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Scope and Method of Study: This report is confined to the materials needed in the science laboratory, the development of a filing system, and facilities for the storage of these materials. Emphasis is placed on the development of the filing system and storage facilities. Contained in the report is a minimum list of materials needed in a science laboratory, based on a class of twelve students, examples of filing systems, methods of storage, and special equipment that would aid in storing of laboratory equipment.

Findings and Conclusions: From a study of the survey of facilities in various high schools the author concluded there is a vital need for some standardized method of storing materials in the science laboratory, and the development of a standard filing system of written or printed materials used in the science laboratory of the small high school. In many of the laboratories the author visited, there was very little arrangement of the materials and storage facilities were usually inadequate. Many of the schools were in the process of refurnishing their laboratories with equipment to aid in teaching Physics and Chemistry.

ADVISER'S APPROVAL James H. Zant

THE ARRANGEMENT AND IDENTIFICATION OF MATERIALS IN THE SCIENCE LABORATORY OF THE SMALL HIGHSCHOOL

BY

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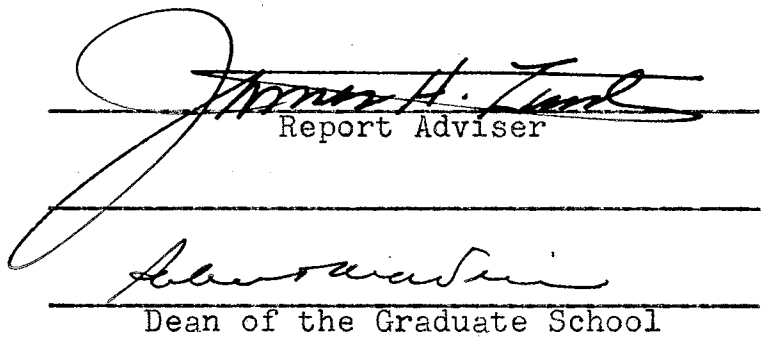

Report Adviser

Dean of the Graduate School

PREFACE

The need for a system of arrangement of materials and equipment in the laboratory of the small high school has become acute in the past few years. This was particularly focused to my attention while a teacher in a school representative of our small schools today. The average enrollment was around eighty-five students. There was one large room used for laboratory of all the sciences taught. During the time I was there the science classes were alternated every other year so that General Science and Chemistry were taught one year, and Physics and Biology the preceding year. There were about twenty-four students in Biology, and General Science, with only six to twelve in the other two classes.

The laboratory was well equipped for a school of that size. There was no inventory of the equipment in the laboratory, and none could be found in the office.

The first thing to do was to make a rough inventory of the equipment to gain some idea of the materials on hand, and those that would be needed during the year. With the assistance of students after school hours, and other help, a fair approximation of the equipment on hand was obtained. An attempt was made to get the material and equipment into an orderly arrangement, but storage facilities were not adequate. It was difficult to find a piece of equipment or

a chemical at a moments notice, even though the inventory showed that it should be in a certain cabinet. The cabinets were poorly arranged, and too deep for much of the material which had to be stored in them.

It was difficult to keep track of the materials used since there was no system of recording the amount to be used in a particular laboratory experiment, at a given time. There was no record of additional chemicals that had been purchased, or where they might be located. Several times chemicals were ordered, only to discover a short time later that in some obscure place, there was enough of that particular chemical to complete the year.

Evidently this was not the first time this had happened to an instructor in this school, for enough test tubes were found in unopened boxes to last a school system of this size for years, if the instructor was reasonably conservative.

At the end of the first year a great improvement had been made on the storage and filing system, but much was still to be done. During the second year a new cabinet was added. This was built by the boys in the Vocational Agriculture department, and cost approximately twelve ($12) dollars. This cabinet added a third more storage space,and enabled me to rearrange the materials so that there was some semblance of order, according to the materials used in a given subject.

When making a final inventory at the end of the second year, a student mentioned some peculiar apparatus located

in a closet under the stairway at the front door. After removing brooms, mops, and other cleaning equipment, we found two aquariums, a Boyle's Law Apparatus, a diesel engine model, a Wimshurst Static machine, and several other pieces of equipment. This should have been in the science laboratory, and could have been used very effectively that year if anyone had known that they were around. After this experience, the janitor opened closets for further inspection, and chemicals were found that had been purchased at least ten years before.

As a result, many dollars worth of equipment and supplies were being wasted, also, the students were being denied many wonderful learning experiences.

Proper storage space had not been provided for valuable equipment, and some had been stored with no record kept of its location. I was unable to efficiently use much of the equipment because the instruction sheets had been lost. This information is essential to an instructor, in the use and care of the equipment. From the survey I have made of different schools, similar experiences have occured in many of them.

Too often in the training of science teachers there is no opportunity to become familiar with the various materials one must later use in the laboratory. There has been very little provision in the teacher training program for a student science teacher to assemble, use, and care for the

equipment for which he will later be responsible in his teaching experiences. He may have used some of the apparatus in the various laboratory courses, but usually it had been taken out of storage and assembled by a laboratory assistant. This inexperience, uncertainity, and fear of breaking expensive equipment, hinders the effectiveness of the young teacher.

If the instruction for the care and proper use of each piece of apparatus in the laboratory was on file, and readily available to the instructor, this would give a greater feeling of security, and in turn produce a better teaching situation. It would possibly reduce the cost of repairs and maintenance of the school laboratory over a period of years.

Another and probably most important argument for the need of an adequate system of storage and filing in the laboratory of the small high school, is the time required to assemble and disassemble the needed materials for a certain laboratory period or demonstration. The teaching load of most small high school science teachers is usually five to six hours of class each day. This means there is little or no time available before or after a class to collect and assemble materials for the laboratory period, and again disassemble and put away these materials so the room may be used by another class the following period.

Frequently, due to the lack of time needed to adequately prepare for a laboratory period or demonstration, the

instructor simply neglects to use this important aid in teaching. The student then must make his own association between learning and experience. Many times this is difficult to do since the learner's experiences are limited. Mr. Douglass has said:

> Unless the learner can associate the spoken or written word with some past or present perceptual experience, the resulting concept will most likely be vague, meaningless, and emphemeral. Elementary school teachers recognize that the lack of reading readiness among younger children may be caused by limited experimental background. Difficulties encountered by older children in other types of learning have similar origin. Meaningful, present learning experiences, can emerge only from significant past experience, which is properly associated in the mind of the child with his immediate needs.[1]

Demonstrations and laboratory experiences properly conducted and connected with a child's own experiences can only be done with good teacher pre-planning, and sufficient time to execute plans effectively.

Too often laboratory periods are of minimum length, and the students are required to gather the materials, perform the experiments, and clean up the laboratory for the next class during this short period. As any teacher who has had some experience knows, this is an impossible task for the students to successfully accomplish, and is even more difficult to do if he has to spend considerable time hunting for

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[1]Douglas, Harl R. and Mills, Hubert H. Teaching in High School (New York, 1948.) p. 305

the materials in a poorly arranged cabinet.

These problems exist for the new teacher as well as the experienced teacher in a new school system. The purpose of this report, is to provide a guide for teachers in the arrangement and identification of materials in the science laboratory of the small High School, so the limited time for the laboratory period may be used efficiently.

There is a wide diversity in size, shape, and amount of equipment in the various laboratories, and there is a wide difference in funds allocated for equipping a laboratory. The guide should be a plan of storage and filing based on a typical laboratory, but adjustable to the local situation according to the ingenuity of the teacher, and the situation involved.

The small high school, refers to those schools with one room devoted to the storage of all science equipment and materials, and the class participation. It may include those schools that have a small store room or closet directly connected to the laboratory room.

In planning the storage space, a suggested list of materials needed in teaching classes in General Science, Biology, Chemistry, and Physics to twelve students, will be used. However, it should be understood that in many instances equipment may be constructed by the instructor or by his students. This is a good way to provide learning experiences for students which many times would not be possible, because of the cost of the expensive equipment, which

is prohibitive to the local system.

With the emphasis in education placed on science due to the government aid to all fields of science, the enlargement and improvement of science departments is inevitable. During the past ten years many science departments have depreciated until there is hardly enough equipment for a lecture demonstration. Others have managed to keep the equipment they had in good repair, but very few of them have expanded with the growing population. As a result of the emphasis placed on science, there should be a large number of these science departments rejuvenated and considerable money will be paid out for new equipment. Much of this equipment, if properly cared for, will last for ten to twenty years.

It is hoped that this report may be a future guide to those who have the responsibility of the arrangement and care of the school science laboratory, that it may be used successfully by any teacher who should be in the system, with the minimum amount of effort and time.

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CHAPTER I

RECOMMENDED MINIMUM LABORATORY EQUIPMENT FOR GENERAL SCIENCE, BIOLOGY, CHEMISTRY, AND PHYSICS

The list contained in this chapter is not intended to be complete. It may be considered to be a minimum list of materials needed for the students to have laboratory practice, either individually or in groups. This does not mean that a particular course should not be taught if some of the materials are not available to the instructor, nor does it suggest that it is necessary to have a laboratory or demonstration period with any one of these subjects in order to teach it successfully.

Any listing of equipment and supplies is necessarily an approximation. This follows from the fact that the experiences that make up the curriculum should and do vary as the objectives of the teaching vary. No listings can be complete, particularly in view of the desirable use of materials and apparatus obtained from local sources. In many instances the building of apparatus is in itself an educational experience.[1]

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[1]Richardson, John S, ed. School Facilities For Science Instruction, by The National Science Teachers Association (Washington, D. C., 1954)

This list has been compiled from lists submitted through the courtesy of the W. M. Welch Manufacturing Company; Oklahoma State Department of Education; The MacMillan Company; Ohio State Department of Education; and National Science Teachers Association. The list is sufficient for a class of twelve pupils, working in groups of four.

The author felt it unnecessary to include a list of chemicals, since each publishing company furnishes a list with their individual texts.

Items and/or description	General Science	Biology	Chemistry	Physics
Ammeter (range o to 10 amps. by .1 amp)				3
Balls, steel 3/4" dia.				6
Balance (select)				
Spring 500 gm.	2			6
2000 gm.				3
Bathroom		1		1
Triple Beam	1		3	2
Barometer				
Aneroid	1			1
Mercury				1
Bar Unequal expansion				1
Battery Jar (select)				
1 quart	1			3
1 gallon	1			3
Batteries (select)				
Dry cell 1.5 volt				4
Demonstration				
Students			6	6
Daniell				1
Beakers (select)				
100 ml				6
250 ml				6
400 ml				6
Bell electric				2
Bell Jar, 1 gal.				
glass, stoppered				1

Items and/or description	General Science	Biology	Chemistry	Physics
Bottles (select)				
Narrow Mouth 4 oz.	½ dz	½ dz	1 dz	½ dz
8 oz.			1 dz	
16 oz.			1 dz	
Wide mouth 4 oz.	½ dz	½ dz	1 dz	½ dz
8 oz.			1 dz	
16 oz.			1 dz	
Insect Killing 8 oz.		12		
Boyles law tube			1	1
Burrettes Morh's				
50 ml			6	
Burner Bunsen	6	3	6	6
Caliper, Micrometer				1
0 to 25 mm				1
Veriner	1			1
Calorimeter, complete	1		3	3
Carriage, Hall's				3
Centrifugal Hoop				1
Charcoal sticks			1	
Clamps				
standare "C"	2			6
Mohr's burettes		3	4	
test tube	2	6	6	3
hose	2		6	3
Coils				
induction				2
primary				2
secondary				2
Collections				
classified animal		1		
slide		1		
insect		1		
botany (local plants)		1		
Commutator				1
Compass				
10 to 16 mm	3			6
45 mm	1			3
Condenser				
complete				6
plates in pairs	1			6
Connectors for electrodes				1 dz
Cord (spool)	1	1	1	1
Corks (assorted)	1 box		1 box	
Cork borer set	1		1	
Cotten, absorbent	1 box	1 box	1 box	1 box
Cover glasses		1 dz	1 dz	
Crucible, porcelain				
with cover No. 2	2	2	6	2

Items and/or description	General Science	Biology	Chemistry	Physics
Culture tubes	6	2 dz		
Cylinders, measuring & bucket	1		1	
Dishes, evaporating 100 mm diameter	6	1 dz	1 dz	6
Petri	1 dz	2 dz		
Crystallizing	2	1 dz	4	
Disk optical and accessories				1
Dissection kit	1	6		
Dissection pan	1	6		
Electromagnet dissectible				1
Electroscope flask form	1			1
Electrophorus Disc				1
Electrolysis apparatus demonstration	1		1	1
student			3	
Electrodes carbon				1 set
Flasks pyrex flat bottom 250 ml	2	2	6	2
1000 ml	2	2	6	2
2000 ml	2	2	6	2
Erlenmeyer 250 ml	2	2	6	2
500 ml	2	2	6	2
distilling 125 ml			2	
250 ml			2	
filter 250 ml			4	
volumetric 500 ml			4	
Funnel, glass 75 mm diameter	2	6	1 dz	2
separatory 125 mm			2	
Galvanoscope, porcelain				3
Gauge, asbestos	1	1	6	1
Generator, Gas Kipp 500 ml				1
Glass Squares 4"	6	6	1 dz	4
Graduated cylinder 50 ml	3	3	6	3
100 ml	1	1	3	1
500 ml			1	

Items and/or description	General Science	Biology	Chemistry	Physics
Herbarium		6		
Label book	1	1	1	1
Lamp, incandescent tungsten filament				
40 watts	4			6
100 watts	2			6
carbon filament				2
Lens set	1			1
Litmus paper student package				
blue	1		6	
red	1		6	
Loadstone	1			1
Magnet, bar steel	6 pr.			6 pr.
horseshoe	6			6
cylindrical	6			6
Magnet board				1
Magnetic needle				
horizontal	1			1
dipping	1			1
Magnifier tripod	6	6		
Mechanical equivalent of heat equipment				1
Meter sticks	3	1	3	6
Microscope, compound	1	2	1	1
Mirror, metal				
concave	1			1
conves	1			1
plain	1			1
Mirror, scale and support	1			1
Osmosis equipment				
bladder form	1			1
Pad, silk	2			2
flannel	2			2
Paraffin parowax		1 lb	1 lb	
Photometer equipment, simple				1
Pins, insect No. 0	1 gr	1 gr		
No. 1	1 gr	1 gr		
Pipette, medicine droppers	1 dz	1 dz	1 dz	
Plane, inclined with pulley				1
Plates, glass				
cobalt			6	

Items and/or description	General Science	Biology	Chemistry	Physics
Receptacle, keyless (light)	4			4
Resonance tubes set				1
Rheostat, slide wire form				1
Rods, friction				
glass	2			2
friction wax	2			2
soft iron round	1			2
friction vulcanite	2			2
Rotator, handy				1
Rubber dam	1			1
Screen, metal semicylindrical with 1x8 mm slit				1
Shot, lead				1 lb ea.
steel				1 lb ea.
copper				1 lb ea.
Slides, prepared (set) usually 25	1	1		
Slides, blank microscopes	1 dz	2 dz		
Slide box, for homemade slides	1	1		
Spatula			6	
Specimen Mounts riker type		12		
Spoon deflagrating			6	
Spring and weight holder				1
Static machine Wimhurst				1
Steam engine model				1
Steam generator apparatus				1
St. Louis motor				
Test tube	1 dz	1 dz	4 dz	
Stoppers, rubber assortment		plain	1&2	0to6
Telegraph set				1
Test tube brush	3	3	6	
Test tube clamp	3	3	6	
Thermometer 110 C	1		3	3
double scale 100C	1		3	

Items and/or description	General Science	Biology	Chemistry	Physics
Thistle tube				
30 cm pyrex			6	
Tongs Crucible	1	3	6	
Triangle 2" wire	1	1	6	
Tube, volume				
co-efficient			1	1
Tuning Fork				
256 vps 384,512	1 ea			1 ea
Voltmeter Range				
0 to 5 volts				1
by .05				1
Watch glass,				
various sizes	6		12	
Weights				
2 Kg				1
set 10 to 500 grm				
(with hooks)			2	2
set 10 to 500 gm				
(slotted)			2	2
set 1 to 1000 gm	1		2	2
Wheel and axle				
diameters in ratios				
of 1357				1
Wing top for burner			6	
Wire gauze, 5"	1		6	2
Wire copper, #18				
DCC				1 lb
#24 plain 4 oz.				4 oz

CHAPTER II

A FILING SYSTEM FOR RELATED MATERIAL

Most small High School Science departments are handicapped in their efficiency from the lack of illustrative and source material for the use of the instructor and student. Instructors may clip magazine articles, bulletins, and other source material, but because of poor filing, it is soon lost and really never used.

Students often times are so busy that they do not have time to scan all magazines for additional current articles on the unit being studied. However, all students from time to time find articles of interest that would be of great value to him and his fellow students, if it were filed and referred to later. This would also provide a valuable guide to the teacher concerning the interests of the class.

A filing system is needed for current materials, demonstrations, instruction sheets on special laboratory equipment, pamphlets, pictures, and special reports for bulletin boards.

A filing system that is approximately the same in every school, would definitely eliminate much confusion at the beginning of each term for the new science teacher.

The ideal filing system should be a four drawer arrangement. This would make possible one drawer for each; chemistry, physics, biology, and general science.

All material should then be cataloged and carefully numbered with file number for quick finding and refiling. Lists of available equipment and location of this equipment for each unit of work would also be very handy for the experienced as well as the inexperienced, science instructor.

On the following pages will be found a suggested outline for getting up a filing cabinet based on the four major science courses, chemistry, physics, biology, and general science. As additional courses are added, additional files could be set up in the same sequence. Secondary title lines may be modified to correlate somewhat with the text being used in a given school, however, most texts follow the same general outline.

Index for a file for physics.

1. Electricity
   - 1.1 Static Electricity: Electrostatic Laws
   - 1.2 Electric Circuits: The Flow of Electrons
   - 1.3 Electric Currents: Heating and Chemical Effects
   - 1.4 Electricity and Magnetism: Force in Magnetic Fields
   - 1.5 Electricity and Mechanical Work: Alternating and Direct Currents
   - 1.6 Electricity for Communication: Wires and Waves

2. Heat
   - 2.1 Temperature and Expansion: Measuring Heat Effects
   - 2.2 Changes of State of Matter: Measuring Heat Quantities
   - 2.3 Transfer of Heat: Methods of Transfer
   - 2.4 Transformation of Heat: Heat does Work

3. Light
   - 3.1 Illumination and Reflection: Measuring Light Intensity
   - 3.2 Refraction and Lenses: Control of Light Rays
   - 3.3 Color and Spectra: Color around Us

4. Mechanics
   - 4.1 Matter and Measurement: The Tools of our Science
   - 4.2 Forces in Liquids: Buoyancy and Gravity
   - 4.3 Forces in Gasses: Fluids in Action
   - 4.4 Forces and Motion: Laws of Motion
   - 4.5 Energy and Power: Machines at Work
   - 4.6 Forces between Molecules: Adhesion and Cohesion

5. Our World of Atoms
   - 5.1 X-rays and Radioactivity: Effects from within Atoms
   - 5.2 Nuclear Energy: A New Source of Energy

6. Sound
   - 6.1 Sounds and Sound Waves: Sound Energy
   - 6.2 Applications of Acoustics: Control of Sound[1]

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[1]Marburger, Walter G., and Hoffman, Charles W., Physics for Our Times, (New York, 1955)

Index for a file for biology

1. Man and insects
   - 1.1 Interesting facts about insects
   - 1.2 Beneficial insects
   - 1.3 Injurious insects
   - 1.4 Kinds of insects
   - 1.5 Reproduction and development
   - 1.6 Methods of collection, observing, and preserving insects
   - 1.7 Ways insects compete with man
   - 1.8 Natural and artificial methods of control

2. Plants
   - 2.1 Interesting articles about plants
   - 2.2 Weeds and their control
   - 2.3 Structure and function of a flower
   - 2.4 Development of seeds
   - 2.5 Structure of seeds and fruits
   - 2.6 Methods of seed transportation
   - 2.7 Mans use of seeds in industry

3. Living cells, the basis of life
   - 3.1 Materials used in studying cells
   - 3.2 What are cells
   - 3.3 Life processes of cells
   - 3.4 Responses of living things to their environment

4. Structure and functions of plants
   - 4.1 Plant roots functions
   - 4.2 Parts of plant stem
   - 4.3 Relation of plants and all life
   - 4.4 Conditions controlling where a plant lives

5. Plant groupings
   - 5.1 Purpose of classifying and naming plants
   - 5.2 Plants having no chlorophyll
   - 5.3 Mosses and ferns and their relatives
   - 5.4 Flowering plants

6. The animal kingdom
   - 6.1 Purpose of classification
   - 6.2 Simplest animals
   - 6.3 Invertebrates without legs
   - 6.4 Invertebrates with jointed legs
   - 6.5 Vertebrates (animals with backbones)

7. Physical and mental good health
   - 7.1 Food a source of energy
   - 7.2 Vitamins
   - 7.3 Selecting proper food
   - 7.4 Laws regulating sale of food, drugs, and cosmetics
   - 7.5 Effect of drugs on the body

8. The human body and its functions
   - 8.1 Movement and the renewal of energy
   - 8.2 Food and digestion
   - 8.3 The blood and its circultion
   - 8.4 Excretion
   - 8.5 Respiration
   - 8.6 Health and diseases of the respiratory tract
   - 8.7 The skin and sense organs
   - 8.8 Nerves, cord, and brain
   - 8.9 Coordination

9. Protection of the body from disease
   - 9.1 Natural protection against disease
   - 9.2 Nature of communicable and other diseases
   - 9.3 Problems of allergies and mental health
   - 9.4 First aid and its importance
   - 9.5 Personal cleanliness and prevention of disease

10. Origin of new individuals
   - 10.1 The beginning of new life
   - 10.2 Types of reproduction
   - 10.3 Development of animal embryos
   - 10.4 How new cells are produced

11. Heredity
   - 11.1 Concept of heredity
   - 11.2 Simple examples of heredity
   - 11.3 Individual differences
   - 11.4 Heredity in man
   - 11.5 Heredity; yesterday and today

12. Life of the past and present
   - 12.1 Records of time
   - 12.2 Records of life in the past
   - 12.3 Results of continuous change
   - 12.4 How man has changed

13. Wise use of natural resources
   - 13.1 Problems of soil conservation
   - 13.2 Conservation of forest resources

13.3 Conservation and protection of wildlife
13.4 Conservation of human life

14. Hobbies in the field of biology[2]

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[2]Vance, B. B., and Miller, D. F., Biology For You (Chicago, 1954)

Index for file on chemistry

1. Mathematics of chemistry
   - 1.1 Weights and measures
   - 1.2 Chemical formulas
   - 1.3 Chemical equations

2. Matter and its Composition
   - 2.1 Elements: liquids, solids, and gasses
   - 2.2 Molecules
   - 2.3 Atoms: structure and energy
   - 2.4 Electrons and other particles

3. Compounds and mixtures
   - 3.1 Acids: manufacture and commercial use
   - 3.2 Bases: manufacture and commercial use
   - 3.3 Salts: manufacture and commercial use

4. Chemistry in industry
   - 4.1 Metals
   - 4.2 Plastics and fabrics
   - 4.3 Fertilizers and insecticides and other chemistry of Agriculture
   - 4.4 Foods and chemitherapy
   - 4.5 Chemistry of hydrocarbons
   - 4.6 Other chemistry in the Industrial Field[3]

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[3]Jaffee, Bernard, New World of Chemistry, (Dallas, 1955)

Index for file on general science

1. The air surrounding the earth
   - 1.1 Exploring the atmosphere
   - 1.2 Doing work with air

2. Water and its uses
   - 2.1 Securing a safe water supply
   - 2.2 Water and sanitation
   - 2.3 Further uses of water

3. Heat and its uses
   - 3.1 Heat in daily life
   - 3.2 How heat is produced and used
   - 3.3 Further control of heat

4. The nature and importance of weather and climate
   - 4.1 Weather and our daily living
   - 4.2 Climate and life

5. Light in our civilization
   - 5.1 Light in daily life
   - 5.2 Lighting and vision

6. Into space with the Astronomers
   - 6.1 The Solar system
   - 6.2 The earth and the moon
   - 6.3 The great bodies in space

7. The changing earth and the wealth it contains
   - 7.1 The changing earth
   - 7.2 Wealth from the earth

8. The work of the world and what it involves
   - 8.1 Matter and energy
   - 8.2 Force, work, and energy
   - 8.3 Doing work with machines

9. Electricity in our civilization
   - 9.1 Magnetism and electrical charges
   - 9.2 Electric currents
   - 9.3 Electricity in daily life

10. The living world
    - 10.1 Living things
    - 10.2 Plant life
    - 10.3 Animal life
    - 10.4 How life continues

11. The organism called man
    - 11.1 The human body and its activities
    - 11.2 Foods: their nature and uses
    - 11.3 Toward a healthier world

12. Using our natural resources wisely
    - 12.1 Conserving renewable resources
    - 12.2 Conserving non-renewable resources[4]

If for some reason a file should be divided into two or more files, they should follow the same sequence with the proper, and code numbers, and could be added to the back of the unit of emphasis.

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[4]Curtis, Francis D., and Mallinson, George Greisen, Science in Daily Life, (Dallas, 1955)

CHAPTER III

A SYSTEM FOR STORAGE OF LABORATORY EQUIPMENT

Storage of equipment is usually a problem every small school faces. In some schools there is not enough storage space to accommodate the equipment, while in other schools it is a matter of poor use or arrangement of the storage space that is available.

In either case, equipment soon loses much of its value, because parts are lost and misplaced. In a few years this expensive equipment is thrown away, since no one knows what it is, where the parts are, or how to use it.

Detailed instruction sheets on methods of maintaining and using the equipment are usually furnished by the manufacturer. These instruction sheets should be labeled to properly identify them with each piece of equipment; then filed where they would be accessible when needed.

Equipment should be inventoried and arranged in the storage facilities to minimize the time required in setting up experiments for any given class.

Cabinets should be lettered and numbered so that they

can be seen easily and quickly. Number each shelf. Each piece of equipment then should be numbered with the cabinet number and shelf number. If a complete list of equipment for each unit is made and placed in the front of the file for that unit, an inexperienced or experienced teacher may know very quickly the available resources and where they are located, for teaching any given subject-matter.

The number even with the title indicates the file where the sheet belongs. The number on the left margin is the number of items on hand. The name and description of the item is in the center of the page. The code number for location of the equipment is on the right margin. The capital letter indicates the course in which the equipment is most frequently used. The first number is the cabinet number, and the second number designates the shelf.

The following pages are sample sheets of equipment lists.

2.1 Equipment List for Temperature and Expansion

Number of items	Name or description	Location
3	Thermometer, Fahrenheit	P-2-1
4	Thermometer, Centigrade	P-2-1
2	Thermometer, Triple scale (F, C, K)	P-2-1
3	Linear Expansion apparatus	P-2-2
1	Expansion ball and ring to fit	P-2-2
2	Compound bar	P-2-2
1	Bimetal thermometer	P-2-2
3	Steam boilers, copper	P-2-3
1	Clinical thermometer	P-2-1
1	Maximum-Minimum thermometer	P-2-1

2.1 Equipment List for Temperature and Expansion

Number of items	Name or description	Location
3	Thermometer, Fahrenheit	P-2-1
4	Thermometer, Centigrade	P-2-1
2	Thermometer, Triple scale (F, C, K)	P-2-1
3	Linear Expansion Apparatus	

1.5 Equipment List for Electricity and Mechanical Work

Number of items	Name or description	Location
2	Galvanometer	P-1-4
2	Generators	P-1-7
3	Electric motors	P-1-5
2	Transformers	P-1-7
2	Ammeters, (D.C. & A.C.)	P-1-4
2	Voltmeters, (D.C. & A.C.)	P-1-4
4	Magnets U	P-1-5
4	Magnets, bar	P-1-5
4	Rod, Soft iron	P-1-5
1 (roll)	Wire #24 copper plain	P-1-5
1 (roll)	Wire #18 Copper DCC	P-1-5

1.1 Equipment List for Static Electricity

Number of items	Name or description	Location
1	Static Machine, Wimshurst	P-1-2
1 (box)	Equipment for static machine	P-1-2
1 (box)	Rods (glass, wax, vulcanite) Pads (silk, flannel, fur)	P-1-1
1 (box)	Cork dust, pith balls	P-1-1
3	Electroscope (pith ball, gold leaf)	P-1-2
2	Leyden jar	P-1-2
2	Discharge rods	P-1-1

1.2 Equipment List for Electric Circuits

Number of items	Name or description	Location
4	Batteries (dry cell 1.5 volt)	P-1-3
2	Batteries (dry cell 6 volt)	P-1-3
1 (box)	Switches	P-1-3
4	Resistors	P-1-4
2	Ammeters (D.C. & A.C.)	P-1-4
3	Rheostat	P-1-4
3	Electric Motors	P-1-5
1	Wheatstone Bridge	P-1-5
1 (box)	Lamps with base 6 volt	P-1-5
1 (roll)	Wire #24 copper plain	P-1-5
1 (roll)	Wire #18 copper DCC	P-1-5

CHAPTER IV

SUPPLEMENTARY STORAGE FACILITIES

Storage facilities of any science department may be improved with a hammer, saw, a board, a few nails and hooks, and some careful planning on the part of the instructor.

The Home Economics instructor can probably give some worthwhile suggestions in arrangement of equipment already available. The shop instructor probably has some boys who would be available to remodel the existing facilities, or construct extra storage.

The Gadget department of the local lumber yard or hardware store, has many useful items which will aid in utilizing storage space, and save the instructor many precious minutes in class preparation. A number of these ideas are listed and illustrated in the following pages. Some of these ideas are a result of the writers own experiences, some were obtained from sources unknown, while others are a result of a survey of the various departments on the Oklahoma State University Campus, as indicated.

Lid holders or racks may be attached to a lower cabinet door or end of a cabinet to hold screens, asbestos pads, and other flat shaped items.

Spice shelves and package shelves which are designed to fit on cabinet doors, could be used to separate small bottles and boxes when shelves are too deep, as illustrated in Figure 1.

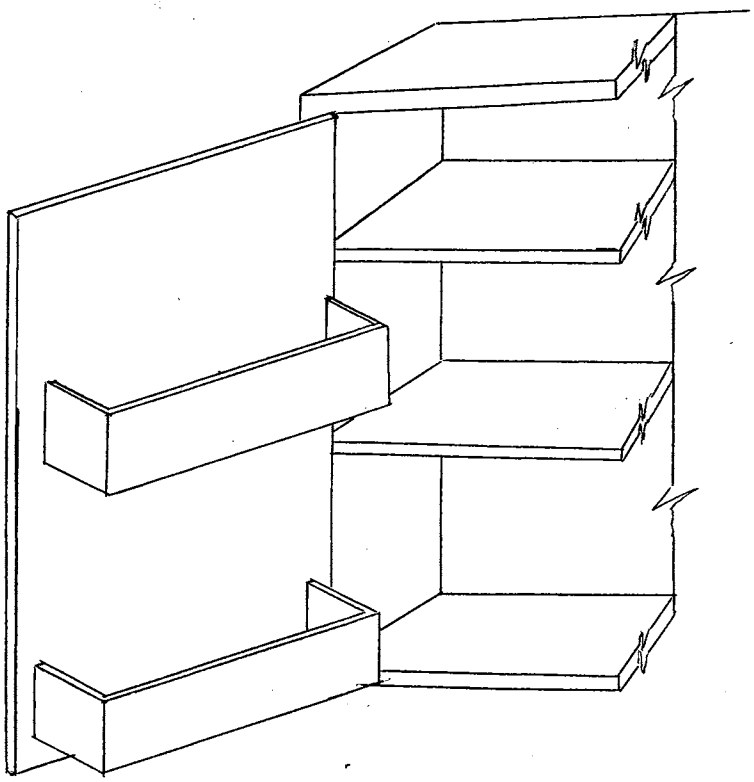

Figure 1. Spice or package shelves attached to a cabinet door.

Pegboard humg on the inside of a closet door or on the end of a cabinet, would furnish additional storage and a place to hang many small articles such as triangles, clamps, meter sticks, spring balances, and protractors.

Glass tubing is an item that requires a great deal of care in storing. If it is placed on a shelf, it rolls off easily, and at the same time it is very difficult to see. A plastic pipe, three or four inches in diameter and cut at various lengths, from six inches to two feet, and fastened to the side of a cabinet makes an excellent rack to hold glass tubing. Three or four of these plastic tubes will hold enough glass tubing of all sizes and lengths for a medium sized chemistry laboratory. Other items that may be stored in plastic pipes are: rods, pipettes, thistle tubes, hydrometers, and thermometers.

One method of making the best use of available wall space and cabinet area is to construct a two-in-one cabinet. This is done by making a small storage door and fastening it to the outside of each cabinet door. This is especially useful in the chemistry department where there are many small bottles of chemicals. A two-in-one cabinet is illustrated in Figure 2.

Sliding cup shelves may be used in very deep cabinets to store any equipment which is usually hung up. Normally this equipment would not be readily accessible, but stored on a sliding cup shelf, it is easily reached by pulling out the shelf. One type of sliding cup shelf is illustrated in Figure 3.

Lazy-susan's or revolving corner shelves, are used very successfully in those hard to get at corner cabinets. A

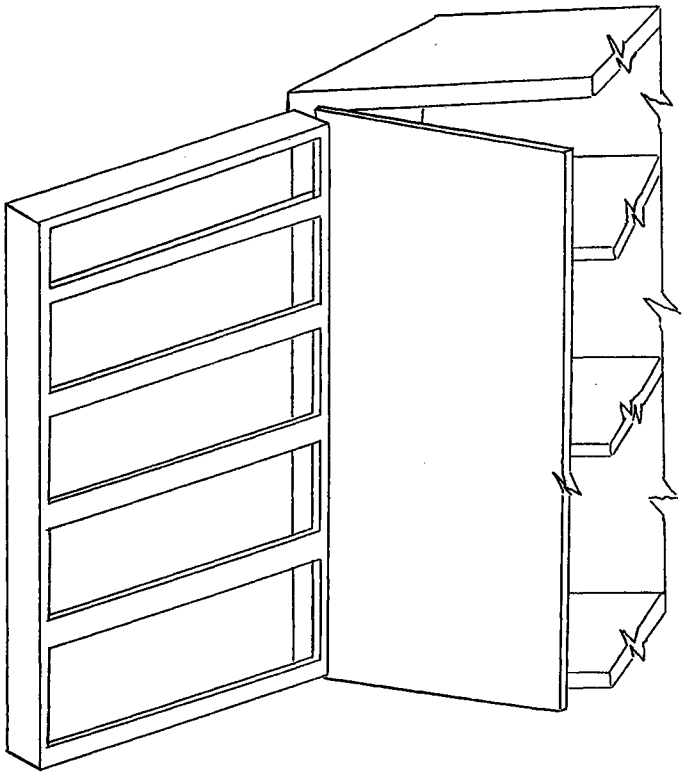

Figure 2. A two-in-one cabinet

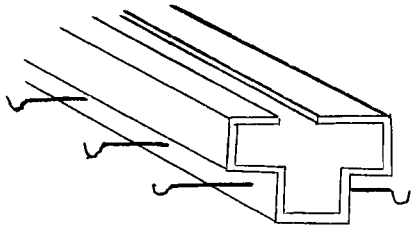

Figure 3. Sliding cup shelf

great deal of storage space may be utilized that was formerly wasted.

Supplies of various kinds such as nails, screws, bolts,

connectors, insulators, Y-tubes, stop cocks, rubber stoppers, corks, and hundreds of other items may be stored in bins made from rectangular gallon cans. If the cans are cut as shown in Figure 4, they fit neatly on a shelf and provide excellent storage facilities. These cans may be used to hold demonstration kits that are used in the elementary rooms. They are easily labeled and readily accessible. Any filling station operator would be glad to furnish empty anti-freeze cans during the fall months.

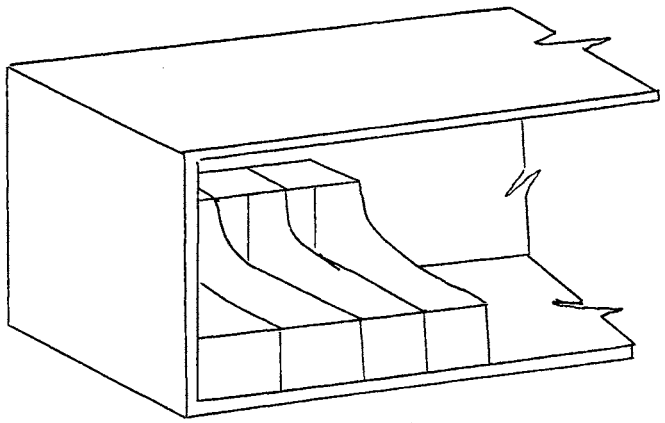

Figure 4. Bins made from anti-freeze cans

Small wooden boxes with a pane of single strength glass in the tops may be constructed in the school shop or purchased from any biological supply house. These

would provide excellent storage for insect collections. A box with a bottom area of twelve square inches, and height of three inches, would provide storage space for twenty to fifty insects, depending on their size. Four boxes of this size would provide adequate space for the insect collections of a small high school at a cost of less than ten dollars, if constructed in the shop, and would use only one and one half cubic feet of shelf space.

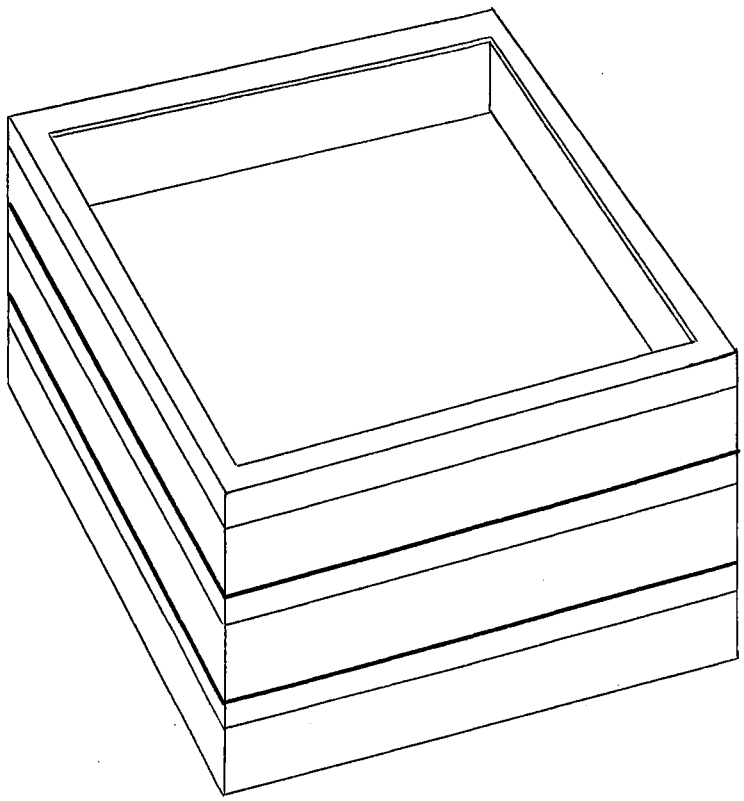

Figure 5. Insect boxes easily constructed in the school shop

Cardboards obtained from laundered shirts provide excellent materials on which to mount pressed plants. If each specimen is placed in a single fold of newspaper, they may be stacked on one another. Several plants belonging to the same family, may be placed in a portfolio and the portfolios stacked on each other. In this manner fifty plant specimens may be stored in approximately one and one half cubic feet of shelf space.

Wooden trays, five inches deep and two and one half feet square, may be used to store mice, rats, kangeroo rats, squirrels, chipmunks, weasel, mink, birds, and other small stuffed animals. These trays may be stacked on one another, or may be constructed so they will slide in and out of the cabinet on a track.

Figure 6 illustrates how trays may be used in storing collections of specimen bottles. If a collection is placed in a tray, and the tray placed in a cabinet, all of the collections may be removed in the same time it would require to remove one or two individual bottles. Therefore, a great deal of time would be saved in moving a collection of thirty specimen bottles.

A small wooden box may be used to store home made slides. Grooves are provided to hold the slides in a vertical position, by glueing corregated cardboard to the sides of the box. This prevents the slides from being scratched while in storage. If the slides are numbered and kept in order they are easily located on a moments notice.

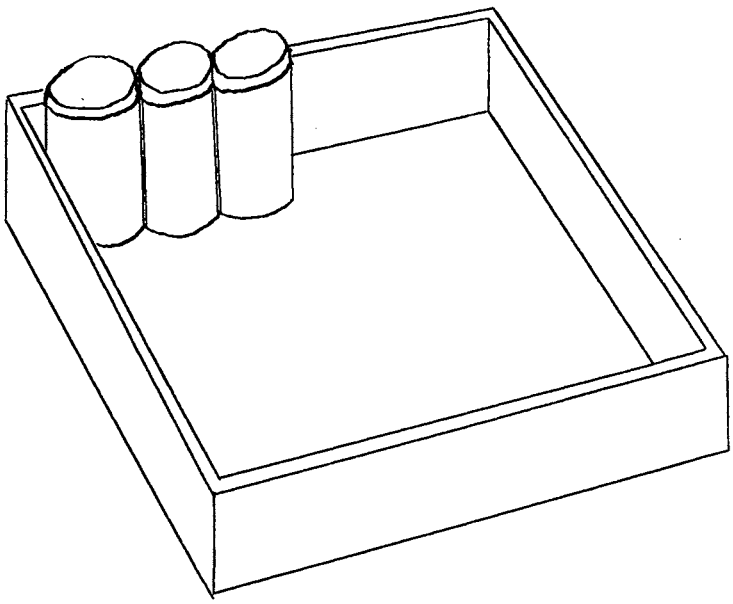

Figure 6. Wooden trays used to store specimen bottles

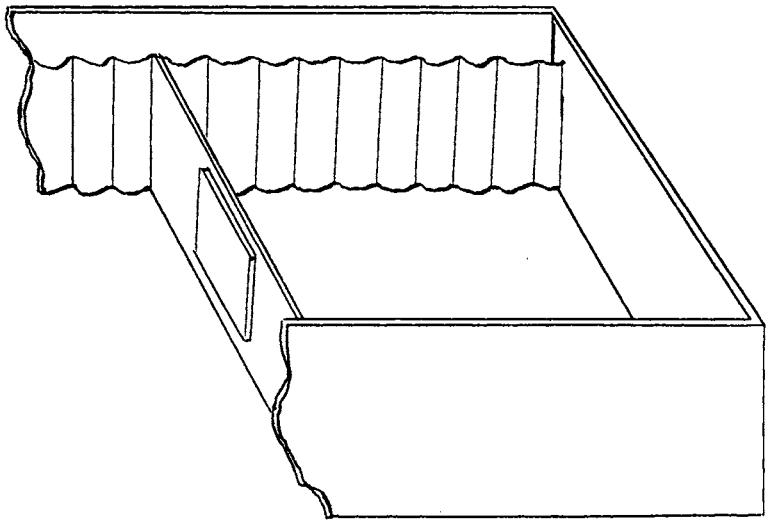

Figure 7. Box to hold home made slides

Inexpensive mounting and storage boxes for insect specimen, may be easily constructed by cutting rectangular frames from paste board boxes and glueing two or more of these together. A card board may be glued on one side for the bottom, and a sheet of cellophane or plastic, may be used for the top.

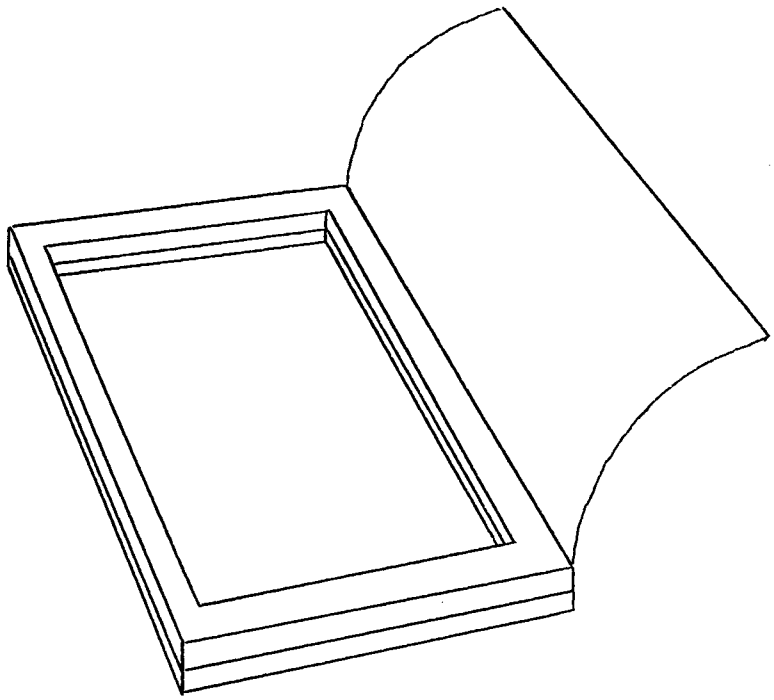

Figure 8. Inexpensive mounting and storage boxes

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