SCIENCE EQUIPMENT AND MATERIALS FOR A COMPREHENSIVE JUNIOR HIGH SCIENCE PROGRAM

by

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THE PROBLEM AND DEFINITION OF TERMS

The successful science program needs adequate equipment. Schools have always had to face the problem of how best to spend available funds in every area. Many times an item which has little use is purchased because there is a lack of information about the relative importance of suggested items for the junior high school science program.

Statement of the Problem

The purpose of this study was to provide master lists of science equipment and materials for a comprehensive junior high school science program.

Importance of the Study

The great increase in scientific knowledge and the great publicity given to science through the space program has pressed the schools to provide better science programs.

Many schools were handicapped by the lack of funds for equipment necessary to implement new curriculums being developed for science.[1]

Title III of the National Defense Education Act has given virtually twice the funds to public schools to spend

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[1] J. Graham Sullivan, "What and How Much Help Can Schools Derive from Provisions of the N. D. E. A.," National Association of Secondary School Principals Bulletin, 44:25, April, 1960.

for permanent science equipment. Although lists of equipment eligible for purchase under this act have been provided, there are no directions in these lists of which to buy first, second, or third.[2]

Many studies have been conducted in the teaching of science. Most of these have concerned themselves with what is being done, and not with what ought to be done. The Encyclopedia of Educational Research makes the following statement concerning the need for research in this area:

> Periodical literature includes a relatively large number of articles discussing various aspects of science facilities. Although many of these are sound treatments and apparently contain many excellent ideas which might be advantageously employed by the science teacher, in general they reflect the considered judgment and experiences of the writers rather than the objectively validated finding of the research.[3]

Definition of Terms

Equipment. Equipment was interpreted as those items needed for science demonstrations and experiments which are not consumed. It did not include equipment which has use outside of the science program.

Materials. In this study, materials was defined as

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[2]Herbert A. Smith, "Purchases Under Title III of the N. D. E. A.," University of Kansas Bulletin of Education, 16:3, May, 1962.

[3]Chester W. Harris (ed.), Encyclopedia of Educational Research (third edition; New York: The Macmillan Company, 1960), p. 1227.

those substances which are consumed in the demonstrations and experiments.

Junior High School. As used in this study, junior high school means any school which satisfies the requirements for junior high schools as listed in the Kansas Secondary School Handbook.[4]

THE NECESSITY OF EQUIPMENT AND MATERIALS FOR THE SCIENCE PROGRAM

Excellent equipment is not the only requisite for a comprehensive science program. The program should also include well-prepared teachers, adequate texts, library resource materials, and audio-visual equipment and materials. The Council of State School Officers also includes, "a supply of appropriate materials, apparatus, and equipment."[5]

Speaking of materials Bach and Blackwood say, "Their chief purpose is to implant ideas in the minds of children and to help them understand scientific concepts."[6]

Not only should teachers be using equipment to do demonstrations and thereby enhance their teaching, but the

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[4]Kansas State Board of Education, Kansas Secondary School Handbook, (Topeka: State Board of Education, 1961), pp. 13-16.

[5]Purchase Guide for Programs in Science, Mathematics, Modern Foreign Languages (Council of Chief State School Officers, Chicago: Ginn and Company, 1959), p. 252.

[6]H. A. Bach and A. C. Blackwood, Science and the Modern High School (New York: Dryden Press, 1956), p. 35.

children also should have the opportunities to observe and describe the world around them, seek explanations, and make predictions.[7]

A comprehensive science program, then, does need equipment and materials. The purpose of this equipment and material is not for display, but for actual use in learning activities. They should find use in making a living science program with teacher demonstrations and student experiments. The main purpose of this study is not to convince the reader that there is a need for just any equipment. The purpose is to help teachers and administrators to know what to buy and collect.

Teaching Quality Determines Usefulness of Equipment

Although there is a need in the science program for equipment and materials, the quality of the program still depends ultimately on the teacher.

Experienced educators, as well as the public, can confuse quantity of equipment with quality of education. The adding of equipment and materials will not guarantee desirable change and increase program effectiveness.[8]

The best equipment can be rendered useless by the

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[7] Ibid., p. 47.

[8] W. C. Miller and A. L. Goldberg, "Important Side Effects of the N. D. E. A.," Education, 85:106-11, October, 1964.

teacher who does not use it or uses it only to entertain. Brandewein expresses this idea with these words. "Significant factors in a good science-learning activity are the teacher and the quality and kind of activities the pupils engage in each day."[9] "The teacher, therefore, is to use materials as a path to an ultimate conclusion rather than as an end in themselves."[10]

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[9]Paul F. Brandewein and others, Teaching High School Science: A Book of Methods, (New York: Harcourt, Brace, and World, Inc., 1958), p. 61.

[10]Philip G. Johnson, "National Developments in Science Curriculum in Elementary and Junior High," School Life, 45:20, October, 1962.

PROCEDURES USED

Educational literature was searched for lists of equipment and materials considered important for the teaching of junior high school science. However, from the literature review, the researcher found only general directions concerning Title III purchases.

As a source of information, the researcher analyzed three junior high school science series, to determine the materials needed in the teaching of these particular texts. Ten textbooks were analyzed: You and Your Resources, You and Science, and The Physical World, published by Harcourt, Brace, and World; Modern Science 1, Modern Science 2, Modern Science 3, and Modern Earth Science, published by Holt, Rinehart, and Wilson; and, Basic Life Science, Basic Earth Science, and, Basic Physical Science, published by the L. W. Singer Company.

The three textbook series which were surveyed are from the list of recommended science textbooks for junior high school and ones which the researcher has used or will use in his science classes.

A list of materials needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

Items were then placed alphabetically in each of the

sub-groups of equipment and materials with the supposition that the items considered necessary by all three textbook companies would be important for a comprehensive junior high school science program.

MASTER LISTS OF EQUIPMENT AND MATERIALS

Master lists will be found in the Appendices. Appendix A includes the list of chemicals; Appendix B includes the list of equipment and apparatus; Appendix C includes the list of glassware; Appendix D the list of expendables and environmental materials; Appendix E the list of models and demonstration equipment; and, Appendix F the list of charts and maps.

A total of 403 items were tallied. Little difference was noted in total number of items found in each series. The L. W. Singer Company included 291 items compared to 280 items for Harcourt, Brace, and World, and 268 for Holt, Rinehart, and Wilson. The Singer series stressed usage of expendable and environmental materials while the emphasis on chemistry and use of chemicals was stressed by Harcourt, Brace, and World.

List of Chemicals

Of the eighty-eight chemicals found in the three textbook series, Harcourt, Brace and World required sixty-four for their demonstrations and experiments. This compared to fifty-four items found in the Holt, Rinehart, and

Wilson series. The L. W. Singer series included thirty-nine chemicals for the experiments in their texts. Of the eighty-eight chemicals found in the textbooks, twenty-one were included in all three series.

List of Equipment and Apparatus

Of the textbook series analyzed, 174 items of equipment and apparatus were found. The L. W. Singer Company included 118 items compared to 116 items for Harcourt, Brace, and World, and 115 items for Holt, Rinehart, and Wilson. Of the 174 items found in the textbooks, sixty-seven were common in all three series.

List of Glassware

There were twenty-eight items of glassware on the master list. The L. W. Singer series of texts listed twenty-four items. Harcourt, Brace, and World included twenty-one different items, and Holt, Rinehart, and Wilson included nineteen. Of the twenty-eight items of glassware found in the textbooks, fourteen were included in all three series.

List of Expendables and Environmental Materials

There were eighty-nine expendable items on the master list of expendables. The L. W. Singer series included eighty-six items for the teaching of their texts. This compared to fifty-six items for Holt, Rinehart, and Wilson, and fifty-five items for Harcourt, Brace, and World. The

L. W. Singer Company called for a wider range of expendable materials, many of which could be found in the home. Of the eighty-nine expendable items found in the textbooks, forty-eight were common in all three series.

List of Models and Demonstration Equipment

The three series suggested eighteen different models and equipment for demonstration purposes. Each series called for the same items.

List of Charts and Maps

Maps and charts were necessary in all textbook series analyzed. There was no difference in the six charts and maps needed for the three series.

SELECTING AND ACQUIRING SCIENCE EQUIPMENT AND MATERIALS

The lists of materials used in the three textbook series were compiled with the assumption that the items listed in the books had educational value or they would not have been included in the books. It would still be wise to evaluate again, before purchasing, the value of an item on purely educational criteria. Harry Milgrom developed a list of criteria of this nature for the elementary schools. This same list seems applicable in many aspects, to the junior high school.

1. Be real things, whenever possible, rather than representations of real things.

2. Be readily available in school, at home, or in the community.

3. Be easy for children and teachers to assemble and use.

4. Be safe for the youngsters to handle. In most situations, for example, plastic containers and tubing may be used in place of a similar glass material.

5. Be clearly visible to all concerned.

6. Help satisfy the natural urge of young people to probe and explore.

7. Help the pupils find answers to some of their questions about the world in which they live, through firsthand "doing" experiences.

8. Make the problem on hand more meaningful and be clearly related to it.

9. Help the children grow in their abilities to observe carefully, report their observations and make predictions based upon these observations.

10. Help the pupils develop initiative and resourcefulness in their approaches to problem solving.

11. Encourage the children to be bold in their use of new materials and techniques.

12. Simplify the complex, for better understanding of basic principles.

13. Be stimulating and challenging so that children will be eager to do more science work in school or at home.

14. Help develop the creative abilities of the youngsters through project planning and construction.

15. Enable the boys and girls to experience the thrill of making "discoveries".

16. Help the children grow in responsibility through experiences with cause and effect relationships. (If you neglect to water a plant it will die.)

17. Give the children the immense satisfaction of

finding out that a tentative explanation is correct, or that a homemade device really works.

18. Help the youngsters learn to cope with new and unexpected situations.

19. Help the youngsters become more secure through knowing.

20. Bring to the boys and girls an appreciation of the beauty and rhythm of natural phenomena.

21. Help the children to learn to work together in planning and carrying out science activities.

22. Inspire the children to look forward to possible careers in science.[11]

Quality Desired

There is a place in the science program for both the commercial, the improvised, and the free and inexpensive materials. There are still things that need to be considered before an item is acquired. First, the science program should determine the equipment and material needs; the equipment and materials should not determine the science program. Second, there are great differences in quality between items of the same name. Be sure to read specific descriptions and consider carefully the quality needed. Third, safety should be considered. Fourth, can the item be stored and distributed so that it is truly useful to the teacher and pupils?[12]

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[11]Harry Milgrom, "On What Bases Should Science Learning Materials be Selected on the Elementary Level?," Science Education, 40:188-89, April, 1956.

[12]Albert Piltz, "Getting the Most from the Equipment Dollar," Instructor, 73:49, January, 1964.

When to Construct or Seek Locally

In the master lists there are many items classified as environmental materials. These are materials that can be found in the homes of the children or in the community. In other sections of the master lists there is a number of items that may be found locally but should be collected and stored in the school if they meet the needs of the educational program. Teachers should not assume too quickly that they can acquire the item when they need it.

The master lists compiled in this report are not intended to be all of the items necessary for a comprehensive science program, nor is it to be construed that all the items need to be purchased. Piltz reiterates this thought:

> There is clearly a place in the science program for both the commercial and improvised equipment. The value of each for its contribution to the educational process must be studied carefully and the determination to purchase or improvise can then be made in relation to program needs and the purposes to be achieved in the learning activities.[13]

It is of value in the classroom to make simple equipment at times. Nurry states, "Exploring young minds need to create and design; growing muscles need to construct." He continues and directs that when this type of inaccurate equipment does not satisfy the inquisitive students, it is

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[13]Albert Piltz, "Getting the Most from the Equipment Dollar," Instructor, 73:49, January, 1964.

at this point that "real" science equipment should be introduced.[14]

Purchasing from Supply Houses

There is a need for both environmental or constructed materials and purchased materials from science supply houses. There are two considerations in favor of purchased materials.

1. Could the teacher use his time more effectively in class preparation than shopping the area for science materials?

2. Could purchased equipment provide a more science-like experience?[15]

Podendorf condensed the arguments on the first of these considerations when he stated:

> Much has been said on the pros and cons of having teachers and pupils design and improvise their own equipment. The practice does encourage teachers and pupils to be creative. More often, perhaps, it results in a classroom program that uses no equipment. It seems unreasonable to expect teachers to spend the little free time they have making equipment for science class. It is most discouraging for the teacher who has invested precious hours making equipment to find when the time comes to use it, that it does not work....It seems more appropriate to the purpose of science programs for the teacher to be able to demonstrate with a piece of equipment in which both teacher and pupils can take pride.[16]

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[14]Bernard E. Nurry, "Science Equipment-Make It or Buy It?," Pennsylvania School Journal, 109:329, April, 1961.

[15]Walter A. Thurber and Alfred T. Collette, Teaching Science in Today's Secondary School (Boston: Allyn and Bacon, Inc., 1959), p. 195.

[16]Illa E. Podendorf, "State of the Sciences," School Life, 59:309, March, 1959.

In defense of the second consideration given above, The Council of State School Officers say that although teachers and pupils can make and gather from local sources many science materials, they should have the opportunity of using carefully made accurate instruments and need these instruments to have science-like experiences for the children.[17]

Purchase Considerations of Selected Items

The master lists could not specify the amount of a certain item to purchase. This must be determined by each school individually. Some items, however, that should be purchased in larger quantities than one are magnets, dry cells, bells, switches, beakers, flasks, test tubes, test tube clamps, evaporating dishes, stirring rods and tuning forks. "Such purchasing can make the differences between a satisfying amount of first-hand experience and little to no first-hand experience."[18]

Although audio-visual equipment was excluded from the master lists, one piece of audio-visual equipment, the micro-projector, was included since it is used exclusively in the science program. A microscope needs to be refocused by each

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[17]Purchase Guide for Programs in Science, Mathematics, Modern Foreign Languages (Council of Chief State School Officers. Chicago: Ginn and Company, 1959), p. 252.

[18]Podendorf, loc. cit.

child, and each child needs a microscope to use, but the microprojector can project a specimen in focus for the entire class. The teacher can also point to particular features of the specimen being sure that the student will note the desired feature of the specimen.[19]

After reviewing the master lists, one might consider the purchase of a science kit or portable science laboratory the answer to acquiring those items most recommended. Piltz warns that the cost is likely to be more if the kit or portable laboratory is purchased than if the same items were purchased individually. Other factors to consider are specifications, quality, serviceability, maintenance, replacement needs, and extent of use.[20]

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[19]Albert Piltz, Science Equipment and Materials for Schools-Suggestions for Supervisors, Administrators, and Teachers, United States Department of Health, Education, and Welfare, OE 29029 (Washington: Government Printing Office, 1961), pp. 23-24.

[20]Albert Piltz, "Getting the Most from the Equipment Dollar," Instructor, 73:80, January, 1964.

SUMMARY AND RECOMMENDATIONS

The literature review showed that good science teaching must include firsthand experiences for the students and that these firsthand experiences for the student depended upon adequate science equipment and materials. What was adequate depended upon the scope and content of the science program in the individual school and the capabilities of the teachers.

As lists of equipment were not available for the junior high school, the researcher analyzed three textbook series, which included ten science textbooks, to determine the materials needed in the teaching of these particular texts. The chief purpose then was to reduce ten such lists to single master lists of sub-groups of equipment and materials.

A total of 403 items were tallied. Little difference was noted in total number of items found in each series. The L. W. Singer Company included 291 items compared to 280 items for Harcourt, Brace, and World, and 268 for Holt, Rinehart, and Wilson. The Singer series stressed usage of expendable and environmental materials while the emphasis on chemistry and use of chemicals was stressed by Harcourt, Brace, and World.

Any purchase by a school should be such that it helps carry out the objectives of the science curriculum. The curriculum should not be molded to fit the equipment.

There is a place for both improvised and purchased materials. The particular teacher must determine which is more appropriate.

In the use of the master lists it is recommended that a school evaluate its present science equipment and materials in reference to those items in each division which were found to be most important. In any one year the purchase of materials should probably provide some new materials from each area. The size of the school, the amount of equipment and materials already in the school, the value of the science program in the eyes of the community, the size of the science budget, and other factors will determine which items the school acquires of the items on the master lists.

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APPENDIX A. List of Chemicals

MASTER LIST OF CHEMICALS

The following list is a complete list of all chemicals as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the chemicals needed in the teaching of their particular texts.

A list of chemicals needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

Of the eighty-eight chemicals found in the three textbook series, Harcourt, Brace and World required sixty-four for their demonstrations and experiments. This compared to fifty-four items found in the Holt, Rinehart, and Wilson series. The L. W. Singer series included thirty-nine chemicals for the experiments in their texts. Of the eithty-eight chemicals found in the textbooks, twenty-one were included in all three series.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace, and World.
2. Holt, Rinehart, and Wilson.
3. The L. W. Singer Company.

For example, the numbers following the item, Acid,

acetic, are 1, 2, 3, which indicates that all three of the textbook companies considered this item as useful or needed in a junior high school science program.

List of Chemicals	Number
Acid, Acetic	1,2,3
Acid, boric	3
Acid, gibberellic	3
Acid, hydrochloric	1,2,3
Acid, nitric	1,2,3
Acid, stearic	1
Acid, sulfuric	1,2,3
Agar Agar	1, 3
Alcohol, denatured	1,2,3
Alum, sodium	2
Ammonia, household	1,2,3
Ammonium chloride	1, 3
Ammonium dichromate	1
Ammonium hydroxide	1,2
Baking soda	1,2,3
Barium carbonate	3
Beeswax	2
Benzene	2
Bromothymol blue	1, 3
Borax, powdered	1,2
Calcium carbide	3

	Number
Calcium chloride	1
Calcium hydroxide	1,2
Calcium oxide	2
Canadian balsam	1
Carbon disulfide	2
Carbon tetrachloride	1,2
Chalk	1,2,3
Charcoal	1,2,3
Chlorinated lime	2
Copper chloride	1
Copper sulfate	1,2,3
Cornstarch	1,2,3
Dextrose	1,2
Drier, paint	2
Ether, ethyl	1,2,3
Ferric ammonium citrate	1
Ferric chloride	1
Ferric oxide	2
Ferrous sulfate	1
Hydrogen peroxide	1,2,3
Iodine crystals	1,2,3
Linseed oil	2
Litmus paper, red, blue, neutral	1,2,3
Lye	1,2

	Number
Magnesium hydroxide	2
Magnesium sulfate	2,3
Manganese dioxide	1,2
Marble chips	1,2
Mercuric nitrate	1
Mercuric oxide	1
Mercury	1,2,3
Methylene blue	1, 3
Mica crystals	1
Phenolpthalein	1,2
Pitchblende	1,2,3
Phosphorus-32	1, 3
Potassium bromide	1, 3
Potassium chlorate	1, 3
Potassium dichromate	1
Potassium ferricyanide	1
Potassium hydroxide	1,2
Potassium iodide	1,2
Potassium nitrate	2,3
Potassium permanganate	1
Quartz crystals	1,2,3
Quicklime	1,2
Rock salt	1,2,3
Silver iodide	3

	Number
Silver nitrate	1, 3
Sodium carbonate	2
Sodium citrate	2
Sodium chloride	1,2,3
Sodium hydroxide	1,2
Sodium nitrate	2
Sodium oleate	1
Sodium phosphate	1,2
Sodium thiosulfate	1,2
Spermaceti	2
Stearin	3
Strontium oxalate	3
Sulphur	1,2,3
Talc	1, 3
Trisodium phosphate	1
Turpentine	2
Zinc oxide	1,2
Zinc stearate	1
Zinc sulfate	1

APPENDIX B. List of Equipment and Apparatus

MASTER LIST OF EQUIPMENT AND APPARATUS

The following list is a complete list of all equipment and apparatus as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the equipment and apparatus needed in the teaching of their particular texts.

A list of equipment and apparatus needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

Of the textbook series analyzed, 174 items of equipment and apparatus were found. The L. W. Singer Company included 118 items compared to 116 items for Harcourt, Brace, and World, and 115 items for Holt, Rinehart, and Wilson. Of the 174 items found in the textbooks, sixty-seven were common in all three series.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace, and World.
2. Holt, Rinehart, and Wilson.
3. The L. W. Singer Company.

For example, the numbers following the item, Alcohol burner, are 1, 2, 3, which indicates that all three of the

textbook companies considered this item as useful or needed in a junior high school science program.

List of Equipment and Apparatus	Number
Alcohol burner	1,2,3
Ammeter	1,2,3
Anemometer	1,2,3
Animal cage	1, 3
Aquarium, with apparatus	1,2,3
Asbestos mat	1,2,3
Asbestos sheet	1,2,3
Balance, spring	1,2,3
Ball and Ring apparatus	1,2,3
Balloons	1,2,3
Barometer, aneroid	1,2,3
Barometer, mercury	1,2,3
Basketball	1
Bell, doorbell	1,2,3
Brush for painting	3
Brush, test tube	1,2
Bunsen burner	1,2,3
Buzzer	1,2,3
Camera	1,2,3
Can opener	3
Cartesian diver	2
Catskin	1,2

	Number
Clamp, burette, round jaws	1,2,3
Clamp, burette v and flat jaws	1,2,3
Clamp, C, iron	1,2
Clamp, condenser, iron	3
Clamp for meterstick	3
Clamp holder	1,2
Clamp, iron, for trip	3
Clamp, Mohr's pinchcock	1,2,3
Clamp, ring stand	1,2,3
Clamp, screw compression	1,2
Clamp, test tube	1,2,3
Cloud apparatus	1,2
Coil spring	1,2,3
Color disk with motor	2
Compass	1,2,3
Compound bar	1,2,3
Conductometer	1,2
Convection apparatus	1,2,3
Corks, assorted	1,2,3
Corks, borer set	1,2
Corks, stoppers	3
Crucibles	1,2
Dissecting pan	1, 3
Dissecting set	1, 3

	Number
Electrolysis apparatus	1,2,3
Electroscope	1
Exhaust pump	1,2
Exposure meter	1
File	1,2
Filter paper	1,2,3
Force pump	1,2
Forceps	2,3
Friction pad, flannel	1,2
Friction pad, silk	1,2,3
Friction rod, glass	1,2,3
Friction rod, lucite	1,2
Friction rod, rubber	1,2,3
Galvanometer	3
Gauze, iron, asbestos	1,2,3
Geologists pick	2
Germinating box	3
Globe	1,2,3
Globe, Hall tellurian	2,3
Gyroscope	1,2,3
Holder lens for meterstick	3
Holder screen for meterstick	3
Hot plate	1, 3
Hydrometer, universal	2,3

	Number
Hygrometer	1,2
Inclined plane	1,2,3
Incubator	1,2
Insect cage	2,3
Insect net	2,3
Lamp, 6 volt	1,2
Lamp, 25 watt	1,2
Lamp, chimney	1,2,3
Lamp, ultraviolet	1, 3
Lamps, 1.3 v.-6 amp.	1
Lift pump	2
Light box	3
Light sockets, miniature	3
Lighter, gas friction	2
Lodestone	1
Magnet, bar alnico	1,2,3
Magnet, bar steel	1,2,3
Magnet, horseshoe alnico	3
Magnet, horseshoe steel	1,2,3
Magnet, wobbly bar	3
Magnifier, tripod	1,2,3
Medicine dropper	1,2,3
Meter stick	1,2,3
Microscope	1,2,3

	Number
Mirror, set	1,2,3
Mortar and Pestle, porcelain	3
Motor, battery	1,2
Motor, St. Louis	1,2,3
Needles	1,2,3
Pan, enamle	3
Pins, dissecting	3
Pins, straight	3
Pith balls	1,2,3
Pliers	1,2,3
Polaroid material	1
Porcelain streak plates	2
Prism, set	1,2,3
Protractor	3
Pulley, double sheave	1,2
Pulley, single sheave	1,2
Radio	3
Receptacle, lamp socket	1,2
Resistor, .5 to 1 megohm	2
Rheostat	2.3
Ring stand	1,2,3
Ripple tank	3
Rod, carbon	3
Rubber stoppers	1,2,3
Rubber tubing, assorted	1,2,3

	Number
Sand bath, 6 inch	3
Screw driver, large	1,2,3
Screw driver, small	1,2,3
Spark coil	3
Spatula, steel	3
Spoon, burning	3
Spoon, deflagrating, brass	1,2
Steam boiler, with fittings	3
Stop watch	3
Stroboscope	3
Support ring, 3 inch	1,2,3
Support ring, 4 inch	1,2
Support ring, 5 inch	2
Switch knife, double pole	1,2,3
Switch knife, single pole	1,2,3
Telegraph key	1,2,3
Telegraph sounder	1,2,3
Telephone receiver	2
Telephone transmitter	2
Telescope	1,2,3
Test tube rack	1,2
Thermometer, alcohol	1, 3
Thermometer, cooking	2
Thermometer, double scale	1,2,3
Tongs	1,2,3

	Number
Trap, steam	3
Transformer	1,2
Tray, enamel	3
Triangle with pipestem	1
Pripod, iron	3
Trough, pneumatic	1,2,3
Tube 6H6	1
Tube, ignition	2
Tumbler	3
Tuning Fork, set	1,2,3
Vacuum plate	1, 3
Vacuum pump	1, 3
Voltmeter	1,2,3
Weight holders	3
Weights (0-500 g.)	1,2
Weights, iron, 1 lb.	3
Weights, metric (1 g.-200 g.)	3
Weights, slotted, metric (10 g.-500)	2,3
Wheeled car	1,2,3
Wire annunciator	1,2
Wire, bell	1,2,3
Wire, gauze	1,2,3
Wire, iron no. 18	1
Wire, iron no. 28	1
Wire, copper no. 18	3

	Number
Wire, copper no. 20	3
Wire, platinum	1,2
Wire, resistance	1,2,3

APPENDIX C. List of Glassware

MASTER LIST OF GLASSWARE

The following list is a complete list of all glassware as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the glassware needed in the teaching of their particular texts.

A list of glassware needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

There were twenty-eight items of glassware on the master list. The L. W. Singer series listed twenty-four items in their texts. Harcourt, Brace, and World included twenty-one different items, and Holt, Rinehart, and Wilson included nineteen. Of the twenty-eight items of glassware found in the textbooks, fourteen were included in all three series.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace, and World.
2. Holt, Rinehart, and Wilson.
3. The L. W. Singer Company.

For example, the numbers following the item, beakers, assorted, are 1, 2, 3, which indicated that all three of the

textbook companies considered this item as useful or needed in a junior high school science program.

List of Glassware	Number
Adapter, glass bent	3
Beakers, Pyrex, assorted	1,2,3
Bottles, 8oz. W.M.	2,3
Bottles, Dropping	2
Bottles, reagent	2,3
Bottle, vacuum	1,2,3
Cylinder, graduate 100 ml.	1,2,3
Cylinder, graduate 50 ml.	1, 3
Condenser, glass 16"	3
Condenser, glass 24"	3
Cover Slips	1
Dish, petri, assorted sizes	1,2,3
Dish, evaporating	1,2,3
Flask, Erlen., Pyrex, assorted sizes	1,2,3
Flask, Florence, Pyrex, assorted sizes	1,2,3
Funnels, Pyrex	1,2,3
Funnel tube, thistle	1,2,3
Glass marbles	3
Glass plates	1,2,3
Glass slides	1, 3
Glass stirring rods	1,2,3

	Number
Glass tubing, barometer	1, 3
Glass tubing, assorted	1,2,3
Jar, battery	1,2,3
Jar, bell	1, 3
Tube connecting "T", glass	2
Tube connecting "Y", glass	1,2
Test tubes, Pyrex, assorted	1,2,3
Test tubes, soft glass	1,2
Watchglass	1, 3

APPENDIX D. List of Expendables and Environmental Materials

MASTER LIST OF EXPENDABLE AND ENVIRONMENTAL MATERIALS

The following list is a complete list of all expendable and environmental materials, as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the expendable and environmental materials needed in the teaching of their particular texts.

A list of expendable and environmental materials needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

There were eighty-nine expendable and environmental items on the master list. The L. W. Singer series included eighty-six items for the teaching of their texts. This compared to fifty-six items for Holt, Rinehart, and Wilson, and fifty-five items for Harcourt, Brace, and World. The L. W. Singer series called for a wider range of expendable materials, many of which could be found in the home. Of the eighty-nine expendable items found in the textbooks, forty-eight were common in all three series.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace and World.

2. Holt, Rinehart, and Wilson.

3. The L. W. Singer Company.

For example, the numbers following the item, Absorbent cotton, are 1, 2, 3, which indicated that all three of the textbook companies considered this item as useful or needed in a junior high school science program.

List of Expendable and Environmental Materials	Number
Absorbent cotton	1,2,3
Airplane cement	3
Apples	3
Battery, 90 v.	1,2,3
Battery, storage, 6 v.	1,2,3
Blotters	3
Black water paint	3
Blueprint paper	2,3
Broom straws	1,2,3
Candles	1,2,3
Cardboard Boxes	1,2,3
Cellophane tape	3
Cheese	1,2,3
Chocolate bar	1,2,3
Cloth, cheese	1,2,3
Cloth, black	1,2,3

	Number
Clover	3
Coal	1,2,3
Coleus	1, 3
Cord, cotton	1,2,3
Drinking staws	1, 3
Dry cell	1,2,3
Dry ice	2,3
Eggs, raw	1,2,3
Eggs, silkworm	3
Elodea leaves	1,2,3
Film sheet	1,2,3
Fish food	1,2,3
Food coloring	1, 3
Gasoline	2
Gelatin	1, 3
Glitter	3
Grapefruits	1,2,3
Gravel	1,2,3
Ground beef	1,2,3
Houseflies	3
Homogenized milk	1,2,3
Ice	1,2,3
Ink	1,2,3
Incense	3

	Number
Lycopodium	1, 3
Light bulbs	1,2,3
Meat, uncooked	1,2,3
Mulberry leaves	3
Nails	1,2,3
Onion skins	1,2,3
Oranges	1,2,3
Paper bags	3
Paper towels	1,2,3
Plaster of Paris	3
Plastic tubing	1,2,3
Pineapple juice	1,2,3
Plants, bean slips	2,3
Plants, castor beans	3
Plants, nasturium slips	3
Plants, petunias	2,3
Plants, sunflowers	3
Plants, tomatoe slips	2,3
Rain water	3
Rubber bands	1,2,3
Sand, coarse and fine	1,2,3
Sand paper	2
Saran Wrap	3
Seedlings, bean	1,2,3

	Number
Seeds, beans or peas	1, 3
Seeds, radishes	1, 3
Seeds, rice	1,2,3
Seeds, wheat	3
Silk	3
Silkworm larvae	3
Silkworm moths, adult	3
Soil, bog	1,2,3
Soil, garden	1,2,3
Soil, swamp	1,2,3
Spinach leaves	3
Sugar	1,2,3
String	1,2,3
Syrup	1,2,3
Tissue paper	3
Timothy hay	1,2,3
Tongue depressors	1,2,3
Toothpicks	1,2,3
Toothpaste	2,3
Vinegar	1,2,3
Wood splints	1,2,3
Wooden matches	1,2,3
Wrapping twine	3
Yeast	1,2,3

APPENDIX E. List of Models and Demonstration Equipment

MASTER LIST OF MODELS AND DEMONSTRATION EQUIPMENT

The following list is a complete list of all models and demonstration equipment as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the models and demonstration equipment needed in the teaching of their particular texts.

A list of models and demonstration equipment needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

The three series suggested eighteen different models and equipment for demonstration purposes. Each series called for the same items.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace, and World.
2. Holt, Rinehart, and Wilson.
3. The L. W. Singer Company.

For example, the numbers following the item, demonstration electromagnet, are 1, 2, 3, which indicated that all three of the textbook companies considered this item as useful or needed in a junior high school science program.

List of Models and Demonstration Equipment	Number
Demonstration electromagnet	1,2,3
Demonstration generator	1,2,3
Demonstration steam engine	1,2,3
Distillation apparatus	1,2,3
Lens, set for demonstration	1,2,3
Metals, demonstration set	1,2,3
Model, airplane	1,2,3
Model, diesel engine	1,2,3
Model, ear	1,2,3
Model, eye	1,2,3
Model, flower	1,2,3
Model, force pump	1,2,3
Model, gasoline engine	1,2,3
Model, human skeleton	1,2,3
Model, leaf	1,2,3
Model, lift pump	1,2,3
Model, simple machines	1,2,3

APPENDIX F. List of Charts and Maps

MASTER LIST OF CHARTS AND MAPS

The following list is a complete list of all charts and maps as found in the lists combined.

As the source of information, the researcher analyzed three junior high school science series, to determine the charts and maps needed in the teaching of their particular texts.

A list of charts and maps needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

Maps and charts were included in all textbook series analyzed. There was no difference in the six charts and maps needed for the three series.

The column headed Number refers to the textbook company list on which the item was found. The key used for this list was:

1. Harcourt, Brace, and World.
2. Holt, Rinehart, and Wilson.
3. The L. W. Singer Company.

For example, the numbers following the item, chart, astronomy, are 1, 2, 3, which indicates that all three of the textbook companies considered this item as useful or needed in a junior high school science program.

List of Charts and Maps	Number
Chart, astronomy	1,2,3
Chart, elements	1,2,3
Chart, General Science	1,2,3
Chart, Geology, with set of minerals	1,2,3
Map, U. S. Relief	1,2,3
Map, U. S. weather, complete set	1,2,3

SCIENCE EQUIPMENT AND MATERIALS FOR A COMPREHENSIVE JUNIOR HIGH SCIENCE PROGRAM

by

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AN ABSTRACT OF A MASTER'S REPORT

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The purpose of this study was to provide master lists of science equipment and materials for a comprehensive junior high school program.

Three junior high school science series were analyzed to determine the equipment and materials needed in teaching when these particular texts are used.

A list of materials needed for each textbook series was compiled. From the three textbook series lists, a master list of all items found in any one of these separate lists was made.

Items were then placed alphabetically in each of the sub-groups of equipment and materials with the supposition that the items considered necessary by all three textbook companies would be important for a comprehensive junior high school science program.

A total of 403 items were tallied. Little difference was noted in total number of items found in each textbook series. The L. W. Singer Company included 291 items compared to 280 items for Harcourt, Brace, and World, and 268 items for Holt, Rinehart, and Wilson. The Singer series stressed usage of expendable and environmental materials, while the emphasis on chemistry and use of chemicals was stressed by Harcourt, Brace, and World. Holt, Rinehart, and Wilson stressed each of the sub-groups equally.

The researcher assumed that items appearing on all of

the lists should be purchased first. Each school would have to evaluate its present equipment and materials as compared with the master lists and then make judgments concerning purchases. No purchase should be made if it does not fit the objectives of the science curriculum of the school.

It was noted that the usefulness of any piece of science equipment depends ultimately on the teacher. There is still a place for both purchased and improvised materials.