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The More Scientific Tests

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c. The next spray should be applied when the leaves are expanding, but before the blossom buds have separated. Bordeaux mixture 100 gallons plus three pounds of lead arsenate.

d. The next spray should be given after the petals have fallen, but before the calyx cup has closed. This will permit the placing of the poison within the cup where the young worms are likely to eat it since they enter the apple largely through this cup. The materials of this spray should be lime sulphur, 2 gallons; 40 per cent nicotine sulphate, 3-4 pints; lead arsenate, 3 pounds; and water enough to make 100 gallons. Ten pounds of slacked lime added to this spray will prevent all possible injury to the foliage. Consult your county agent for further information.

Success in spraying depends upon several things, a few of which are given. 1. Prepare carefully before time to spray. 2. Have definite knowledge of what one is trying to do. 3. Spray thoroughly. 4. Spray on time. 5. Sprays should not be applied while trees are in bloom.

II. Harvesting the Apples.

Many crops bring a minimum income after having been well grown because of failure to harvest at the right time or in a proper method.

1. Equipment. A good ladder, a good picking receptacle, boxes or barrels to receive apples after they have been picked.

2. Date for picking apples.

a. Judging maturity. (1) The ripe apple usually has brown seeds. (2) The ripe apple has a stem which separates easily from the spur. (3) The ripe apple has a skin of a characteristic color.

3. Picking the apples.

a. Leave the stem on the apple. b. Do not pick the fruit spur. c. Place apples carefully into the basket. d. Take apples from picking basket one by one and lay them into the storage box. e. Make two or more pickings if the variety ma-

tures irregularly and if it has a large demand from consumers. f. Pick only dry apples. g. Gather all fruit from the ground after the picking has been finished.

III Storing apples.

1. Use low temperatures but be sure to stay above 29° F. or freezing will occur.

2. Keep a uniform temperature.

3. Keep the storage room moist, about 80 per cent.

4. Provide ventilation.

5. Keep the room dark.

6. Consult Department of Horticulture, State College, Ames, Iowa, for information on storage cellars.

Winfield Scott.

THE MORE SCIENTIFIC TESTS

Scientific testing has contributed several things that may be recalled here with profit. First of these, it has given us much more reliable measures of pupils' abilities and accomplishments than by the "old-type" tests we were able to get. Reliability of a test refers to its accuracy in measuring. It means that if a written test shows a pupil to have a score of, say, 85, another pupil's written test of equal ability the same score, and it will give the same score whether marked by one teacher or any other.

Almost two decades ago Starch and Elliott showed that without the aid of standard tests or scales grades given to the same paper in geometry or composition varied widely, as much as from 28 to 92 when the passing grade was 75. Just as it is difficult to evaluate with any reasonable degree of accuracy essay-type tests in geometry or composition, so are such tests in any field found difficult to grade with accuracy.

Tests, frequently called "objective tests" in addition to their being scored accurately and therefore uniformly by all teachers have the advantages of being easy to score, of requiring less critical evaluating and hence less nervous energy, of being very speedily scored, and of pinning the pupil down to the definite point

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on which the examiner wishes to test him.

The last point is seldom enjoyed by the weaker pupils. They complain that such tests are mostly a matter of guessing (so often really true) and are very confusing, that the question is not clearly stated or they don't know exactly what is wanted. On the contrary, the same pupils write freely enough in essay-type tests, vaguely believing they are covering the topic when they do not even touch upon the point wanted; or if they do, their statements are not sufficiently clear to let the reader decide with certainty that the pupil understands the point on which he is being tested.

From his general opinion of the pupil's ability gained from opinions of class work, he concludes that the statement, while not explicitly giving the point under question, must be intended to embrace it; and he gives the pupil the credit. In this way the student is given the benefit of the doubt, a fact noticeable to him and appreciated by him. Hence, why should he not prefer the less exacting type of examination?

W. S. Monroe and R. E. Carter (Bureau of Educational Research Bulletin, No. 14, Urbana, Univ. of Ill., 1923) give 20 different types of mental activity called for in essay questions, such as recall, compare, give the causes, explain, state the relationships, illustrate, classify, discuss, criticize, outline. Questions of this kind are still perhaps the most common ones. They are the easiest to make but the most difficult to correct or score. Some teachers claim for them that they test things like the pupil's ability to organize that cannot be tested by objective tests. However, if the objective tests are carefully constructed they will test anything that the essay-type does.

Dr. Begeman's article on Magnetism will serve as a basis for our illustrations. If the reader answers

the questions as he reads them, they will make the points of our discussion most clear and concrete to him. Answering the tests will also enable him to compare the results of the different tests.

Essay-Type Test

1. How is interstellar space characterized?
2. Discuss the approach to the subject of magnetism as found in high school texts.
3. Describe the making of artificial magnets.
4. Show how the law of polarity may be illustrated.
5. Give the quantitative law of polarity and explain it.
6. Give illustrations of the "law of inverse squares" and show the relation of this law to polarity.
7. Which do you consider the most important phenomenon of a magnet, and why?

(Note. Not until all the following tests are written should the reader turn again to the article to score his answers.)

Tests Whose Scoring is Objective

Perhaps easiest of all to construct is the true-false type of "objective" test. Whole sentences are sometimes cribbed from the text and incorporated in the test without change, while other sentences before being incorporated are made false by the substitution of a word of opposite meaning of one in the original sentence by omitting a part or by adding a false word or phrase. This type of test when so used tests primarily recall of fact or information, hence should be used very little. However, almost any type of judgment, weighing, or comparing can be tested by this form of test.

The direct question form of test is usually more attractive to the student and is about as easy to make as the above. Since it does not bear so strong a suggestion, it is to be preferred to the true-false form.

1. Does Einstein hold that there are three fields of force that characterize interstellar space? (a recall question.)
2. Does Dr. Begeman disagree with Einstein on the above point? (Judgment and evaluation required.)

3. Can magnetism be produced by employing electricity? (Inference).

4. Do all molecular substances theoretically possess properties of magnetism?

5. Do natural iron magnets consist of molecules that are composed of four atoms of iron and three atoms of oxygen?

6. Are even small magnets expensive?

7. Were magnets known long before the Middle Ages?

8. Are horse shoe magnets usually natural magnets?

9. In order to make artificial magnets must one use tempered steel?

10. Must pieces of steel about eight inches long be used in making magnets because shorter pieces will not hold magnetism?

11. Must one first build an electro-magnet before he can magnetize steel?

12. If the pole strengths of a magnet were made two and one-half times as strong as before, would the force between the poles be made six and one-fourth times as great as before?

13. If the distance between the poles of a magnet is increased uniformly, is the force between them reduced uniformly?

14. Does the force between poles decrease directly as the distance between the poles increases?

15. Does the intensity of a field of force correspond to the number of lines of force?

16. Does a single line of force have a measurable quantity?

Another type of test question easy to prepare is the recall or single word answer. This is mostly limited to questions on facts. For example,—How many fields of force are usually given? Name a field of force besides electric and gravitational that pervades all interstellar space.

The same fact may be quizzed in the completion form of test, thus,—The three all pervading fields of force are the gravitational, electric, and _____. As often constructed the completion form is perhaps more perplexing to the student than either of the above forms and does not test anything that they do not.

“Multiple choice questions” test ones recognition or identification rather than his recall. They are easier than other tests for the pupil if they quiz merely facts given in the text but can be made to test any degree of comprehension, comparison, relationship, or inference. An easy type:—According to Einstein the number of pervading fields of force in interstellar space is,—one, two, three, four, five. A more difficult question:—The best reason for approaching the subject of magnetism from the standpoint of ferromagnetism in high schools is,—1. Electro-magnetism is more difficult to comprehend than ferromagnetism, 2. Ferromagnetism is more readily available. 3. Ferromagnetism is easier to handle, 4. Electro-magnetism will not show the same things in demonstration. If the instructor wishes to make the question depend more upon evaluation and less on recognition, he can state it something like this:—Which should be introduced first in high school physics, electro-magnetism or ferromagnetism? Check the reasons for your answer of those given below. (Here are given good, poor, and false reasons for the student to check.)

If space permitted other types of tests, matching, misfitting terms, analogies, etc. would be given. A comprehensive set of each type covering the article above would perhaps be of interest for purposes of comparison.

Objective tests require more time for their construction than the essay type; but the satisfaction of having tested more points specifically, and of being able to score the papers more accurately, easily, and speedily will more than compensate.

(The reader will now compare with the text of Dr. Begeman's article his answers to the set of seven “essay-type” questions and check his answers to the “direct-question” test with the following key if he wishes to compare the two types of tests as to scores made, ease of scoring and other points. Key: Question 1. No; 2. No; 3. Yes; 4. Yes; 5. No; 6. No; 7. Yes; 8. No; 9. No; 10. No; 11. No; 12. Yes; 13. Yes; 14. No; 15. Yes; 16. Yes. Subtract the number of wrong

answers from the number of right ones to find the percent you know of the answers. This method of scoring assumes that for each wrong answer you make without knowing it you by chance get one right without knowing it.)

E. O. Finkenbinder.

SUGGESTIONS FOR HEALTH CLASSES

Health

(Continued from March)

a. If one has been exposed to smallpox should he be vaccinated at once? Smallpox, I; Smallpox, III.

b. What factors should one look for in buying a new pair of shoes? Shoes, I.

c. A child has been bitten by a dog which is suspected of being mad. How can it be determined if the dog really has rabies? What should be done with the dog? What should be done with the child? Rabies, III; Rules and Regulations of the State Board of Health, III.

d. Who is most responsible for a person's first set of teeth? His second set of teeth? Good Teeth, I; Children's Teeth, V; Building Baby's Teeth, V; Save Those Baby Teeth, V; Caring for Teeth, V; Eating for Teeth, V; Prevent Tooth Decay, V; Spare the Sweets and Save the Teeth, V.

e. One of the boys in high school went home one noon because he was so sick that he did not feel like staying longer. He was so ill the next morning that a physician was called. The physician diagnosed the case as diphtheria and had a placard put on the house. The physician stated that there must be a carrier in town, as there had been no recent case of diphtheria. What is a carrier? How can one be detected? What type of placard was placed on the house and how long would it have to be there? Can the father go from the home to his work daily, and can the brother in the eighth grade and the sister in the kindergarten keep going to school? Can diphtheria be prevented? Diphtheria, I; Chart of Communicable Diseases Among School Children, III; Does the Giving of

Toxin-antitoxin Pay in Iowa? III; What is Diphtheria? III; Diphtheria is Preventable, III; Rules and Regulations of the State Board of Health, III.

These few concrete illustrations of the use that can be made of the material listed will suffice to show its value for the health classes. An ingenious teacher will find many more ways than those suggested in this article for making the work in the health classes interesting by the use of such reference material.

BELVA L. SWALWELL.

MAGNETISM

Physics

Interstellar space is characterized by the existence of three all pervading fields of force denoted respectively as gravitational, electric, and magnetic. Einstein in his general theory of relativity demonstrates mathematically that these three force fields are but different aspects of one universal field. To the average man, however, these three natural forces will always appear as separate distinct entities.

In the high school texts on physics the subject of magnetism is approached from the standpoint of ferromagnetism. The subject of electro-magnetism is treated later as one of the most striking properties of an electric current. Our remarks on magnetism, accordingly, will be limited to magnetism as manifested by different forms of iron. It should be recognized, however, that there are other metals; such as, nickel and cobalt and even quite a number of metallic alloys that can be used to illustrate the simple phenomena of magnetism. According to the electro-magnetic theory of matter all forms of molecular substances possess in their fundamental structures the properties of magnetism.

In taking up the subject of magnetism for instruction, we usually begin with the natural magnet. A natural magnet consists of a piece of block iron ore whose molecular composition consists of three atoms of iron and four atoms of oxygen. Such magnets were known to the ancients long before the Christian era. During the early middle ages