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ABSTRACT

Traditional-classical programs, individualized instruction, differentiated staffing, flexible-modular scheduling are all programs and ideas much discussed in the field of education today. However, science instruction is still in the logarithmic phase of change. Curricular and instructional styles alter so rapidly that often reference points are blurred and communication tends to break down. If these changes are to be truly significant, they must be fundamental, involving the whole learning spectrum--physical environment, teaching options, and learning patterns. It is the intent of this publication to cast some light on the possible physical arrays or options that would complement a school or a science department philosophy. Three types of secondary schools are considered: small (600-800 students), large (1500-1800 students), and the middle school (5-8 grades). Two general types of physical plans are presented: the classical plan (self-contained classrooms) and the innovative plan (experimental schedules, flexible-modular alternatives, and individualized instruction). Most of the layouts presented are based on the assumption that the greatest portion of the science student's time will be spent in the laboratory and in the science resource center. (Author)

# DESIGN FOR SCIENCE FACILITIES

1 2

MINNESOTA STATE DEPARTMENT OF EDUCATION

1971

## SCIENCE FACILITY PLANNING COMMITTEE

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| Mr. Jay Tyson, AIA | Architect<br>Hendrix Associates<br>Minneapolis, Minnesota |

## SCHOOL PLANS AND LAYOUTS

| | |
|---|---|
| Mr. Donovan Wagner, AIA | Architect<br>Hendrix Associates |
| Mr. Dale Ellickson | University of Minnesota |

## EDITING AND FORMAT

| | |
|---|---|
| Mr. Richard C. Clark | Science Consultant<br>State of Minnesota |

# PREFACE

Traditional-classical programs, individualized instruction, differentiated staffing, flexible-modular scheduling are all programs and ideas much discussed by educators today. Science *instruction, as indeed are all instructional areas, is still in the logarithmic* phase of change. Curricular and instructional styles alter so rapidly that oftentimes reference points are blurred and consequently, communication tends to break down. Often one hears a traditional program criticized by those who have developed their own individualized programs but an inspection of this new program may turn up a traditional curriculum that has merely been chopped into individual sections or modules called learning packets. It appears, therefore, that if changes are to be truly significant, they must be fundamental, involving the whole learning spectrum; physical environment, teaching options, and learning patterns. *It is the intent of* this publication to cast some light on the possible physical arrays or options that would complement a school or science department philosophy. For the purposes of this workbook, we have considered three types of secondary schools: Small (600-800 students), large (1500-1800 students), and the middle school (5, 6, 7, and 8 grades). We have also considered two general types of physical plans, based, of course, on the type of offering that will be presented within the walls of that facility.

CLASSICAL PLAN: Sometimes this is called the traditional plan. Generally it features self-contained classrooms with little or no provision made for individualized study, uncommitted time, or student-resource centers.

INNOVATIVE PLAN: The school employing this plan will probably experiment with its schedule, offering flexible-modular alternatives to youngsters. Most would employ some degree of individualization, either through a smorgasbord of problems or through learning packets of some kind. Extensive provision is made here for uncommitted time and for science resource centers of which the laboratory would be an integral and vital part.

For convenience, we have organized the materials into separate packets. The packets, of course, represent no final word, no answers, but are merely intended to aid teachers, administrators, and architects in designing and planning for their new or remodeled facility. Consequently, a minimum of space has been devoted to a description of facilities and a maximum of open space has been provide.

STATE SCIENCE CONSULTANT

# INTRODUCTION

## REGULARITIES

Since a great part of science is involved with a study of regularities, it seemed to the planning committee that regularities would be incorporated into the total product, applicable equally to all plans developed. Most of these are listed below:

1. For each plan, an attempt has been made to provide a basic set of parameters...a box, if you will. Alternate designs, then, consist of different configurations within the confines of the basic box or outline. It was felt this arrangement provides the reader with a definate comparative framework so that he can more easily make up his mind with respect to the final product.

2. Since science is primarily an inquiry-based discipline, the science department should be located near other disciplines that tend to employ similar aims, objectives and methods. Traditionally, architects and other school planners have placed the science facilities adjacent to those of the mathematics department. The committee felt,

perhaps, that a more realistic arrangement would place science with social studies. (See Fig. 1). With the advent of environmental education and environmental awareness, cooperative ventures between the two department are natural and desirable. The closer the two disciplines are together in space, the more teacher interactions are possible.

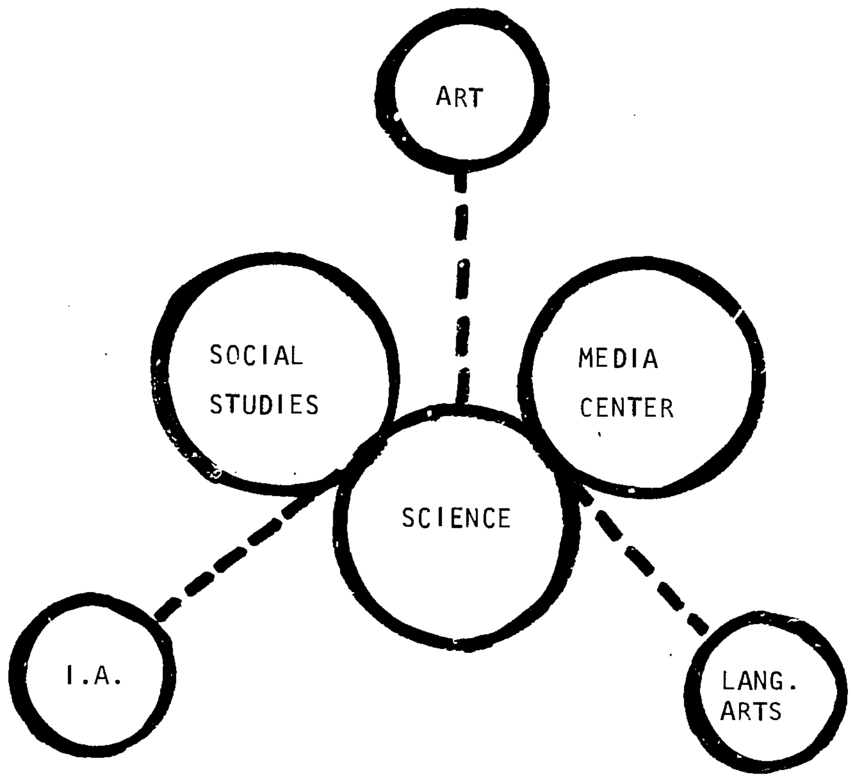


FIGURE 1

3. It was also assumed, that each secondary school should devote some portion of its campus to environmental site development, thereby, transforming the outdoors into an additional classroom.

4. In this publication, no distinction has been made between junior and senior high classroom facilities. Since science is laboratory oriented, creating a science facility without adequate provision for inquiry defeats the whole purpose of science at the junior and senior high school level.

5. Likewise, little or no distinction has been made between classrooms belonging to the various science disciplines: chemistry, biology, physics, etc. Schools designing science facilities will wish to specify which rooms are for what subject. The planning committee felt that its overall objective of maximum flexibility would best be served if discipline designations were not made. In all plans, from innovative to classical, the concept of total self-contained science classrooms has been disregarded as too expensive. Central storage of supplies and equipment is strongly advocated.

6. The planning committee, having taken the position that good communication between staff members breeds cooperation and, hopefully, a better all-round curriculum, has provided for common, pleasant office space for science staff members. This office space could also be used by students, if desired, and provides for some limited storage.

7. The library media center is vital to any science framework. The combining of traditional library facilities with those of the audio-visual department results in a multi-purpose facility that includes the following services: Collections of both print and non-print materials that are well organized and easily accessible to students and teachers; central indexing or cataloging of student resource center materials; photographic and dark room capabilities, small group meeting areas and carrels, both wet and dry. It is presumed that a media center would always be located somewhere within the school, and that its services would be available to science teachers and students. The paradigm below indicates the basic infigurations and regularities assumed in this publication.

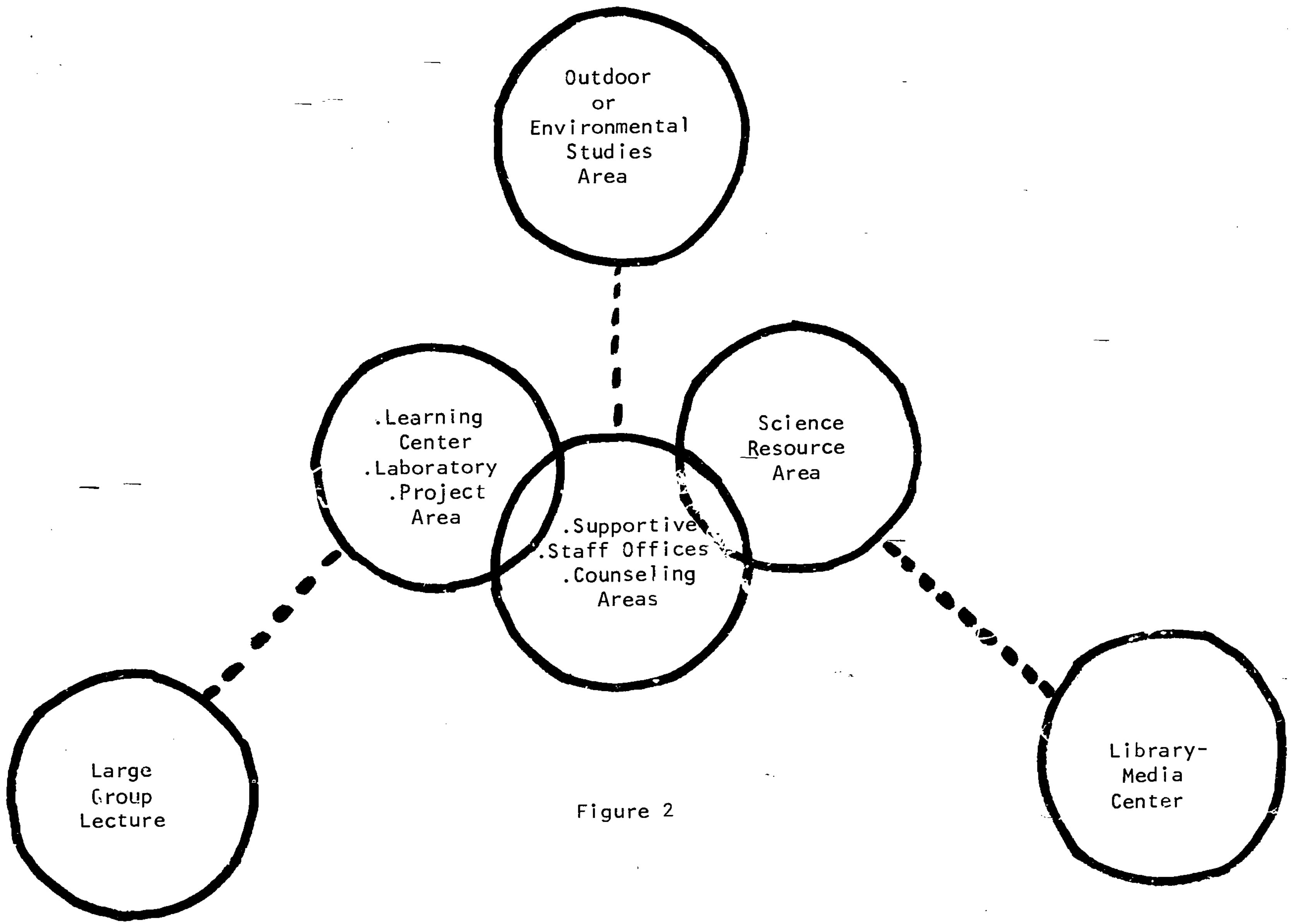
Outdoor or Environmental Studies Area
.Learning Center
.Laboratory
.Project Area
Science Resource Area
.Supportive
.Staff Offices
.Counseling Areas
Large Group Lecture
Library-Media Center

Figure 2

As indicated in Figure 2, the science suite comprises a complex of interacting units--each vital to the functioning whole. Although the science cluster that is illustrated in various forms herein does not appear to be unusual, it may offer enough departures from the norm to warrant some explanation.

The prototype of the more innovative plans illustrated elsewhere in this handbook has traditionally provided facilities for large groups as well as small group instruction. Plans developed in this publication recognize the need for both capabilities, but propose a slightly different orientation. As the paradigm indicates, large group facilities are relegated to another site within the school such as the auditorium, or a section of it. The reason for this apparent rejection of the large group concept is that too much dependence upon the large group is contrary to basic philosophical tenants of science instruction.

It was felt that most of the student's time should be spent in the laboratory collecting data and the remainder in medium or small groups for the purpose of pre- and post-laboratory discussions*. The small groups, when permitted by the curriculum, can be conducted in the student resource center. Additional space would also be available for them in the media center. The concept of a science resource center, for students and its subsequent inclusion in basic science facility plans, is new to most teachers and administrators. Its purpose is to provide for accessibility, beyond that of the media center, to a variety of specialized print and non-print references. *The resource center does not duplicate essential services or collections to be found in the media center.* Its permanent collection contains materials specifically related to the science curriculum, such as multiple copies of texts or supplemental texts, pamphlets,

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* The discussion here regarding the Science Students Resource Center assumes some element of flexibility in the daily schedule, that students have some unscheduled study time. and that the laboratory is open at least a portion of the day. It is also assumed that by omitting traditional lecture areas additional space could be provided in the Science Student Resource Center for intermediate and small groups.

periodicals, general reference materials (encyclopedia, dictionaries), plus heavily used science reference materials such as taxonomical keys, chemistry, physics, and biological science handbooks. The center may also have collections of books and other materials on temporary loan from the library-media center.

The primary function of the library-media center is to act as information disseminator for the entire school. This implies that the science resource center is an arm of the media center. Most print and non-print items in the resource center are ordered, processed, and catalogued through the media center. All science materials, whatever their locations, are selected cooperatively by the science teachers and media specialists.

A library aide would be located in the science resource center, whenever possible, to supervise and assist students with materials and equipment. Ideally, the aide should have some science background as well as media center training. Center equipment specifications will depend upon the curriculum the department elects, the size of the school, the extent of the budget, and other related factors. However, some basic equipment suggestions can be provided: (1)

Movable display racks for periodicals, paperbacks, and pamphlets; (2) Shelving for books; (3) Movable storage cabinets for audio visual materials; (4) Audio visual equipment [intended especially for individual or small group use: a. filmstrip projector, b. slide projector, c. tape recorders, d. cassettes, play back units with earphones, e. 16-mm projector with earphones, f. 8-mm standard and super 8 projectors, g. video tape receivers, h. film loop projector; (5) Tables and chairs [the tables designed for four students or less]; (6) Carrels [a. dry, b. wet - wired for electricity, c. wet - for carrel experiments, d. wet - dial access, video screen keyboard and light pen, if feasible]; (7) Check out area for print and non-print materials; (8) Acoustical flooring, ceiling, and walls; (9) Files for teacher prepared materials; (10) Card catalog for resource center permanent collection; (11) Desk for teacher aide.

The third paradigm indicates possible flow patterns that would involve the science center. As you can see, it illustrates that through pre-lab discussions, students are introduced to the problem that will be explored in the laboratory. If necessary, students proceed to the resource center to establish a method for attacking the laboratory problem. Some students may proceed directly to the laboratory, conduct the demonstration or experiment and collect data. They, then, would proceed to the resource center to collate and analyze their data. They then would proceed to a small post-lab discussion. During a post-lab students would have the opportunity of adding their data to a class or departmental histogram. The data would be analyzed and conclusions would be validated.

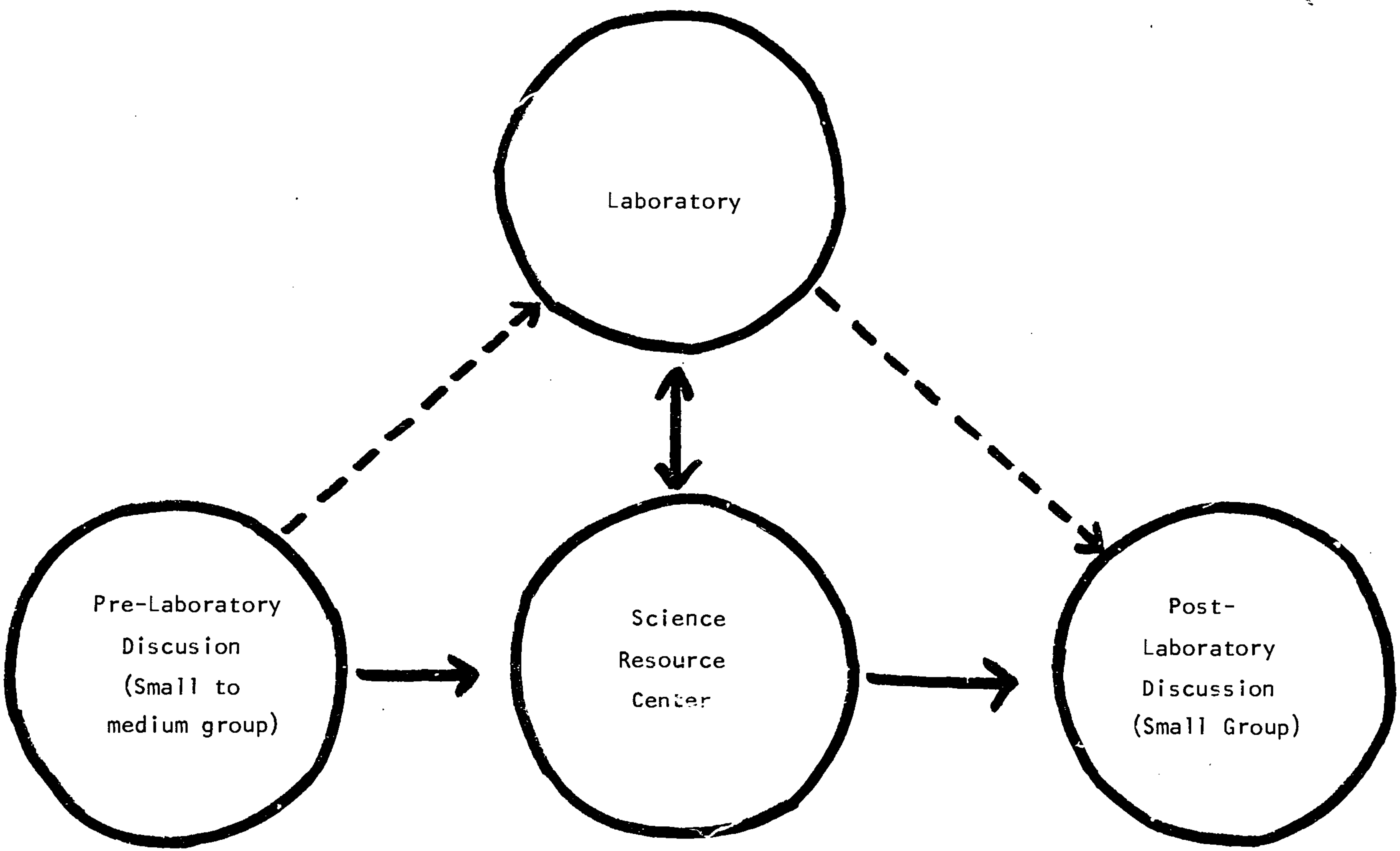



Figure 3

Laboratory-Science Resource Center Flow Pattern

TWO BASIC PHILOSOPHIES OF EDUCATION ARE REFLECTED IN ARCHITECTURAL PLANNING FOR SCIENCE SPACES:

1

## THE TRADITIONAL SCHEME

THE BOUNDARIES OF EACH TEACHING STATION ARE STRICTLY SET BY

A. FLOOR-CEILING WALLS
B. DEMOUNTABLE WALLS
C. FOLDING PARTITIONS

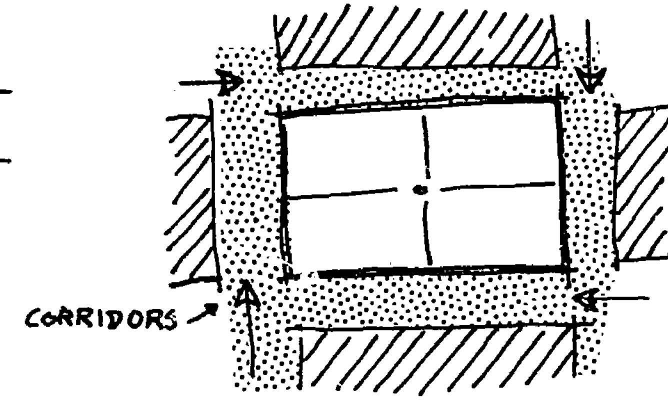



ILLUSTRATION: WALLS & PARTITIONS DELIMIT INDIVIDUAL SPACES — BY FIRE CODES — EACH SPACE MUST HAVE ACCESS & EGRESS TO THE OUTSIDE OR TO PUBLIC SPACES [CORRIDORS, COMMON AREAS] WHICH ALLOW FOR DIRECT EGRESS — NO SPACE MAY EGRESS INTO ANOTHER PRIVATE SPACE.

2

## THE OPEN OR LANDSCAPE SCHEME —

THE BOUNDARIES OF EACH TEACHING STATION ARE DETERMINED BY THE MUTUAL DECISIONS OF THOSE USING THEM

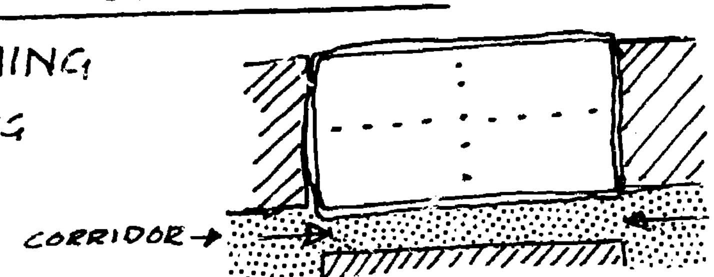
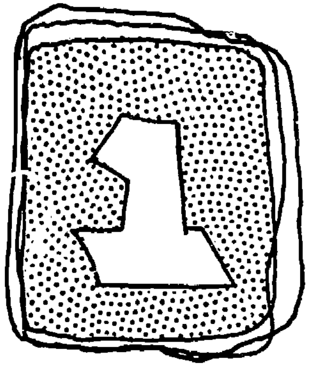



ILLUSTRATION: NO INTERIOR WALLS — — SPACES ARE DEFINED BY THE EQUIPMENT & PEOPLE USING THE SPACE.

# DEFINITIONS
## OF CHANGE

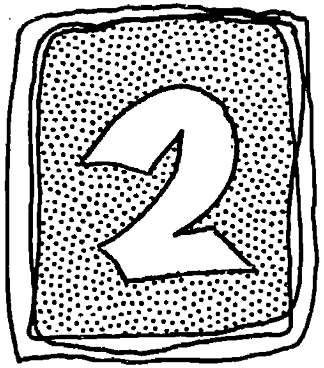


**DIVISIBILITY** – CAPABILITY OF AN INTERNAL SPACE TO BE CHANGED (DELIMITED) INTO NEW SPACES

THIS MEANS:

① CHANGES MAY BE PERFORMED BY THE USER BUT FOR OUR PURPOSES WE ASSUME THAT CHANGES CAN ONLY BE MADE BY SPECIALIZED LABOR

② THESE CHANGES MAY NEED SPECIALIZED MATERIALS AND EQUIPMENT.



**FLEXIBILITY** – CAPABILITY OF AN INTERNAL TO BE CHANGED (DEFINED) SOLELY BY THE USER.

THIS MEANS:

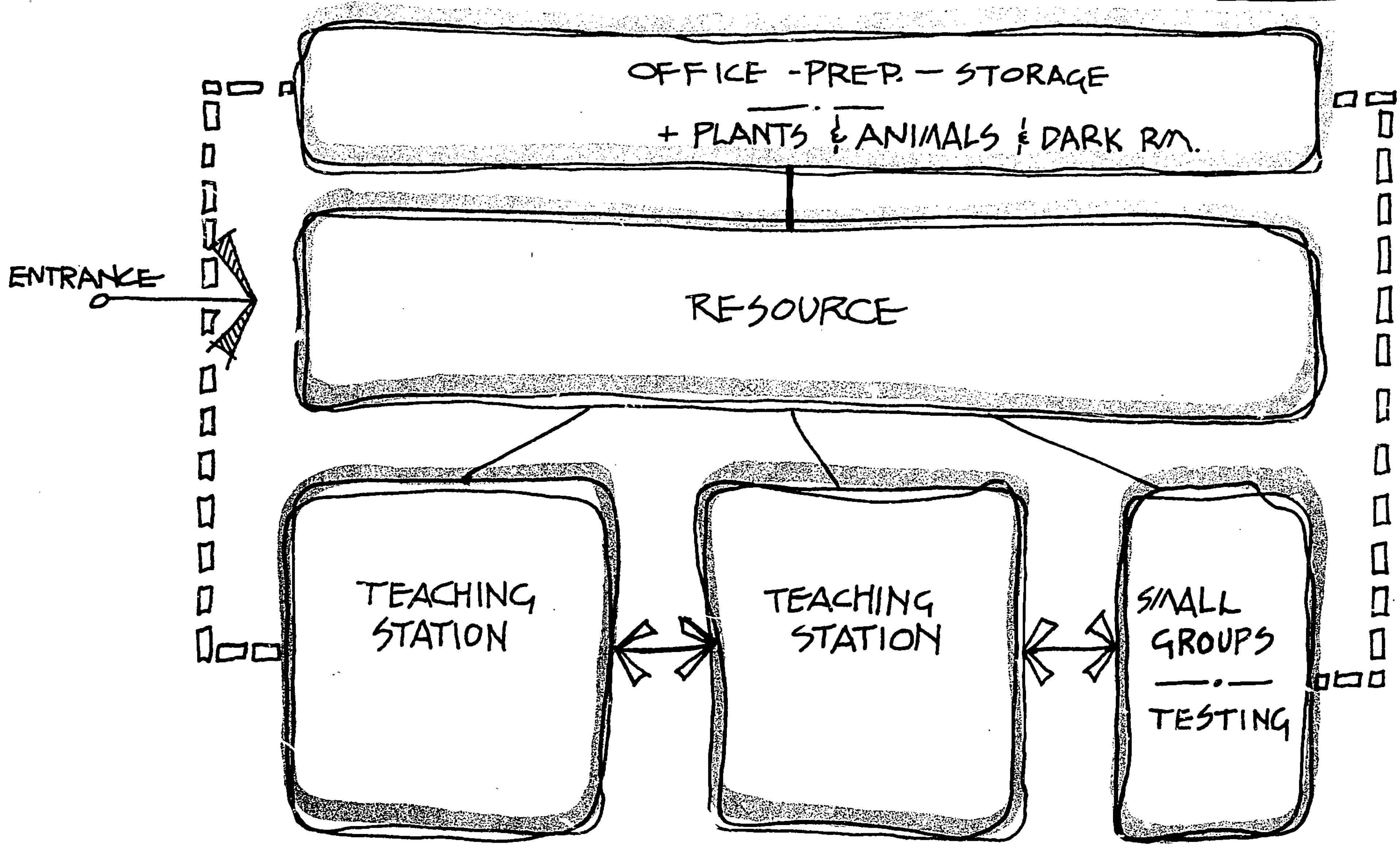
① THE EQUIPMENT USED SHOULD HAVE OPTIMAL FUNCTIONALITY & MOBILITY – – SINCE LIMITED AMOUNTS OF EQUIPMENT WILL GIVE OPTIMAL FLEXIBILITY.

② DEGREES OF FLEXIBILITY – DETERMINED BY THE NUMBER OF USABLE CHANGES – THE MORE USABLE CHANGES, THE GREATER THE DEGREE OF FLEXBILITY.

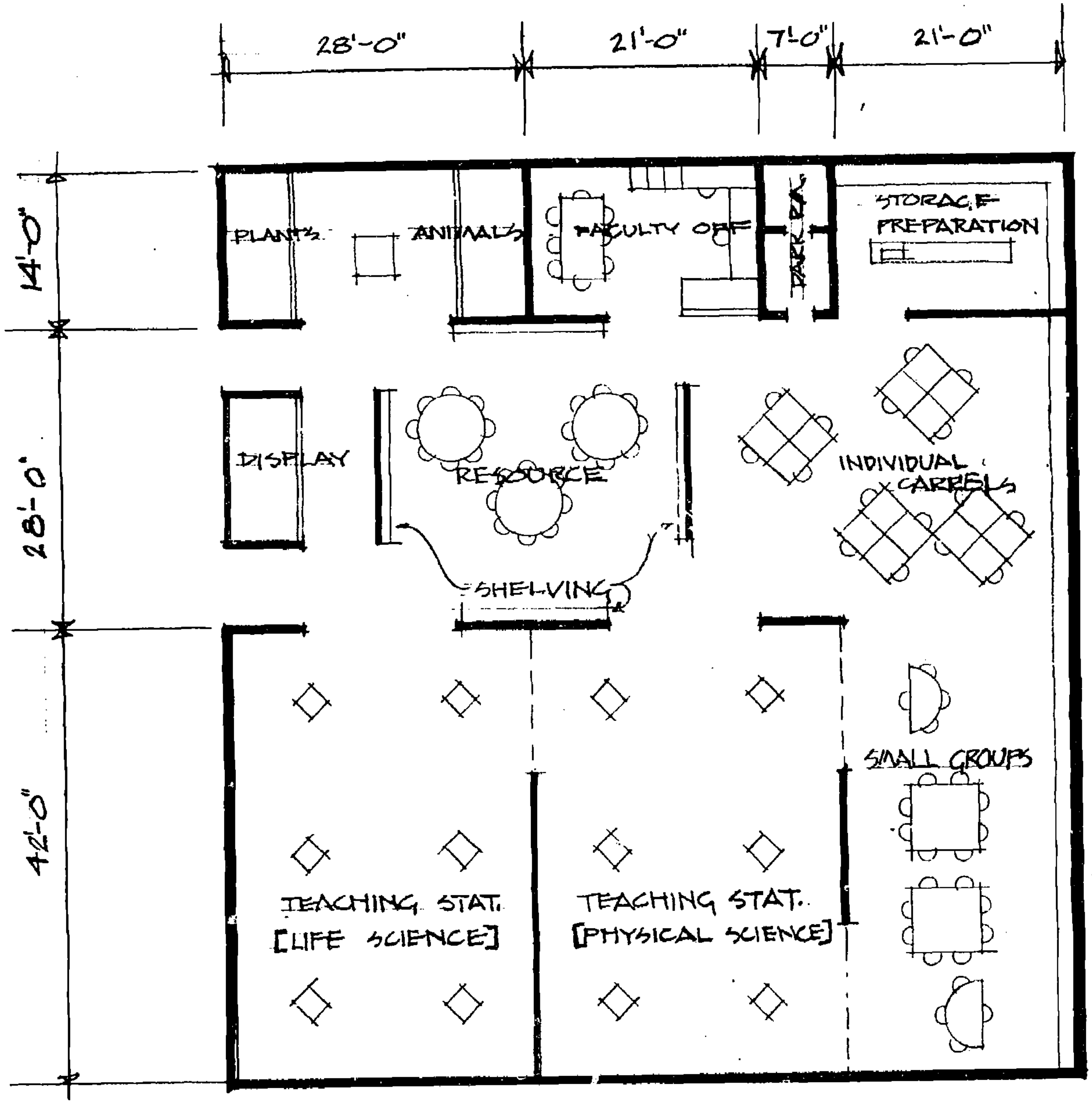
# SMALL SCHOOL

TYPICAL LAYOUTS FOR A
FLEXIBLE PROGRAM.

SCHEMATIC OF RELATIONSHIPS




SMALL SCHOOL- FLEXIBLE




## SMALL SCHOOL - FLEXIBLE

AREA — 6350 #

12 LAB MODULES x 8 STUD./MOD.
= 96 STUDENTS / PERIOD.

6 PERIODS / DAY = 576 STUDENTS

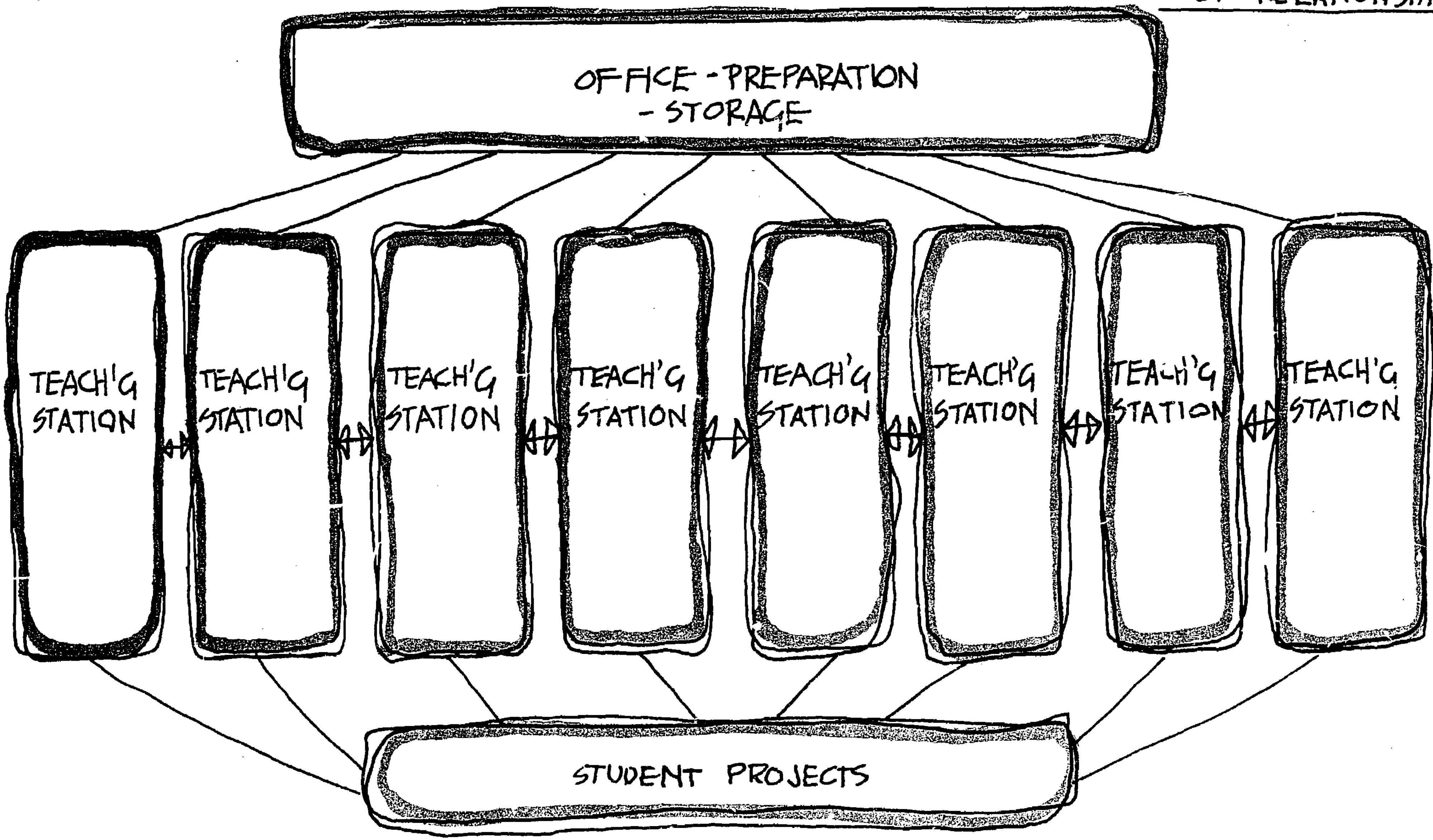
— PLAN —

SCALE 1/16 = 1'-0"

# LARGE SCHOOL

TYPICAL SCIENCE LAYOUT FOR A CLASSICAL PROGRAM

SCHEMATIC OF RELATIONSHIPS




LARGE SCHOOL CLASSICAL

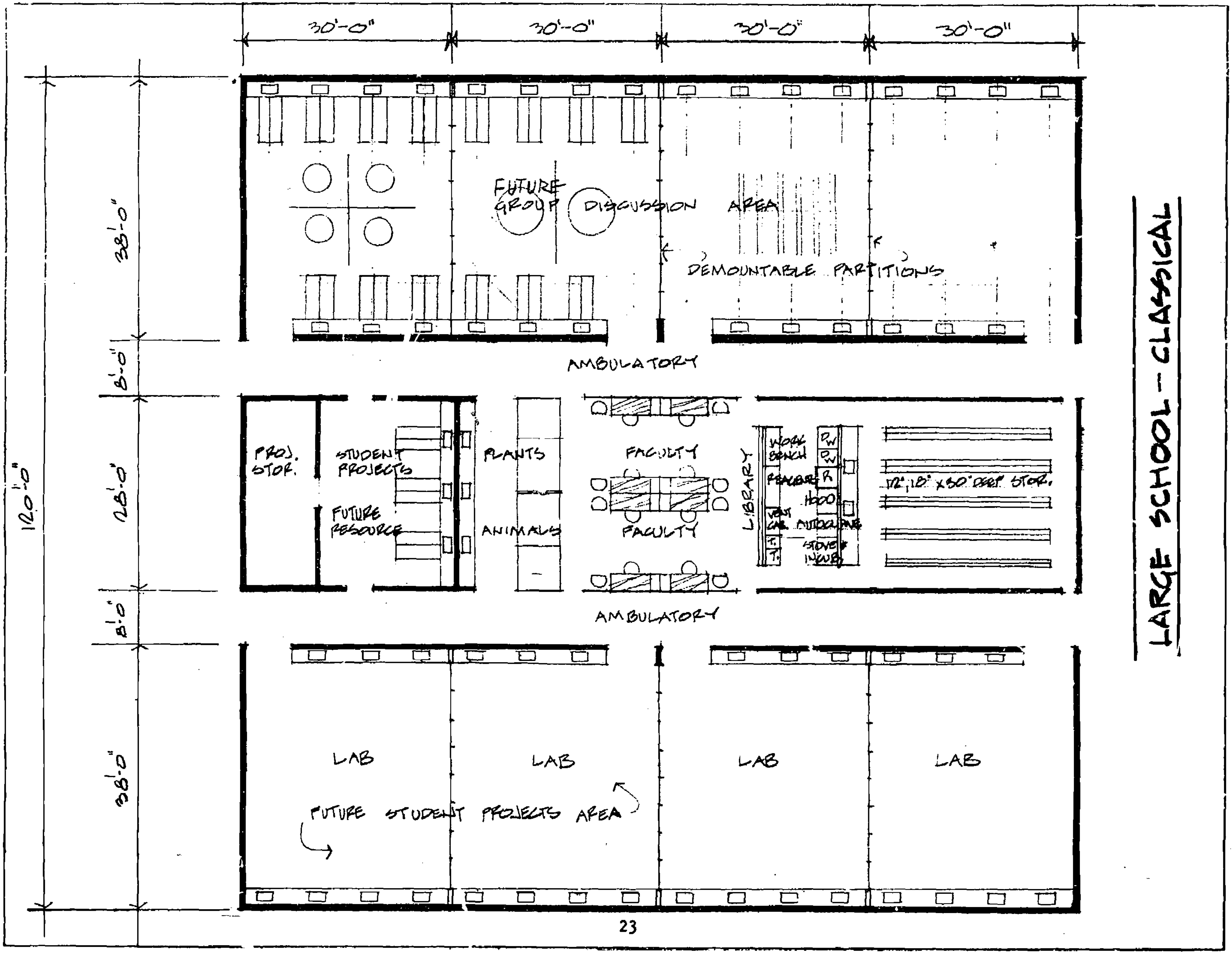
# LARGE SCHOOL -- CLASSICAL PROGRAM

DEMOUNTABLE PARTITIONS BETWEEN LABORATORIES FOR CONVERSION TO FLEXIBLE SCHEDULING.

LAB STATIONS (FIXED AROUND PERIMETER) MAY BE ASSIGNED TO GROUP PROBLEM SOLVING OR INDIVIDUAL PROJECTS IN ANY COMBINATION DEPENDING UPON INSTRUCTIONAL DEMANDS

CENTER SPACE REMAINS OPEN FOR PRE- AND POST- LABORATORY DISCUSSIONS IN ANY SIZE OR NUMBER OF GROUPS.

ALL LABORATORY TABLES ARE PORTABLE -- ONLY PERIMETER COUNTER WITH SINK -- GAS AND ELECTRICAL OUTLETS ARE FIXED.

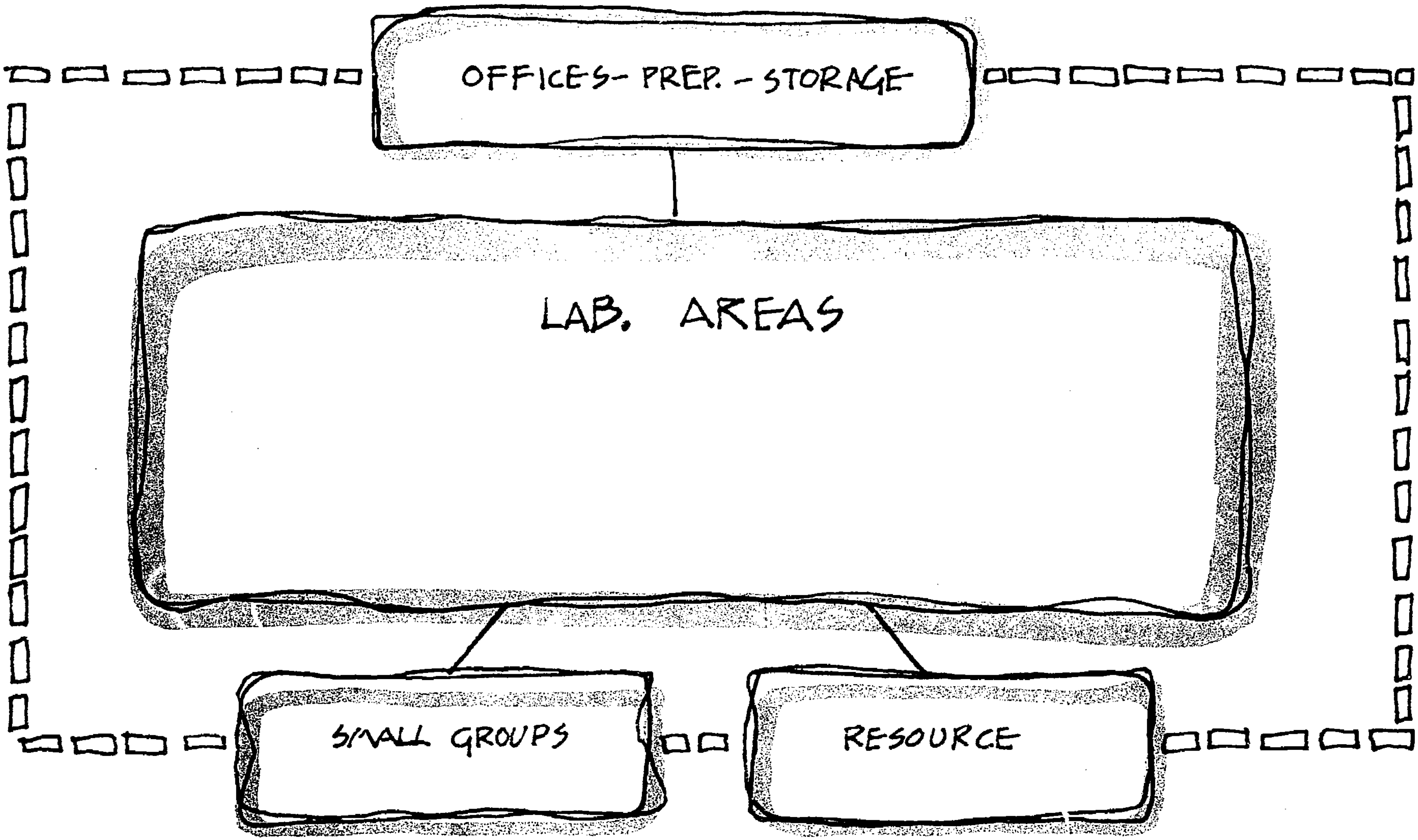


LARGE SCHOOL - CLASSICAL
30'-0"
30'-0"
30'-0"
30'-0"
120'-0"
38'-0"
8'-0"
28'-0"
8'-0"
38'-0"
FUTURE GROUP DISCUSSION AREA
DEMOUNTABLE PARTITIONS
AMBULATORY
PROJ. STOR.
STUDENT PROJECTS
FUTURE RESOURCE
PLANTS
ANIMALS
FACULTY
FACULTY
LIBRARY
WORK BENCH
FREEZER
HOOD
STOVE & INCUB.
12', 18' x 30' DEEP STOR.
AMBULATORY
LAB
LAB
LAB
LAB
FUTURE STUDENT PROJECTS AREA

# LARGE SCHOOL

TYPICAL SCIENCE LAYOUT FOR A FLEXIBLE PROGRAM

## SCHEMATIC OF RELATIONSHIPS




LARGE SCHOOL
-FLEXIBLE

# LARGE SCHOOL -- FLEXIBLE PROGRAM

VISUAL BARRIERS ARE CREATED BY FEW FORMAL PARTITIONS 6'-0" TO 7'-0" HIGH -- AT MOST, FOLDING PARTITIONS.

LAB STATIONS ARE FIXED ISLAND ARRANGEMENTS -- ESPECIALLY SUITED FOR MEDIUM AND LARGE SIZE GROUP INVOLVEMENT 24 SERVICE ISLANDS SERVE 8 STUDENTS EACH -- TOTAL, 192 STUD/HR

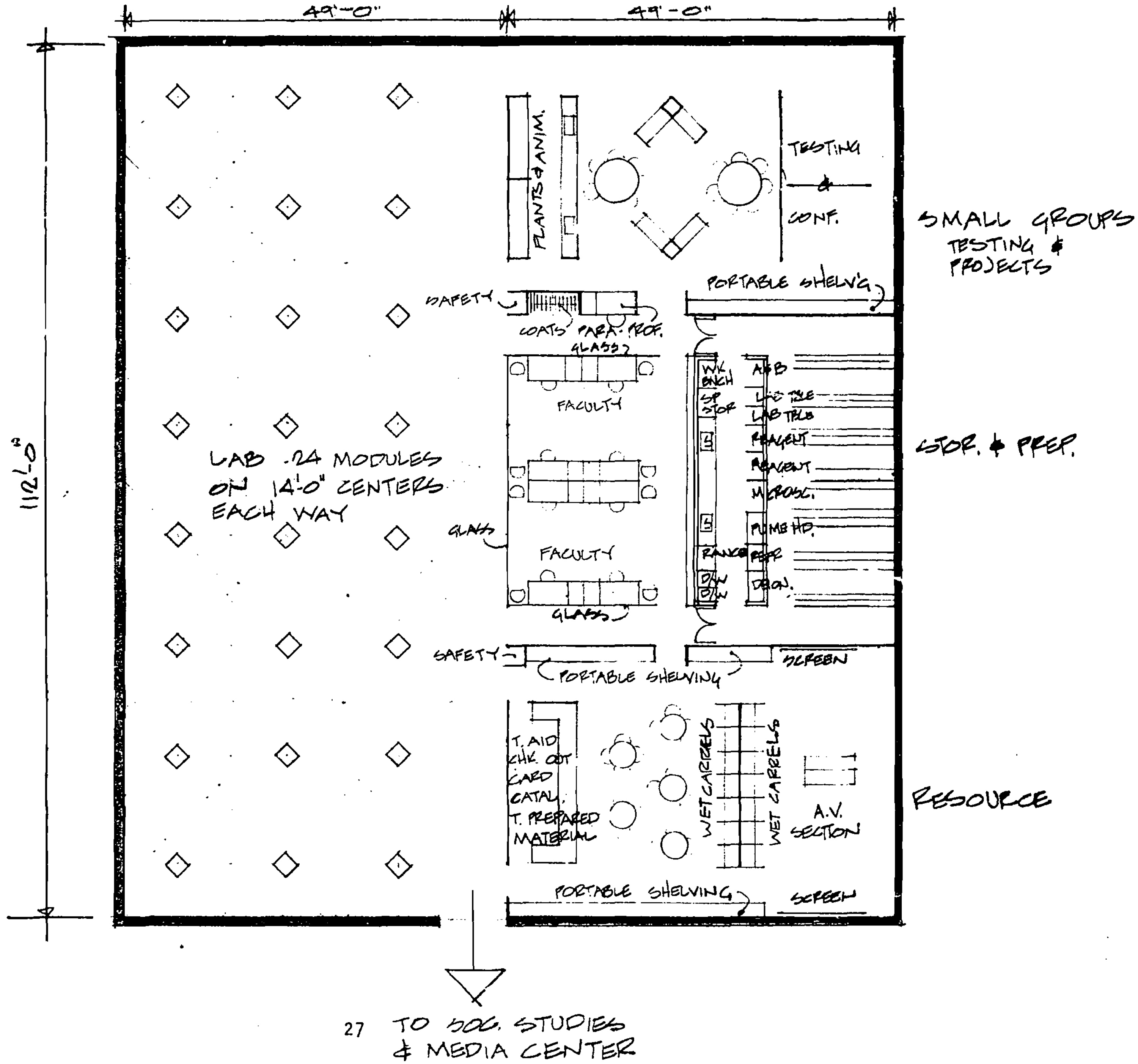
INDIVIDUAL PROJECTS CAN BE DONE IN THE SMALL GROUPS AREA. PRE- AND POST- LAB DISCUSSIONS ARE CONDUCTED AROUND FIXED ISLANDS -- ALL LAB TABLES ARE PORTABLE.

FIXED ISLANDS CONSIST OF 2'-0" x 2' -0" SINKS WITH GAS AND ELECTRICAL OUTLETS.

STORAGE IS IN PERIPHERAL WALL STORAGE UNITS AND FACULTY ROOMS.

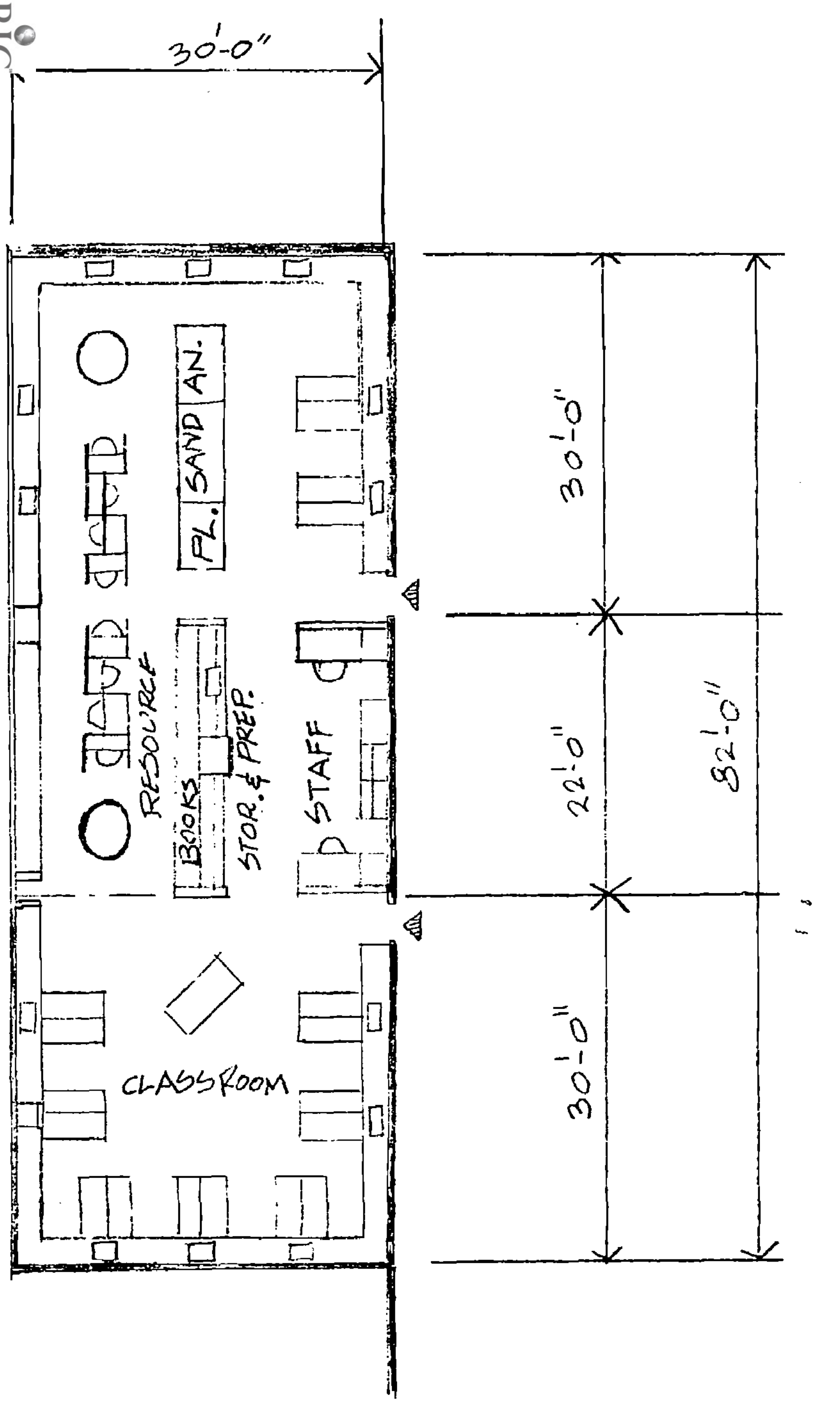
# LARGE SCHOOL - FLEXIBLE

AREA — 11,000#



# MIDDLE SCHOOL

TYPICAL LAYOUT FOR SCIENCE AREA
REMODELING




PLAN - MIDDLE SCHOOL - REMODELED

FLEXIBLE CURRICULUM SCALE 1/16 = 1'-0"

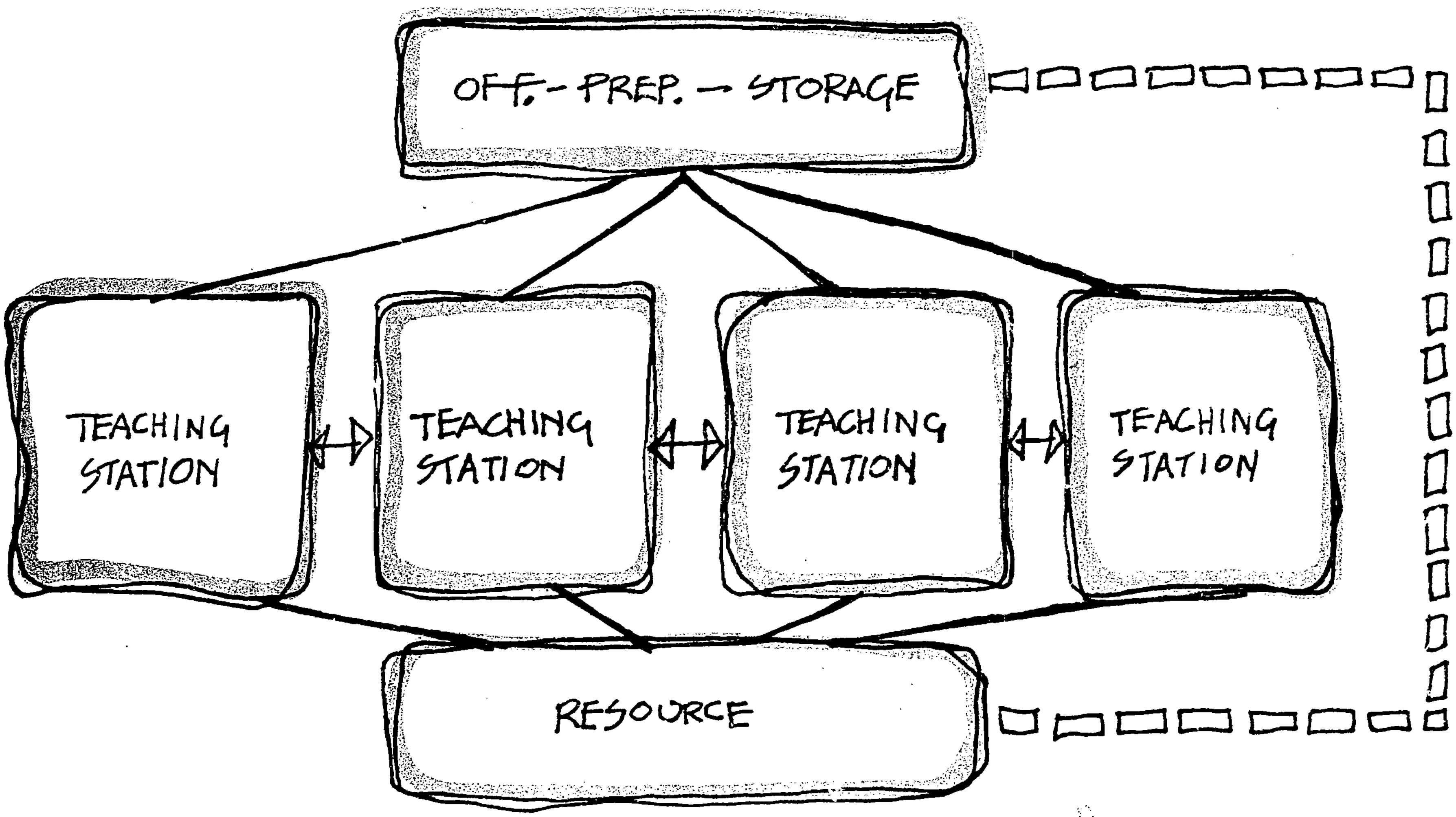
AREA 2460#

7 SERVICE AREAS - PERIMETER INSTALLATION
EACH LAB CLASSROOM - TOTAL 14 AREAS

# MIDDLE SCHOOL

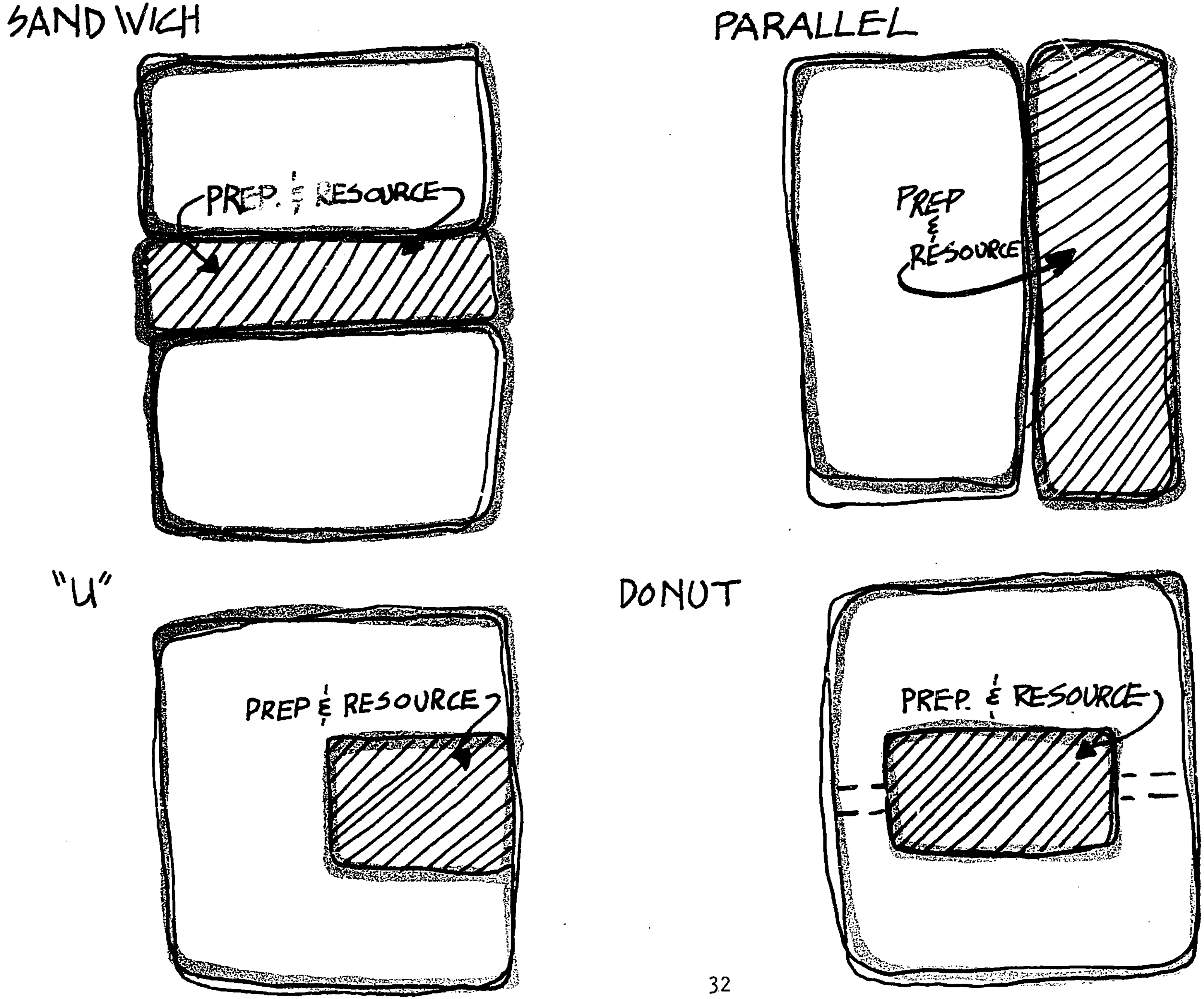
## TYPICAL SCIENCE LAYOUTS FOR NEW CONSTRUCTION

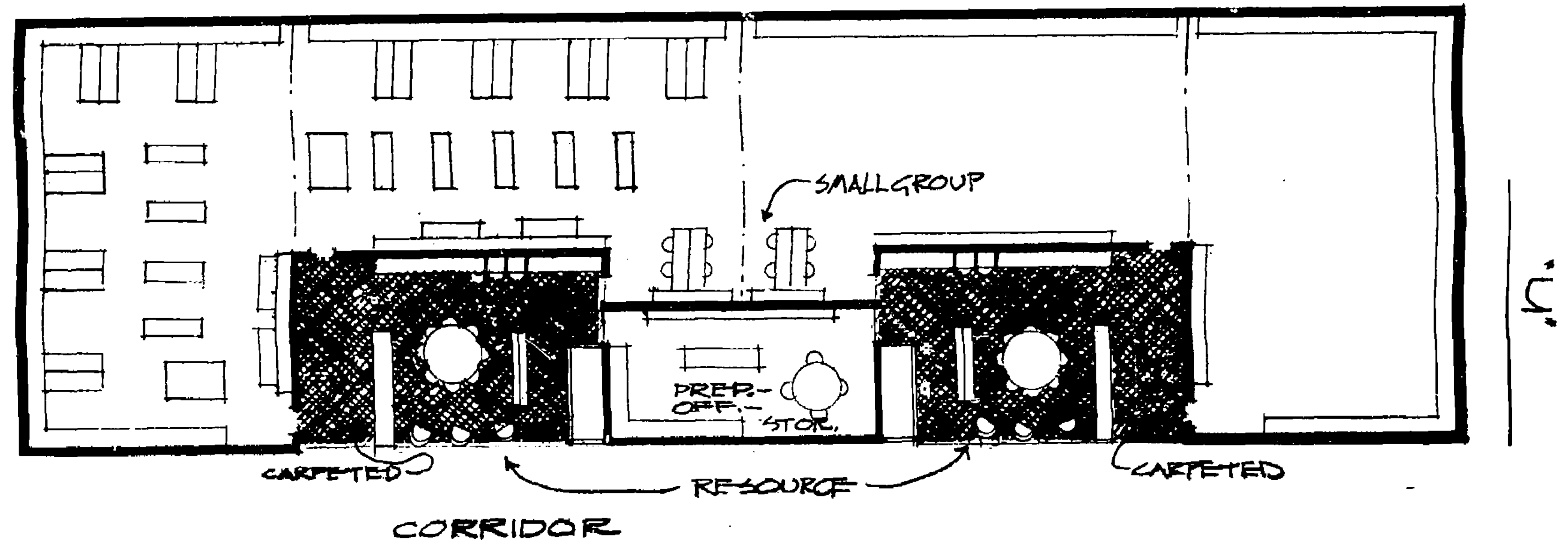
SCHEMATIC OF RELATIONSHIPS

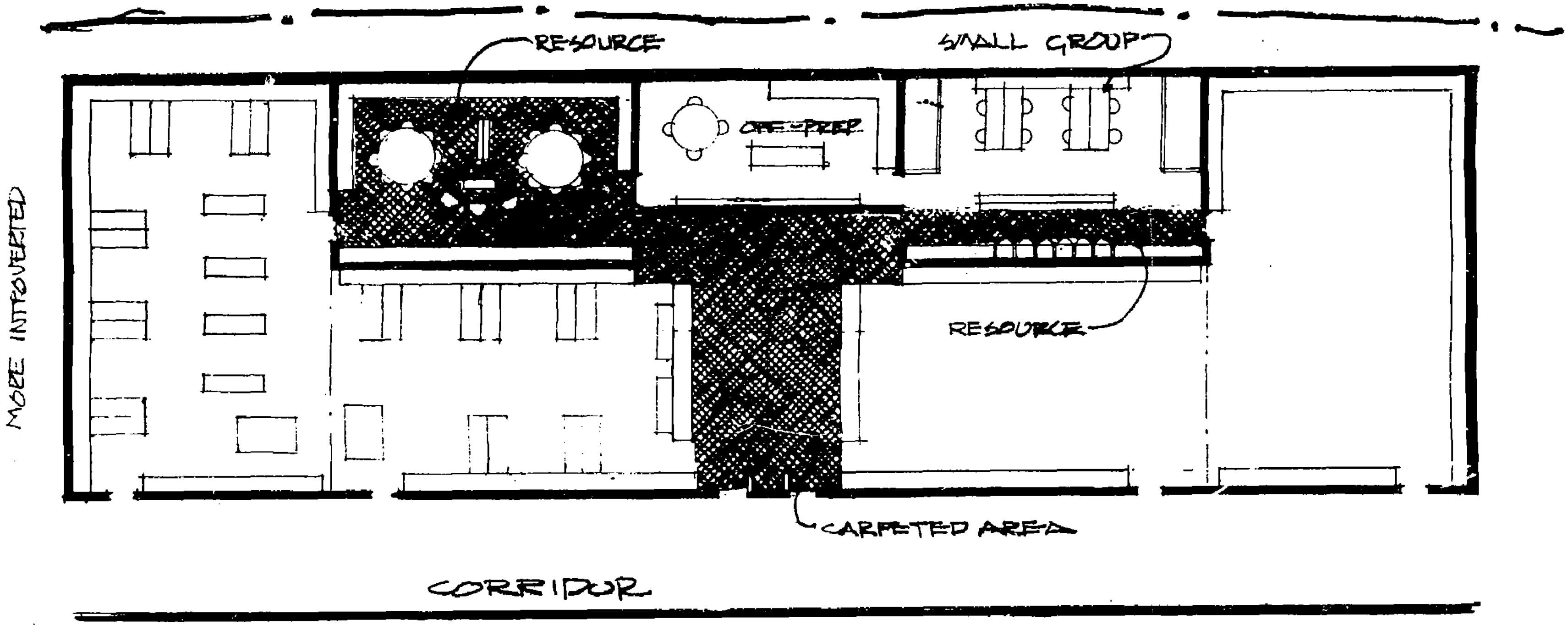



MIDDLE SCHOOL
TRADITIONAL
& OPEN

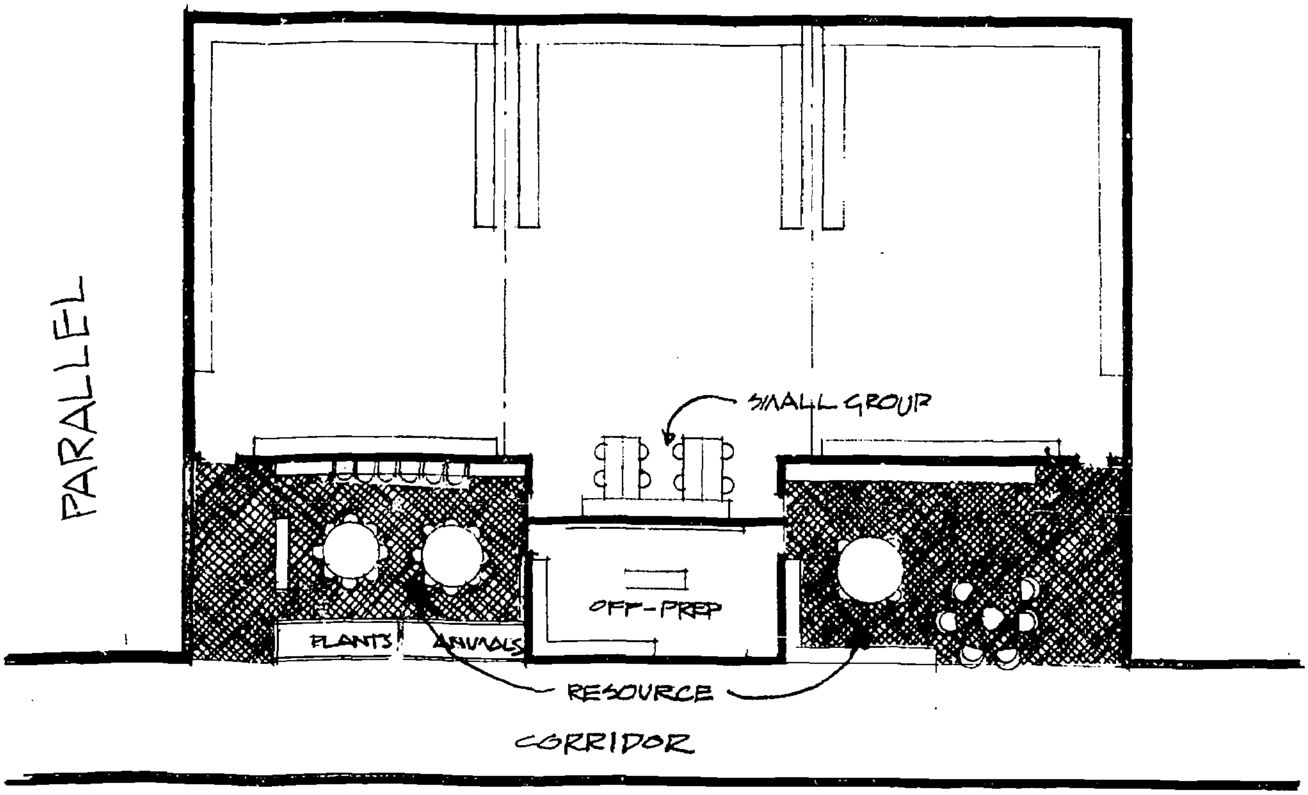
# SCHEMATICS OF FORM FOR TRADITIONAL



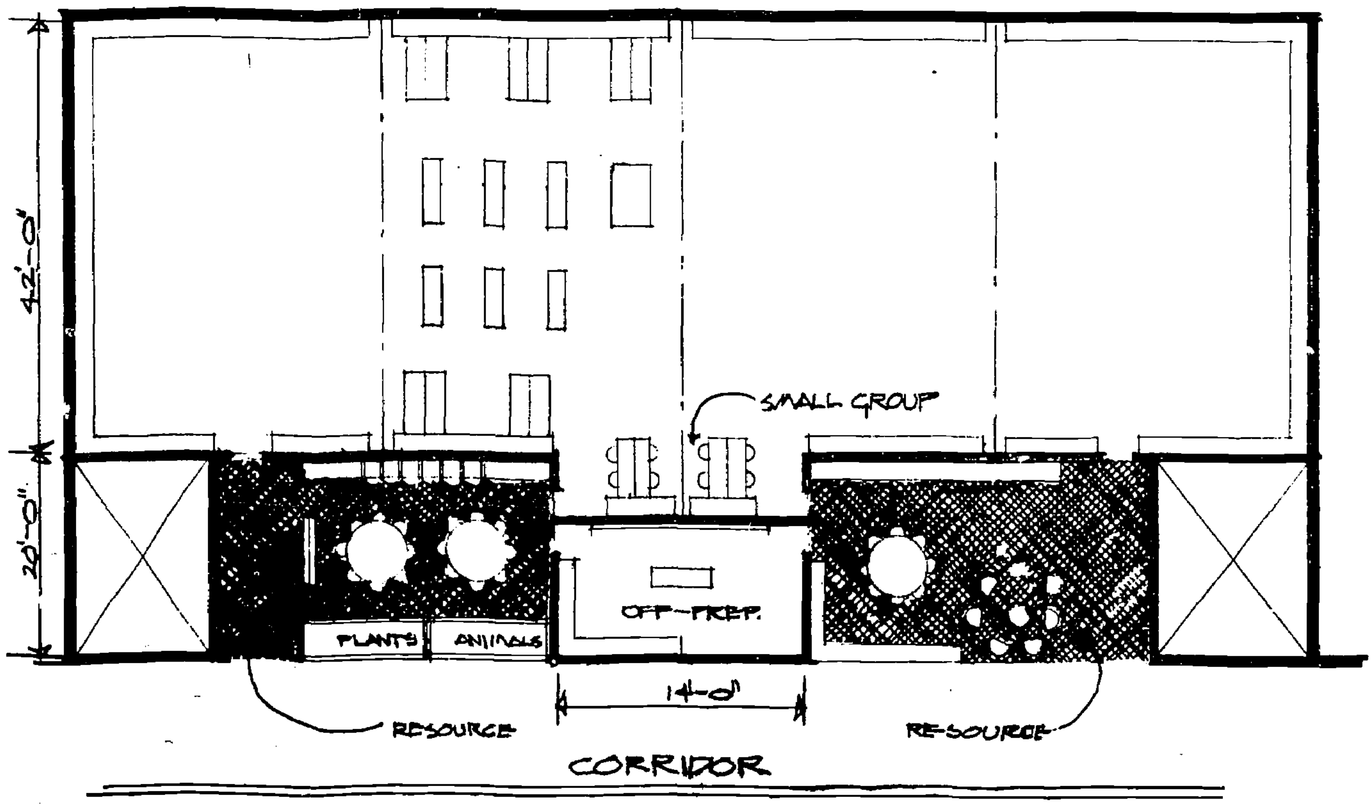

"U"
SMALLGROUP
PREP.-
OFF.-
STOR.
CARPETED
RESOURCE
CARPETED
CORRIDOR


MORE INTROVERTED
RESOURCE
SMALL GROUP
OFF.-PREP.
RESOURCE
CARPETED AREA
CORRIDOR

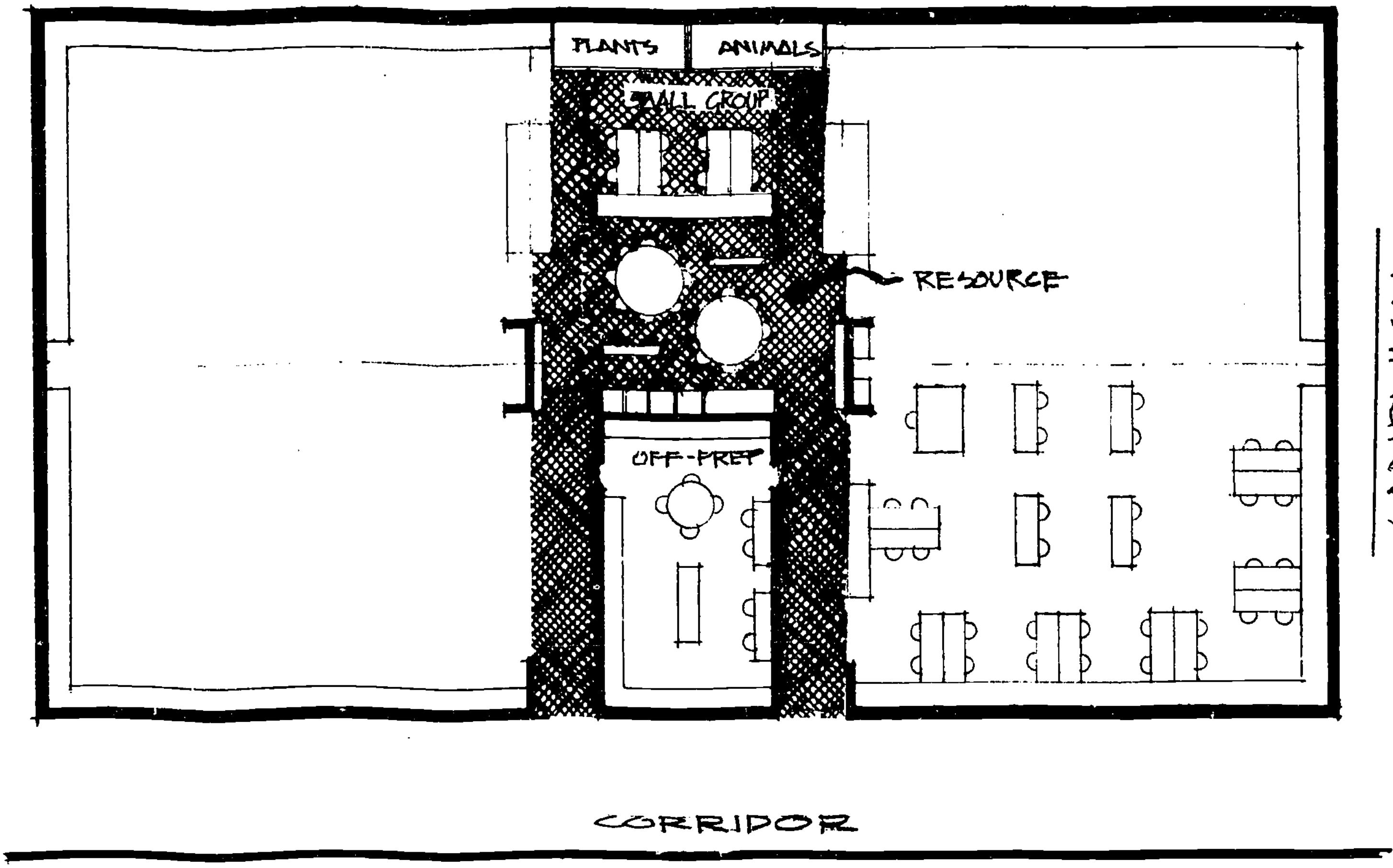
PARALLEL

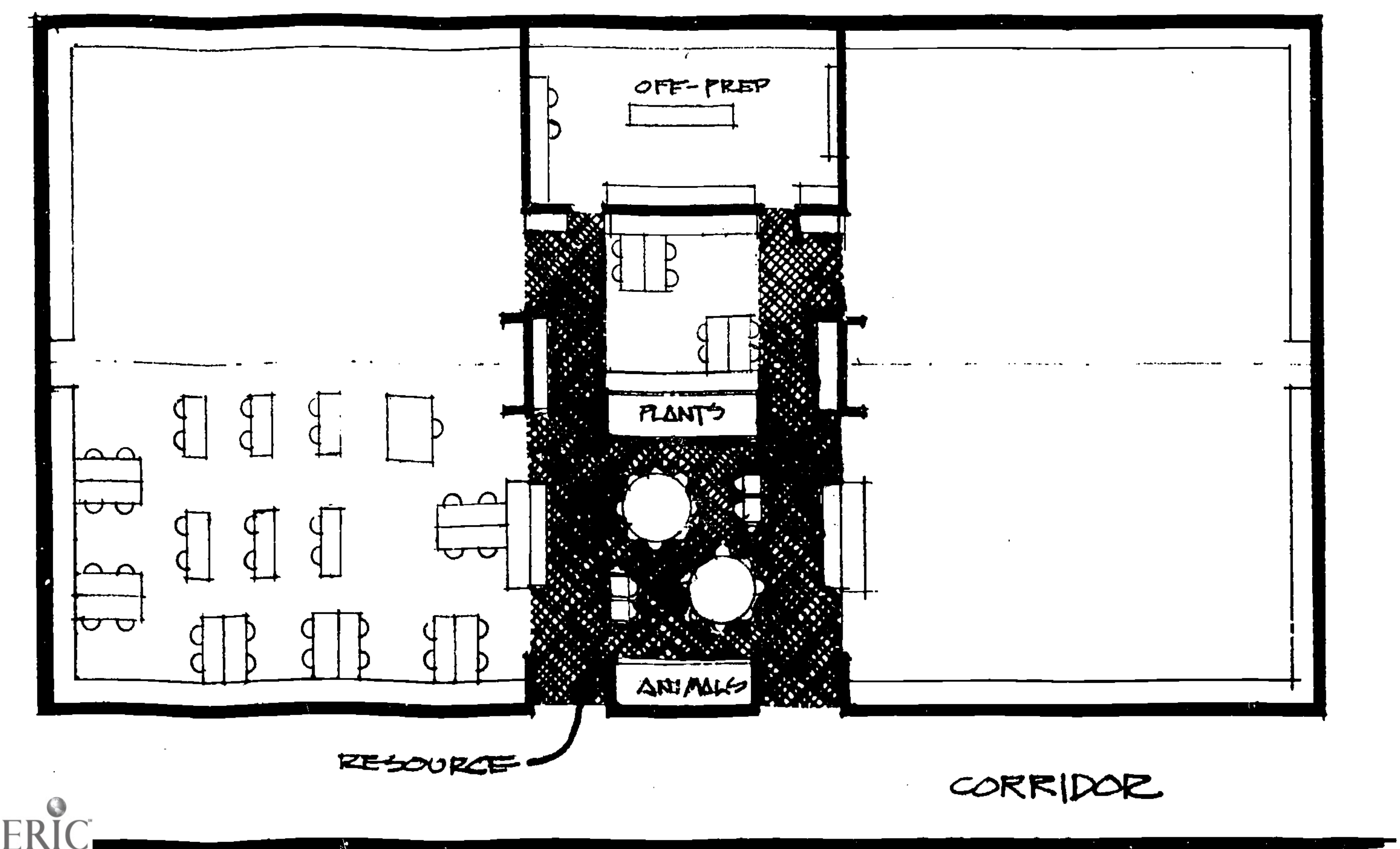

SMALL GROUP
OFF-PREP
PLANTS
ANIMALS
RESOURCE
CORRIDOR



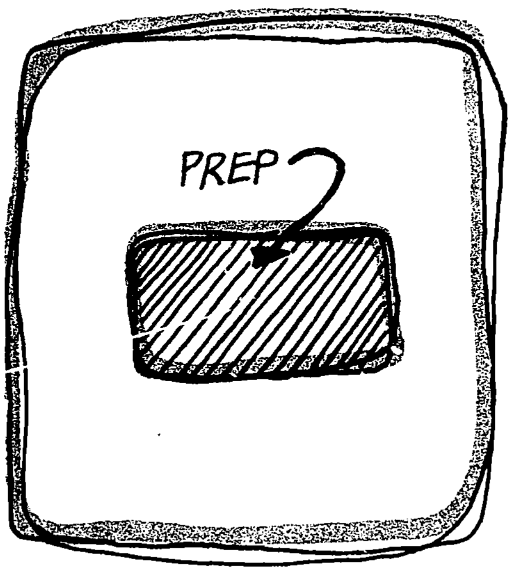

42'-0"
20'-0"
SMALL GROUP
OFF-PREP.
PLANTS
ANIMALS
14'-0"
RESOURCE
RE-SOURCE
CORRIDOR

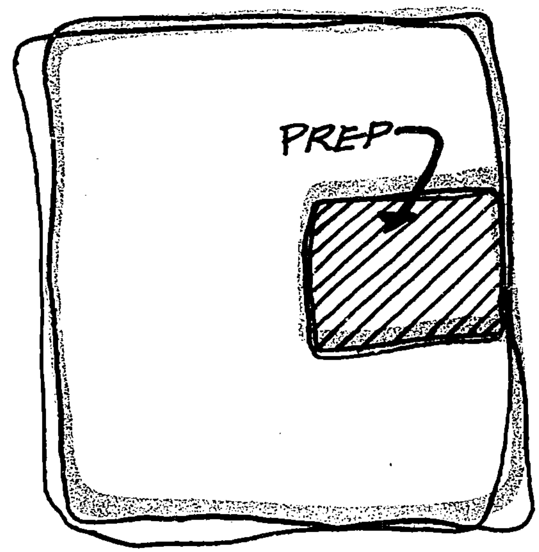
# SANDWICH

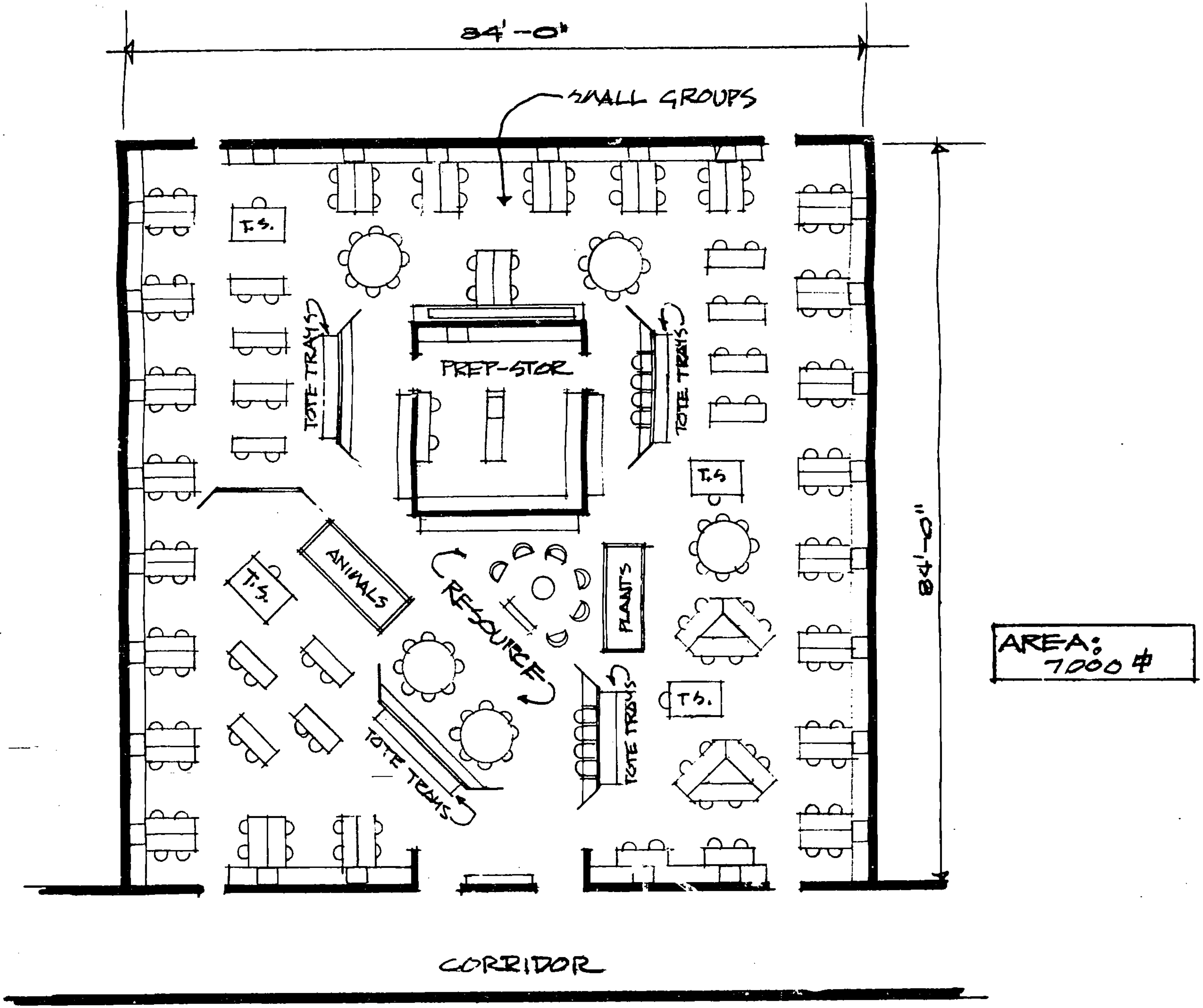

PLANTS
ANIMALS
SMALL GROUP
RESOURCE
OFF-PREP
CORRIDOR


OFF-PREP
PLANTS
ANIMALS
RESOURCE
CORRIDOR

# SCHEMATICS OF FORM FOR OPEN PLAN

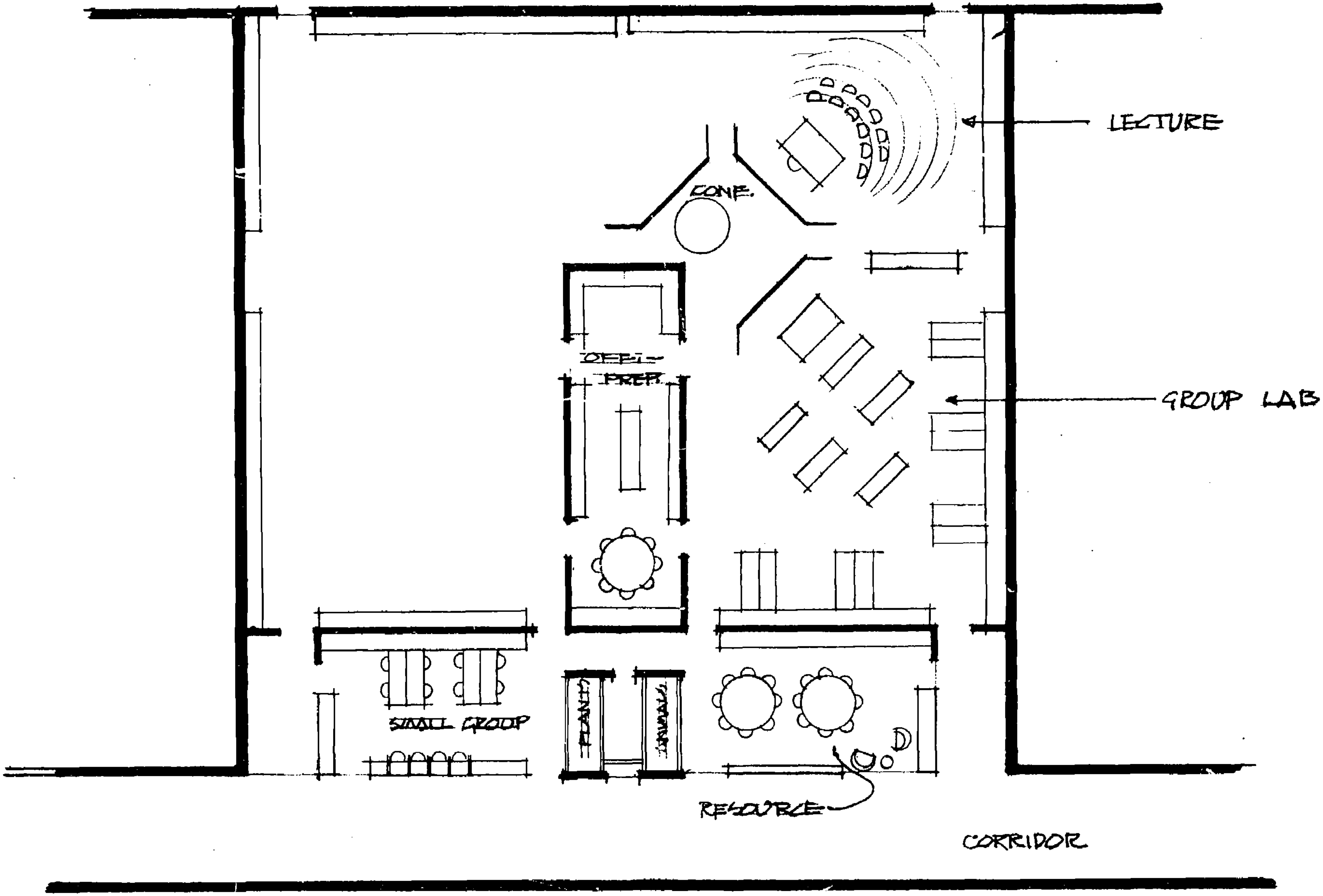


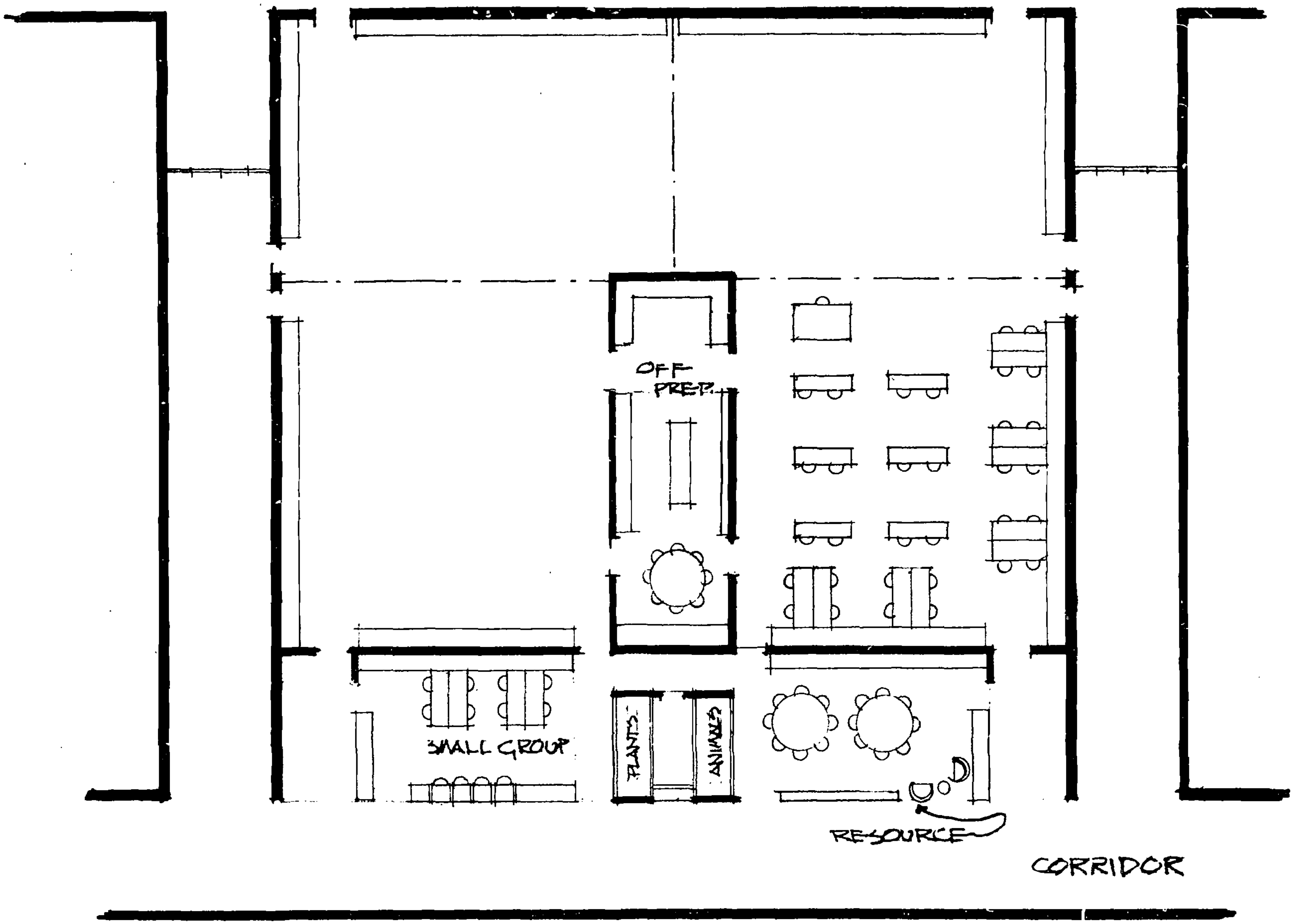

84'-0"
SMALL GROUPS
T.S.
TOTE TRAYS
PREP-STOR
TOTE TRAYS
T.S
84'-0"
ANIMALS
T.S.
RESOURCE
PLANTS
TOTE TRAYS
T.S.
TOTE TRAYS
AREA: 7000 #
CORRIDOR

SOME PROPOSALS WILL FIT BETWEEN THE TRADITIONAL & OPEN SCHEMES.

THE FOLLOWING ILLUSTRATE SUCH SCHEMES.




OPEN
VARIATION #I






TRADITIONAL
VARIATION #1