a modified test that allowed them to choose the test item type. It was hypothesized that students would perform better on a modified-choice test (Test B) than on the traditional (Test A). Students were tested over three different science lessons using both types of tests. It was found that on the average, there is not significant difference between scores on the two test types. The discussion suggests possible reasons for this result, and brings out the fact that some students did perform significantly better on Test B.

Alternate Formats for Testing:
Changing a History of Failure

Testing continues to be one of the most controversial issues education. Educators have long debated the relative effectiveness of different methods of evaluating student performance. Not only is the present situation considered far from ideal, it may also be jeopardizing the scholastic careers of many students. According to Paris, Lawton, Turner, and Roth (1991), low achievers in particular are often so disillusioned by the time they reach high school that these students use poor test-taking strategies, which in turn distort their test results. Such findings raise the questions: Why are these pupils so discouraged? What causes this test burnout?

In 1986, Braun, Rennie, and Gordon demonstrated that students' test scores vary when different types of tests are used. They implied that certain forms of testing tend to discriminate against some students. Carcelli, Taylor, and White (1980) found that some kinds of test questions require additional intellectual skills as well as knowledge of content information. Additionally, Sternberg (1989) showed that administrators often wrongly classify students who suffer from test anxiety.

The two types of tests most frequently administered to elementary school students are standardized tests and teacher-made tests (sometimes based on published tests accompanying textbooks). Standardized tests are the most statistically useful for comparing local and national norms. These tests represent the attempt by educators to devise a totally objective instrument.

Recently, however, extensive use of standardized achievement tests like the ITBS, TCAP, and CTBS has come under close scrutiny. Many studies have dealt with different aspects of such testing. Wood (1982) and Marso and Pigge (1989) surveyed the attitudes of school personnel toward standardized testing. Wise, Ducan, and Plake (1985) researched the effect on third graders of using separate answer sheets on ITBS tests. Hill and Horton (1986) and Sudweeks, Baird, and

Petersen (1989) dealt with test anxiety. Numerous researchers have focused on test-wiseness (Phillips, 1983, Stewart & Green, 1983, Prell & Prell, 1986). Glazer (1993) sharply criticized standardized testing, and urged that "tests . . . offer more options for children to demonstrate growth" (p. 68). Lee (1992) was critical of the "negative impact" of widespread standardized testing in the early grades.

A pilot study done by Snyder, Chittenden, and Ellington (1993) demonstrated that standardized testing was a poor measurement of the reading abilities of low-achieving students. Students who failed the test were actually functioning quite well in classroom reading. The researchers found that the lower the student's test score, the larger the discrepancy between test results and observed behavior. However, Stiggins (1985) and Griswold (1988) found that elementary teachers tend to rely more on teacher-made tests and personal observation, and that they rank standardized testing as one of the least important factors in determining grades.

Teacher-made tests have also been the focus of a number of studies. Powell and Gillespie (1990) emphasized the difference between selected-response and constructed-response tests. Sax and Reiter (1980) debated the relative merits of true-false and multiple-choice tests. McMorris, Urbach, and Connor (1985) studied the effects of including humor in test item construction.

According to Sternberg (1989), traditional pencil-and-paper tests do not measure all three types of intelligence (analytical, creative, and practical). In addition, new voices are advocating the use of more creative evaluation instruments. These include Mitchell (1991), Hein (1990), Perrone (1991), and Herman, Aschbacher, and Winters (1992). Glazer (1993) and Lee (1992) recommended using original stories, portfolios, performance samples, checklists, projects, and other types of "authentic" evaluation. Glazer finds the increasing balance of assessment methods encouraging.

However, this trend poses a new set of problems. As Hein (1990) asserts, it is more difficult to interpret tests that evaluate thinking skills than those that merely measure knowledge of facts. Perrone (1991), commenting on some of the new methods of evaluation, posited that "They call upon us to ask . . . what would cause us to say that our students are thinkers, readers, writers, or comprehenders of knowledge, and to then work out systematic processes to follow up such questions" (p. 166). Obviously, this can make assessment practices more powerful and credible, while at the same time aiding in student learning.

Marso and Pigge (1989) studied 800 Ohio school personnel, and found that most of the teachers did, in fact, write their own tests and test items, but these teacher-made tests were very error-prone and rarely analyzed. Herman and Dorr-Bremme (1984) found that nearly four fifths of all teachers did not receive adequate training and experience to construct good classroom tests.

Watanabe and Algozzine (1989) found a number of factors that increased performance of special education students on teacher-made tests. These factors included using columnar format for multiple choice items, giving examples for each question type, stating directions clearly at the beginning of each section, using black and white ink (no blue dittoes), and varying types of questions.

Wood, Miderhoff, and Ulschmid (1989) added a number of items found to help mildly disabled mainstreamed students: avoiding frequent use of fillers (E--all of the above) in multiple choice items; clustering matching items in groups of no more than 10; highlighting words such as NOT, NEVER, and ALWAYS that appear in true/false questions; and providing word banks and large answer blanks.

Statement of the Problem

Since research shows that instructors depend heavily on teacher-made tests, it is important to continue searching for ways to improve performance on this particular assessment tool. Answers to the following questions are imperative. What aspects of the test itself can teachers modify? Will students benefit from being able to select the format of their test questions? Do students' scores increase when tests are modified according to their preference of format? Is there a correlation between the student's performance on the format of his choice and the time that it takes him to complete the test? Do males and females perform equally well on different test formats?

Purpose of the Study

The purpose of this study was to determine whether students perform better on a test modified to allow choice of item format than on a traditional test that requires them to answer all test items.

Statement of Hypotheses

The research hypotheses were: (a) students perform better on a modified-choice test than on a traditional test on magnetism, (b) students perform better on a modified-choice test than on a traditional test on waves, and (c) students perform better on a modified-choice test than on a traditional test on simple machines.

Limitations of the Study

Since this researcher designed the instruments used in this study and conducted the actual teaching of the lessons, a question may be raised as to experimenter bias. The practice gained by being tested over the same material twice should also be considered, as should the fatigue caused by repeated testing. The practice effect was hopefully ameliorated by reversing the order in which the student received Tests A and B for each consecutive repetition. Another factor that was not specifically addressed in this study was the equivalence of cognitive difficulty level between the two types of test formats.

Method

Subjects

Subjects were 25 students (12 girls and 13 boys) from a fourth grade class at the Southern College lab school, Spalding SDA Elementary School. Students received class credit for the time spent in the study, but were not graded on participation. Each student was evaluated using both a traditional (Test A) and a modified-choice test (Test B). Two students completed only part of the study; their results were not included in the analysis.

Materials

Materials used in Lesson 1 (Magnets) included an assortment of small magnets and paperclips, and a magnet science kit (bar magnets, washer magnets, horseshoe magnet, wire/nail/battery electromagnet). Lesson 2 (Waves) involved the use of a Slinky, assorted rubber bands, and a cello belonging to one of the students. Lesson 3 (Simple Machines) was taught using assorted weights, pulleys, a lever assembly (meter sticks and fulcrum), and a small screw-operated lift.

See Appendix A for copies of the preliminary survey and miscellaneous paperwork. Appendix B contains the objectives, lesson plans, and tests for each unit.

Procedures

Prior to commencement of research, the ethicality of this study passed review by the Southern College Committee for Research Involving Human Subjects. Written consent was obtained from the principal of Spalding Elementary School, the classroom teacher, and the students involved (See Appendix C).

At the outset of this project, students were given a preliminary survey to determine which of three test formats they preferred. Options given were the following:

Test A--a traditional test with True/False, Multiple Choice, Matching, Short Answer

Test B--a modified traditional test; designed so that each section (T/F, MC, Matching, SA) covers all concepts; student chooses two of the four to complete

Test C--an orally administered test based on a check sheet

The research was conducted in a series of four 90-minute periods, with 90 minutes devoted to each of the three lesson units and the remaining 90 minutes allotted for briefing/debriefing.

After an introductory explanation in Session 1, during which the researcher discussed purposes and procedures, students were taught the first portion of the Magnets lesson. Session 2 included a review of Magnets, Tests A and B, and a brief introduction to the next lesson on Waves. The Waves lesson and testing were completed in Session 3, and Simple Machines introduced. The last session involved finishing instruction, review and testing over the Simple Machines lesson.

The seating arrangement was used to develop a staggered grouping, with one half of the class taking Test A first, and the other Test B. For consecutive lessons, the groups were reversed, with the students who received Test A first getting Test B the next time and so forth.

Results

A preliminary survey of student test type preference was conducted at the outset of this study.

Table 1 summarizes the results of this survey. Two students in the class of 25 did not respond to the survey, but of the 23 responses, 14 of the students (60.9%) preferred a modified test that allowed them to choose the item type (Test B) over a traditional test (Test A). The majority of these were girls; ten of the eleven girls (90.9%) chose Test B.

Insert Table 1 about here

It was therefore hypothesized that students would perform better on a modified test (Test B) than on a traditional test (Test A). To test the null hypothesis of no difference, student performances were compared when tested over the same material by both Test A and Test B. Of the 25 subjects, two completed only partial testing and their scores were not computed into the final analyses.

The results for each of the six tests are presented in Table 2. The data were analyzed using a *t*-test for dependent samples. Students' performance on

Tests A & B for the unit on Magnetism supports the null hypothesis that there is no statistically significant difference between students' scores on traditional and modified-choice tests over magnetism ($p>.05$).

Insert Table 2 about here

Analysis of students' performance on Tests A & B for the unit on Waves supports the null hypothesis that there is no statistically significant difference between students' scores on traditional and modified-choice tests over waves.

Analysis of students' performance on Tests A & B for the unit on Simple Machines supports the null hypothesis that there is no statistically significant difference between students' scores on traditional and modified-choice tests over simple machines.

It was also hypothesized that a relationship exists between preference and performance. Correlation coefficients were computed for the data. The results are displayed in Table 3. Only the correlation coefficient for Magnets B (-.3584) was found to be statistically significant; a preference of test type A was found to be inversely related to performance on Magnetism Test B ($p<.05$). This relationship did not hold true for any other tests. Also, there was not a significant relationship between gender and performance.

Insert Table 3 about here

One interesting finding evidenced in this analysis relates to the relative difficulties of Tests A and B. It also provides a way to compare the various units. Table 4 presents the correlation coefficients between test format and unit type. A positive relationship was found between Test A and Test B in the unit on Magnetism. The same correlation occurs for the units on Waves and Simple Machines, implying a high degree of content equivalence between the A and B forms of each test. In addition, there were also significant relationships between Magnets A and the following:

Waves A (.7035) & B (.6143), and Simple Machines A (.6922) & B (.5249). Statistically significant relationships ($p<.01$) were found between all tests except Waves B & Magnets B, and Simple Machines B & Waves B ($p>.01$). This indicates that the tests represented closely equivalent levels of difficulty.

Insert Table 4 about here

Discussion

The results of this study support the claim that there is no significant difference between students' scores on traditional and modified-choice tests. The means on each set of tests were very similar.

However, one question raised by this study is this: Are students "set in their ways" of test-taking as early as fourth grade? Most of the testing in their educational experience up to that point has been identical in format. It could also be questioned if students were tested more often in a number of different ways, and therefore more accustomed to variety, would their scores on the various test styles improve? Do students need to be tested in several ways to attain a balanced educational experience?

The relationship between preference of test type and gender appears to point to the need for further study. Why did most girls prefer Test B? While the overall majority preference was for Test B, more boys chose Test C. Further analysis of these results could prove interesting.

It should be noted that in 28 of the 69 sets of A-B tests (40.6%), students performed better on the modified test format (B) than on the traditional (A). Three students scored better on Test B every time. Future research could address the following questions: What characteristics predispose those particular students to perform better on a particular test type? Should we test students using the format on which they have been found experience the most success?

The present investigation demonstrates that on the whole, students are not helped by a modified-choice test format. This is not to suggest, however, that some students do not experience a benefit from being able to choose which type of test questions they answer. This study indicates that while some students do perform better on a modified-choice test, the overall averages between the two test types are not significantly different, leading to the conclusion that the process of test performance may be more complex and multifaceted than previously thought.

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Appendix A

Introductory Material

NAME________________________

WHICH TEST DO YOU LIKE BEST?

There are three (3) kinds of tests described below. There is an example of each kind of test. Read how each kind of test is described and the examples of ALL of the different kinds of tests. When you are finished reading those, place an X in the blank of the one that you like best. You don't have to answer the questions on the test examples. This is just to show you what each kind of test is like. Your job is to choose which one of the three kinds of tests you'd rather take.

______Test A: This test is your normal sort of test, with some True/False, some Multiple Choice, some Matching, and some Short Answer questions. As usual, on this test, you are supposed to answer all the questions.

EXAMPLE OF TEST A:

1. T F Saturn is the largest planet.

2. The planet closest to the sun is
   a. Earth
   b. Mercury
   c. Jupiter
   d. Saturn

3. Match the names of the planets with their characteristics.

   _____1. Mars a. beautiful planet with many rings
   _____2. Saturn b. most like Earth

4. Which planet is farthest from the sun?_____________

_______Test C: This test is different from the other two. Instead of a "normal" test, the teacher uses a check sheet to ask you questions. Instead of writing the answers you talk them out loud. The teacher gives you a copy of the check sheet before test time, and it looks like this.

EXAMPLE OF TEST C:

GOOD	FAIR	POOR	
			1. Tell which planet is largest.
			2. What planet is considered very beautiful and has many rings?
			3. Which planet is closest to the sun?

OPENING

Good morning, y'all. My name is Sharon Wright, and I'm a student at Southern College. I'm studying to be a teacher. I'm working on a class project, and Mrs. Swafford has said that I could ask you guys to help me. How many of you like tests? Yeah, well, I don't always think they're so hot either. What I'm doing is trying to find a way to make them easier for people. I have an idea, and I need some people to help me test it out. Would you like to help with that? You won't get a grade on your report card for the things that we do during this time, but I hope that you'll learn some interesting things--including how you do best on tests.

Now before we get started, I'm going to explain everything to y'all in detail. Part of doing "scientific research" is keeping an exact record of everything you do. That's why I'm reading to you instead of just talking. So I'm going to explain my plans to you, and I'll give you a chance to ask questions after I'm done. Just save your questions until then, please, so that I can be sure you understand.

Do you remember a few weeks ago when Mrs. Swafford gave you a survey that asked you to tell which kind of test you liked best? It looked like this (show survey). It had three different kinds of tests you could choose from. There was the "normal" kind, with T/F, MC, SA, & Mtch. Then there was another kind where you get to choose two sections to do and leave out the other two. And the last one was the one with the checksheet where you explain the stuff out loud to the teacher. Remember that? Well, the most people picked the middle one, Test B. I thought that was interesting, so what I want to do is to find out whether people actually DO better on that kind of a test than on the "normal" one, Test A. I don't know which way things will turn out.

What I'm planning to do is to teach you three different science lessons, and then give you two different kinds of tests over each one. Some people will start off with Test A (the "normal" one), and some people will start off with Test B (the one where you choose two sections and leave out two sections). Test A will have a red cover sheet, and Test B will have a blue cover sheet to help you tell them apart. If (NAME) got Test A (with the red cover sheet) first, (s)he would go ahead and answer all the questions the best that (s)he could and turn it in. Then (NAME) could get up and stretch, go and get a drink or go to the bathroom real quick, and come back. Next, (s)he would come up to the desk and get a copy of Test B (with the blue cover sheet) and take it. I don't like having to give you guys two tests in a row, but that's the only way to find out how you do on both of them.

So, let's go through this again. Let's say that (NAME) gets a blue test first--the one where (s)he has to pick two parts of it to do. (NAME), if you had to pick two kinds of questions to answer, and you could do T/F, MC, Mtch, or SA, what would you choose? This is just for our example. (pause) Okay, (NAME) would do the XX and XX sections of the blue tests. What about the XX or XX? Does (s)he have to do those? No, (NAME) doesn't have to do any of the XX or XX questions on the blue test. So (NAME) finishes the XX and

XX questions. Now what does (s)he do? Raise your hand if you know the answer, and I'll choose someone to tell us. (pause) That's right. (S)he turns in the blue test and goes to get a drink or whatever. Then (s)he comes back and gets the red test. Deos (s)he go and talk to (NAME) and see how (s)he's doing? No. Does (s)he come up and ask me questions about what the right answers were on the blue test? No. (S)he gets a copy of the red test and goes back to his/her desk. (NAME) answers ALL of the questions on the red test, and then turns it in. Anytime that you get the red test, you have to answer ALL of the questions. Anytime that you get the blue test, you get to choose two sections to do. The directions are on top of each test to help you remember.

You may be wondering if everybody will be able to find out what grade you get on any of these tests. The answer is NO. I'll keep the tests myself, and if I show them to anybody, I won't show them your name. You will be able to find out how you did on each kind of test, and so will Mrs. Swafford. But when I figure out the results from the group, I will use letters and numbers, NOT NAMES. I'm going to write up the group results for my research paper, but I will NOT use any of your names. When I'm done writing about this project, I will explain to several different groups of teachers what I found, but like I said, I will not ever use names. What I'm hoping is that we find out a way to help people get better grades on tests, and lots of teachers will want to use it. Wouldn't y'all like that?

Okay, now it's time for me to answer any questions that you have. You may raise your hand if you have a question, and I'll call on you and try to answer it. (Q & A time)

What I'm asking you to do for this project is lend me your brains--just do the best that you can on each one of these tests. One thing that I want to make clear to you is that YOU HAVE THE RIGHT TO CHOOSE TO QUIT THIS AT ANY TIME. Will you repeat after me? "I have the right to decide to quit this project any time I want to." (repeat) Naturally I hope that you will stick with it and help me finish my research, but if youdon't want to, I will let you quit. If you choose to drop out of the research project, Mrs. Swafford and I will find something else for you to do while the rest of the class continues.

Now I'm going to pass out a consent form. This is a piece of paper that I'd like everybody to sign. Signing your name on this paper does NOT mean that you have to do everything in this study. It just means that you understand what's going on, and that you understand that you can quit if you want to. (pass out forms)

Appendix B

Objectives, Lesson Plans, and Tests for Each Unit

LESSON 1: M A G N E T S

OBJECTIVES

Upon completion of this lesson, students will be able to:

1. name at least five magnetic objects
2. name at least five non-magnetic objects
3. to explain the concept of molecular alignment in magnetized materials
4. describe how a compass works
5. demonstrate an understanding of the Law of Magnetic Poles
6. name at least 3 different ways that magnetism or magnets are used
7. recognize and name correctly a natural magnet
8. show how electromagnetic induction works
9. demonstrate how to magnetize an object by contact with a magnet
10. show how to magnetize an object by stroking it with a magnet

LESSON PLANS

open by reading Mickey's Magnet

state objectives
    name natural magnet
    name magnetic/non-magnetic objects
    know 3 ways to make a magnet
    know how a magnet really works

show lodestone
    introduce students to naturally occurring magnet
    write name on board
bring out different magnets; have students handle them and discuss magnetic and non-magnetic objects
    make a list on the board of things that magnets do and don't attract
    magnets do NOT attract all metals
        primarily iron and steel are attracted
        copper, aluminum, and tin are not attracted
observe contact magnetism--a chain of paper clips becomes magnetized
    point out that a magnet can be "made" by contact
    start list on the board of ways to make a magnet
discuss second way of "making" a magnet--electromagnetic induction
    demonstrate with wire/battery magnet
    point out second way to "make" a magnet
    this particular kind is called an electromagnet
another way to "make" a magnet is by stroking something with a magnet
    demonstrate with scissors
    point out third way to "make" a magnet
    explain that the molecules in a magnet are aligned
        draw picture on board
        line children up back-to-front for example
observe polarity of magnets (with human chain--hands on backs of each other's heads)
    state that all magnets have "North" and "South" poles
    observe what happens when two magnets are placed close together
        introduce Law of Magnetic Poles (write on board)
        OPPOSITES ATTRACT AND LIKES REPEL
these three ways of making magnets have something in common--all are temporary effects
    two kinds of magnets--temporary/permanent
discuss uses of magnets and magnetism
    electric can opener, message holders, key holders
    compass and navigational equipment
        show how compass works
        explain that it points to magnetic pole (not geographic N pole)
        show how a compass is affected by the presence of a magnet
review objectives

LESSON 1 TEST A

TRUE AND FALSE: Circle the correct response.

T F 1. All the molecules in a magnet point the same direction.

T F 2. Touching a paper clip to a magnet is magnetizing it through electromagnetic induction.

T F 3. Stroking a screwdriver with a magnet is one way to magnetize it by lining up the molecules.

T F 4. A compass works better if you hold a magnet close to it.

T F 5. All metals are attracted by magnets.

MULTIPLE CHOICE: Choose the BEST possible answer.

6. If the North poles of two magnets are placed close together, they will

   a. push apart

   b. pull together

   c. do nothing

   d. lose their magnetism

7. If the North and South poles of two magnets are placed close together, they will

   a. push apart

   b. pull together

   c. do nothing

   d. lose their magnetism

8. Passing a current through a wire makes it magnetic through

   a. electromagnetic induction

   b. stroking

   c. magnetic contact

   d. thermonuclear magnetism

9. Which of the following is NOT attracted by a magnet?

   a. scissors

   b. paper clip

   c. pop can

   d. iron railroad spike

10. Which of the following IS attracted by a magnet?

   a. aluminum foil

   b. copper penny

   c. stainless steel knife

   d. nickel

MATCHING: Write the letter of the best possible response in the blank. One response will not be used.

_____11.	points due North	a.	lodestone
_____12.	stays powerful for a long time	b.	temporary magnet
_____13.	North pole of the "earth magnet"; where a compass points	c.	magnetic field
_____14.	a natural magnet	d.	permanent magnet
_____15.	loses its magnetism after a while	e.	compass
		f.	magnetic pole

SHORT ANSWER: Complete the following the best that you can.

Give examples of three different ways that magnets are useful to people (3 pts).

____

____

____

The Law of Magnetic Poles states that likes ______________ and unlikes ______________ (2 pts).

LESSON 1 TEST B

Choose TWO of the four sections to complete. For example, you could do the multiple choice and short answer, or the true/false and the matching. You must finish TWO sections, and you may leave out the other two. If you do the multiple choice and short answer, just leave the other two sections blank.

TRUE OR FALSE: Circle the correct response.

T F 1. A magnet is attracted to an aluminum can.

T F 2. A magnet is attracted to a pair of metal scissors.

T F 3. All the molecules in a magnet are lined up so that they are pointing the same direction.

T F 4. A magnet affects which way a compass will point.

T F 5. If the North pole of one magnet comes close to the South pole of another magnet, they will push away.

T F 6. A natural magnet is called a compass stone.

T F 7. Electromagnetic induction means passing a current through a wire so that the molecules all point the same direction.

T F 8. Stroking a screwdriver with a magnet makes all the molecules point different directions.

T F 9. Travelers never use magnets to help them.

T F 10. A paper clip stuck to a magnet will act like a magnet itself.

MULTIPLE CHOICE: Choose the best possible answer.

1. If the North poles of two magnets are placed close together, they will

   a. push apart

   b. pull together

   c. do nothing

   d. lose their magnetism

2. Passing a current through a wire makes it magnetic through

   a. electromagnetic induction

   b. stroking

   c. magnetic contact

   d. thermonuclear magnetism

3. All the molecules in a magnet

    a. point different directions

    b. point North

    c. point toward the center of the magnet

    d. point the same direction

4. Which of the following is NOT attracted by a magnet?

    a. scissors

    b. paper clip

    c. pop can

    d. iron railroad spike

5. Which of the following IS attracted by a magnet?

    a. aluminum foil

    b. copper penny

    c. stainless steel knife

    d. nickel

6. A compass

    a. points toward the North pole of the Earth magnet

    b. is affected by any magnetic field

    c. does NOT point at the geographic North Pole

    d. all of the above

7. A lodestone

    a. is a rock that possesses magical powers

    b. was found only in the Middle Ages

    c. is a natural magnet

    d. was discovered by Albert Einstein

8. What will happen to a screwdriver if you stroke it carefully with a magnet?

   a. it will become magnetic and pick up nails

   b. all of the molecules in it will point different directions

   c. it will give off sparks if you put it in water

   d. it will point North

9. Making a magnet using CONTACT means

   a. passing a current through a wire

   b. stroking something with a magnet

   c. touching something to a magnet

   d. heating something to red-hot

10. Which of the following items CAN involve the use of magnets?

   a. airplane navigational equipment

   b. electric can opener

   c. compass

   d. all of the above

SHORT ANSWER

1. Name something that WOULD be attracted to a magnet.

____

2. Name something that WOULD NOT be attracted to a magnet.

____

3. Tell what is meant by electromagnetic induction.

____

____

____

4. What is special about the molecules in a magnet?

____

____

5. How does a compass work?

____

____

____

6. What does it mean to make a magnet by contact?

____

____

7. Name three different ways that magnets are used to help people.

____

____

8. What does the Law of Magnetic Poles say? Draw a picture to illustrate it.

____

____

9. What is a natural magnet called? What does it look like?

____

10. Why does stroking a screwdriver with a magnet make it become magnetic?

____

____

MATCHING: Write the letter of the correct response in the blank at the left. Two responses will not be used. Please read carefully.

_____1. points to the North Pole of the Earth magnet	a. attractive to a magnet
_____2. uses an electrical current to line up molecules	b. not attractive to a magnet
_____3. metal safety pin	c. compass
_____4. natural magnet	d. lodestone
_____5. touching something to a magnet to magnetize it	e. electromagnetic induction
_____6. opposites attract, likes repel	f. contact
_____7. metal coin	g. stroking
_____8. rubbing something carefully with a magnet	h. magnetic field
_____9. one of the many things people use magnets for	i. Law of Magnetic Poles
_____10. has all the molecules pointing the same direction	j. navigation
	k. any magnetic material
	l. glass

LESSON 2: W A V E S

OBJECTIVES

Upon completion of this lesson, students will be able to:

1. identify the amplitude of a wave
2. identify the frequency of a wave
3. identify the wavelength of a wave
4. name at least 3 different kinds of waves and the media through which they can travel
5. measure and compare the attributes of different waves
6. explain the difference between longitudinal and transverse waves
7. tell how sound waves are changed by altering their frequency
8. tell how sound waves are changed by altering their amplitude
9. demonstrate an understanding of wave phases
10. tell the difference between constructive and destructive interference

LESSON PLANS

introduce slinky, make different kinds of waves

STATE OBJECTIVES

- longitudinal
- transverse

talk about things that travel in waves besides slinkies
- sound, light, heat, magnetism, electricity
- introduce media--things that sound can and can't travel through
  - wave must have a medium

wave characteristics
- amplitude
- wavelength
- frequency
- draw or lay out rope "waves"
- have kids measure different attributes
- wave phases
  - constructive/destructive interference

sound waves
- how affected by amplitude (loudness)
- how affected by frequency (pitch)
- how affected by wavelength (intensity)

REVIEW OBJECTIVES

LESSON 2 TEST A

TRUE OR FALSE: Circle the correct response.

T F 1. A wave's frequency means how fast it is going.

T F 2. Amplitude is the "width" of a wave.

T F 3. The wavelength of a wave is the distance from one peak to the next peak, or from one valley to the next valley.

T F 4. Destructive interference is when two waves meet to make a bigger wave.

T F 5. The material that a wave travels through is its medium.

MULTIPLE CHOICE: Choose the best possible answer.

6. Which of the following things can travel in waves?

   a. sound

   b. light

   c. water

   d. all of the above

7. My grandfather had a hearing aid that made sounds louder. Which of these did it affect?

   a. wavelength

   b. frequency

   c. amplitude

   d. medium

8. Which of the following waves has the greatest amplitude?

   a.

   b.

   c.

   d.

9. My cat hates high-pitched noises. Which of the following frequencies would bother him the most?

   a. 40 Hz

   b. 2300 Hz

   c. 510 Hz

   d. 180 Hz

10. Two waves are in phase. Which of the following is true?

    a. they have peaks at the same time and valleys at the same time
    b. when one has a peak, the other has a valley

    c. they have different frequencies

    d. they have different media

MATCHING: Write the letter of the correct response in the blank. One response will not be used.

_____11.	the "width" of a wave	a. transverse wave
_____12.	travels in the same line without moving up and down	b. amplitude
_____13.	has peaks and valleys	c. medium
_____14.	how fast a wave is going	d. wavelength
_____15.	the distance from one peak of a wave to the next one	e. frequency
		f. longitudinal wave

SHORT ANSWER: Complete the following the best that you can.

16. Name three kinds of waves and one thing they can travel through (3 pts).

____

____

____

17. Draw two waves interfering constructively, and two waves interfering destructively. Make sure the difference is clear, and label which is which (2 pts).

LESSON 2 TEST B

Choose TWO of the four sections to complete. For example, you could do the multiple choice and short answer, or the true/false and the matching. You must finish TWO sections, and you may leave out the other two. If you do the multiple choice and short answer, just leave the other two sections blank.

SHORT ANSWER

1. Tell what is meant by the amplitude of a wave. You may use a drawing to help you if you wish.

____

____

2. Tell what is meant by the wavelength of a wave. You may use a drawing to help you if you wish.

____

____

3. Tell what is meant by the frequency of a wave. You may use a drawing to help you if you wish.

____

____

4. Name three different kinds of waves and the media through which they can travel.

____

____

____

5. Draw a wave that has a wavelength the same length as your thumb.

6. How can you tell the difference between a longitudinal and a transverse wave?

____

____

____

____

7. Sound wave A has a greater amplitude than sound wave B. Tell what is different about the way they sound.

____

____

8. Sound wave C has a greater frequency than sound wave D. Tell what is different about the way they sound.

____

____

9. If two waves are going up at the same time and going down at the same time, are they in phase?

____

10. Explain in your own words what happens when two waves interact constructively.

____

____

____

MATCHING: Write the letter of the correct response in the blank at the left. Two responses will not be used.

______1.	the "width" of a wave	a.	amplitude
______2.	a space with no air, where sound waves cannot travel	b.	wavelength
______3.	travels in the same line, without moving up and down	c.	medium
______4.	determined by the amplitude of a wave	d.	frequency
______5.	how fast a wave is going	e.	vacuum
______6.	two waves meeting each other and making a bigger wave	f.	constructive interference
______7.	determined by the frequency of a wave	g.	destructive interference
______8.	the distance from one peak of a wave to the next one	h.	longitudinal wave
______9.	two waves going up and down at the same time	i.	transverse wave
______10.	has peaks and valleys	j.	pitch
		k.	loudness
		l.	in phase

TRUE OR FALSE: Circle the correct response.

T F 1. A wave's frequency means how fast it is going.

T F 2. Amplitude is the "width" of a wave.

T F 3. The wavelength of a wave is the distance from one peak to the next peak, or from one valley to the next valley.

T F 4. Light travels in waves.

T F 5. A wave that has a frequency of 25 Hz (25 times every second) is going slower than one with a frequency of 14 Hz (14 times every second).

T F 6. A longitudinal wave moves along the same line without moving up and down.

T F 7. A sound wave that has a frequency of 820 Hz sounds lower to your ear than one that has a frequency of 440 Hz.

T F 8. A sound is louder if it has a bigger amplitude.

T F 9. If two waves are "in phase," that means that when one has a peak, the other one has a valley.

T F 10. When two waves going opposite directions meet and make a bigger wave, that is constructive interference.

MULTIPLE CHOICE: Choose the best possible answer

1. Wavelength measures

   a. how fast the wave is going

   b. the distance between peaks

   c. what the wave travels through

   d. how wide the wave is

2. Amplitude measures

   a. how fast the wave is going

   b. the distance between peaks

   c. what the wave travels through

   d. how wide the wave is

3. Frequency measures

   a. how fast the wave is going

   b. the distance between peaks

   c. what the wave travels through

   d. how wide the wave is

4. Which of the following statements is NOT correct?

   a. Light is a wave that can travel through glass.

   b. Sound is a wave that can travel through a vacuum (where there is no air).

   c. Radio signals are waves that can travel through air.

   d. Electricity is a wave that can travel through metal.

5. Which of the following waves has the longest wavelength?

   a.

   b.

   c.

   d.

6. A wave that moves along the same line without moving up and down is a(n)

    a. longitudinal wave

    b. transverse wave

    c. ultrasonic wave

    d. lateral wave

7. My cat hates high-pitched noises. Which of these frequencies will bother him the most?

    a. 440 Hz

    b. 250 Hz

    c. 880 Hz

    d. 1760 Hz

8. A ninety-year-old woman has a hearing aid that makes sounds louder. Which of the following does her hearing aid change?

    a. wavelength

    b. frequency

    c. amplitude

    d. medium

9. Two waves are in phase. Which of the following is true?

    a. When one has a peak, so does the other one.

    b. When one has a peak, the other has a valley.

    c. They have different frequencies.

    d. They have different media.

10. What happens when two waves interfere destructively?

    a. They combine to make a stronger wave.

    b. They collide and cause an explosion.

    c. They damage the medium through which they are traveling.

    d. They combine to make a smaller wave.

LESSON 3: S I M P L E   M A C H I N E S

OBJECTIVES

Upon completion of this lesson, students will be able to:

1. give a scientific definition of work
2. identify each of the 5 simple machines
3. demonstrate how a lever works
4. demonstrate how a pulley works
5. demonstrate how a screw works
6. demonstrate how a wedge works
7. demonstrate how an inclined plane works
8. identify common examples of simple machines
9. use the concepts of simple machines to solve practical problems
10. tell the difference between simple and compound machines

LESSON PLANS

tell story about pulling up fence post with lever

students turn to seat partner and list the 5 simple machines

define key terms
- "work"--moving something, not just effort
  - cite examples of things that are and aren't "work"
- fulcrum
  - draw diagram & label
- plane

introduce and give examples
- lever--fulcrum/meter stick setup with several 2 kg weights
- pulley--rope and compound pulley used to lift weights
- inclined plane--meter stick
- wedge--scissors, knife, doorstop
- screw--screw-operated lift

let students experiment with different machines

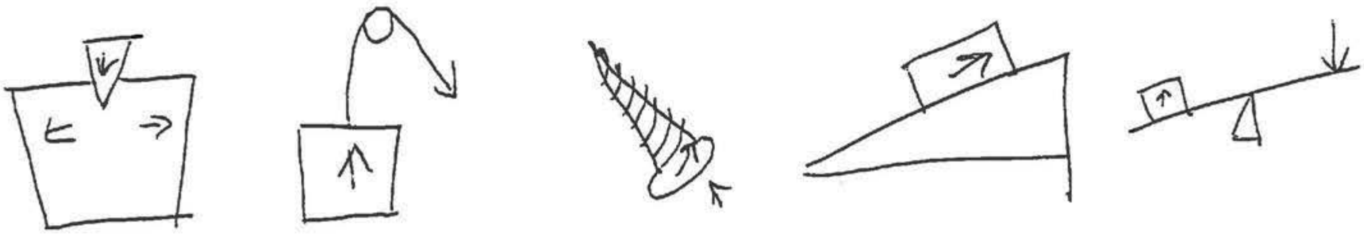
discuss ways to use machines to solve problems

worksheet

NAME________________________

SIMPLE MACHINES MAKE OUR LIVES EASIER

WEDGE PULLEY SCREW INCLINED PLANE LEVER



Each of these basic machines makes life easier. Each one helps us to do work in some way. The following things use one of these five kinds of simple machines. Write the items from the list under the name of the correct machine.

axe, ramp, propeller, chisel, drill, see-saw, block and tackle, doorstop, fishing pole, moving dolly, screwdriver (to open a paint can), claw hammer (to pull out a nail), steps, crane, ladder, winch, fan

WEDGE	PULLEY	SCREW	INCLINED PLANE	LEVER

Now imagine that you have a heavy box to load onto a truck. The box is so heavy that you cannot lift it. How will you use one of the simple machines to help you? Tell which one you'd use and draw a picture of how it would work to help you.

You are trying to make a hole through a piece of wood so you can put a bolt through it. Which type of machine will you use to help you?

You are splitting kindling wood. One piece is very hard to split. What will you use to make your job easier?

LESSON 3 TEST A

TRUE AND FALSE: Circle the correct response.

T F 1. A see-saw is an example of a pulley.

T F 2. A compound machine is made of more than one simple machine.

T F 3. The fulcrum is the balance point of a lever.

T F 4. Simple machines make it possible to do a certain amount of work with less effort.

T F 5. In scientific terms, finding the answer to a math problem is "work."

MULTIPLE CHOICE: Choose the BEST possible answer.

6. A staircase is an example of a(n)

   a. lever

   b. wedge

   c. inclined plane

   d. screw

7. An axe being used to split wood is an example of a(n)

   a. inclined plane

   b. pulley

   c. wedge

   d. screw

8. An airplane propeller is an example of a(n)

   a. lever

   b. pulley

   c. wedge

   d. screw

9. Which one do you usually use to open a paint can?

   a. lever

   b. pulley

   c. wedge

   d. screw

10. Which one is used by a crane when it lifts heavy building materials?

   a. inclined plane

   b. pulley

   c. wedge

   d. screw

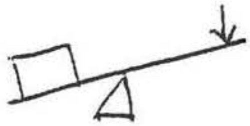
MATCHING: Write the letter of the correct response on the blank. One response will not be used.

_____11. 

_____12. 

_____13. 

_____14. 

_____15. 

a. lever
b. pulley
c. screw
d. wedge
e. inclined plane
f. hinge

SHORT ANSWER: Complete the following the best that you can.

16. Give a scientific definition of "work" (2 pts).

____

____

17. Tell how you could use a simple machine to get something heavy down off of the top shelf in your garage. There are lots of different ways; use a drawing to help show your answer if you want (3 pts).

____

____

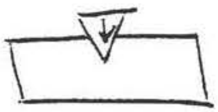
____

____

LESSON 3 TEST B

Choose TWO of the four sections to complete. For example, you could do the multiple choice and short answer, or the true/false and the matching. You must finish TWO sections, and you may leave out the other two. If you do the multiple choice and short answer, just leave the other two sections blank.

MATCHING: Write the letter of the correct response in the blank at the left. One response will not be used.

_____1. 

_____2. 

_____3. 

_____4. 

a. screw
b. compound machine
c. "work"
d. lever
e. ramp
f. inclined plane
g. crane
h. pulley
i. propeller
j. see-saw
k. wedge

_____5. example of a screw

_____6. example of a lever

_____7. combination of several simple machines

_____8. example of an inclined plane

_____9. moving something through space

_____10. example of a pulley

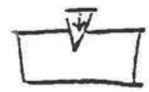
MULTIPLE CHOICE: Choose the BEST possible answer.

1. Which of the following is a picture of a lever?

a. 

b. 

c. 

d. 

2. Which of the following is a picture of an inclined plane?

a. 

b. 

c. 

d. 

3. A staircase is an example of a(n)

a. lever

b. wedge

c. inclined plane

d. screw

4. An axe being used to split wood is an example of a(n)

a. inclined plane

b. pulley

c. wedge

d. screw

5. An airplane propeller is an example of a(n)

a. lever

b. pulley

c. wedge

d. screw

6. Which one do you usually use to open a paint can?

   a. lever

   b. pulley

   c. wedge

   d. screw

7. Which one is used by a crane when it lifts heavy building materials?

   a. inclined plane

   b. pulley

   c. wedge

   d. screw

8. Which of the following is an example of scientific "work"?

   a. picking up a paper

   b. pushing a lawnmower

   c. throwing a baseball

   d. all of the above

9. Which of the following is NOT true about compound machines?

   a. they use several different kinds of simple machines

   b. they make work easier than using a simple machine does

   c. they must always use a pulley

   d. they are very common

10. Which simple machine COULD you use to put something heavy up on a high shelf?

    a. inclined plane

    b. pulley

    c. lever

    d. all of the above

SHORT ANSWER: Complete the following the best that you can.

1. Give an example of scientific "work" and tell why it is a good example.

____

____

2. Draw a picture of a lever. Label the fulcrum; show the object that is being lifted and where the force is applied.

3. Name something that uses a pulley, and tell how it works (2 pts).

____

____

____

4. What is the difference between a simple machine and a compound machine?

____

____

5. A propeller is an example of a simple machine. Which one is it, and why?

____

6. What simple machine could you use to get something heavy out of a deep pit in the ground (there are several possibilities)? Draw a picture to show how you would do it (2 pts).

____

____

7. Name something that is an example of a wedge, and draw a picture of how it works (2 pts).

TRUE OR FALSE: Circle the correct response.

T F 1. In scientific terminology, "work" is anything that takes effort, like solving problems in your head.

T F 2. A see-saw is an example of a wedge.

T F 3. A ladder or ramp is an example of an inclined plane.

T F 4. A common example of the screw is a propeller.

T F 5. Scissors and other blade tools use pulleys to do work.

T F 6. Opening a paint can with a screwdriver is using a lever.

T F 7. A compound machine uses more than one kind of simple machine to make work even easier.

T F 8. An inclined plane makes work easier because it is easier to lift something on an angle than to lift it straight up.

T F 9. A wedge uses a fulcrum to hold some of the weight of a heavy object so that it is easier to lift it.

T F 10. A pulley makes it possible to raise something UP by pulling DOWN on a rope.

Appendix C

Consent Forms and Other Administrative Forms

SOUTHERN COLLEGE
HUMAN PARTICIPANTS REVIEW FORM

Date 01 06 94

DIRECTIONS: Please type and submit in triplicate

1. A. Name Sharon E. Wright
   B. Department Education (Psychology)
   C. Title of study Alternative Formats for Testing
   D. Date research will start: 01 24 94 Anticipated date of conclusion: 02 04 94
   E. Type of Project: X Research
      ___ Education (COURSE RELATED)
   F. Type of Support: ___ Internal
      ___ External
      (please specify granting agency) ___
      X none

2. Brief description of procedures to be used. (If doing a study that uses a questionnaire, you must attach a copy of that questionnaire.) Students will be taught a short unit on a topic, then tested using a traditional test (some mult. choice, matching, short ans., t/f questions) and a modified test (student chooses 2 of the above 4 sections). Measure is repeated 3 times.

3. Where will this study be conducted? Spalding Elem., Mrs. Swafford's 4th Grade

4. A. Will electrical or mechanical equipment be used? YES (NO)
   If "yes" how has equipment been checked for safety?

   B. Is a psychologically noxious stimulus or stress of some sort (sense of insecurity or failure, assault upon values, fatigue, or sleep deprivation) to be used in this study? (YES) NO

   C. If answering yes to either A or B.
      1. Describe the nature of the stress induced and/or the noxious stimulus or stimuli employed. Students will be subjected to only minimal and routine risks of failure associated with any kind of test.
      2. Describe the precautions you have taken with regards to any stress induced and/or any noxious stimulus employed. Students will be prepared for the testing situation by a pre-research briefing.

   D. Is deception to be used in this study? YES (NO)
   If "yes" what is the nature of this deception?

   E. Have provisions been made for debriefing and any potentially necessary subject follow-up? (YES) NO

   If "yes", please describe.
   Students will be debriefed in a closing session.

F. Describe, in detail, any risks to participants that were not addressed by the previous parts of this question. Also specify how you plan to minimize these risks.

N/A

5. What will you do if participants exhibit signs of harm (e.g., crying, disoriented behavior)?
Such behavior is not anticipated; if there is a problem, participant will be reminded of the right to withdraw from the study.

6. Will your participants be limited to students at Southern College? YES (NO)

If "no" explain.
The research concerns testing on the elementary level.

Fill in the following so that we know more about the characteristics of your participants.

A. Sex: ____ Male ____ Female X Both
B. Age group(s): 4th grade (9-11)
C. Special ethnic group (please specify): no
D. General state of health: good
E. How will participants be chosen? students in selected 4th grade class

7. How many participants will you need?
All class members = 25

8. What educational gain do you think the participants will obtain from being in this study?
Participants will increase their knowledge in the areas of waves, magnets, & simple machines, and become aware of their testing preference.

9. How will you ensure the confidentiality of each subject's data? Address the following five phases:

A. When collecting it. Data will be collected & handled only by researcher.
B. When coding it. Only researcher will have access to code key.
C. When storing it. Data will remain solely in the researcher's possession.
D. When analyzing it. Only the researcher and research advisor will have access.
E. When disposing of raw data. Data will remain in researcher's possession.

10. How will your findings/results of study be used? Results will be presented to the class, the teacher, and the principal. Findings will also be presented before the Honors Committee and Faculty Assembly.

11. I have enclosed a copy of the informed consent form and the sign-up sheet. (YES) NO
If "no," why not?

12. All participants will fill out a written informed consent form before they begin the study. (YES) NO
If "no," why not?

13. My responsibilities as a researcher are clear to me. (YES) NO
Type the name of each researcher under the corresponding signature line. All researchers must sign.

Sharon E. Wright (signature) 1/6/94
Sharon E. Wright Date

____
Date

____
Date

If you are a student your research advisor or supervisory instructor must respond to the following question.

14. I have personally discussed the proposed study with the researcher(s), and I approve of the study and will provide close supervision of procedures and ethical standards. Furthermore, these individuals have been informed of their responsibilities as a researcher; namely that:
    (a) they should not lightly miss sessions for which subjects have signed up;
    (b) they should be prepared to describe the purpose and nature of the study to subjects at the completion of the study if the subject wishes;
    (c) the subject has the right to terminate the session at any point;
    (d) even if the subject doesn't terminate the session, the researcher should terminate the session if the subject shows signs of extreme discomfort;
    (e) if a subject becomes distraught, comforting the subject takes priority over all other tasks;
    (f) subjects' privacy is to be respected;
    (g) subjects fill out the informed consent form before they participate in the study. YES NO

Ruth Williams Morris 1-13-94

Signature of Research Advisor Date

Dr. Ruth Williams-Morris

Name of Research Advisor, typed

ACTION BY HUMAN PARTICIPANTS COMMITTEE AND DATE

Signed Ruth Williams Morris 1-14-94

Chairperson, Human Participants in Research Committee Date

Distribution: HPRC file; Academic Administration file; Investigator/Project leader

January 6, 1994

This is to certify that I, Teryl Loeffler, do give my permission and consent for Sharon Wright to conduct an experimental research project in Mrs. Swafford's fourth grade classroom. I understand what this project is to involve, and approve of its rationale.

Signed,

Teryl Loeffler, principal
Spalding Elementary School

January 6, 1994

This is to certify that I, Betty Swafford, do give my permission and consent for Sharon Wright to conduct an experimental research project in my classroom. I understand what this project is to involve, and approve of its rationale.

Signed,

Betty Swafford

Betty Swafford, fourth grade teacher
Spalding Elementary School

I agree to participate in the study conducted by Sharon Wright in Mrs. Swafford's class beginning January 25, 1994. I know that my teacher and the school principal have given their approval for this project. I understand that I have the right to withdraw from this study at any time.

student's name today's date

Table 1

Student Responses to Preliminary Survey By Gender

	Percentage of		
Preference	Boys	Girls	Total
Test A	16.7	0.0	8.7
Test B	33.3	90.9	60.9
Test C	41.7	9.1	26.1
Undecided	8.3	0.0	4.3

(n=23)

Table 2

Means, Standard Deviations, and t-test Analyses for Statistical Significance on Each of Six Tests

Test		M	SD	t	
Magnets	A	14.26			
	B	14.43			
			2.717	-0.614	ns
Waves	A	9.61			
	B	10.09			
			3.799	-0.494	ns
Machines	A	13.69			
	B	12.87			
			2.790	1.420	ns

(n=23)

Table 3

Correlation Coefficients Showing Relationships Between Preference, Gender and Performance on Each of Six Tests

Test Type	Preference	Gender
Magnets A	-.1580	-.0804
Magnets B	-.3584	.0611
Waves A	-.1013	-.2340
Waves B	-.1552	.0049
Simple Machines A	-.2015	.1132
Simple Machines B	-.3033	.2261

(n=23)

Table 4

Correlation Matrix Showing Relationships Between Test Format and Unit Type

	Magnets A	Magnets B	Waves A	Waves B	Simple Machines A
Magnets					
B	.6964 p=.000				
Waves					
A	.7035 p=.000	.5628 p=.003			
B	.6143 p=.001	.4291 p=.021	.5601 p=003		
Simple Machines					
A	.6922 p=.000	.5817 p=.002	.8088 p=.000	.5144 p=.006	
B	.5249 p=.005	.5528 p=.003	.6846 p=.000	.4498 p=.016	.8616 p=.000

(n=23)