

Summer 7-1-1964

A Guide for Expansion of Course Offerings in General Metals at Shumway Junior High School in Vancouver, Washington

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A GUIDE FOR EXPANSION OF
COURSE OFFERINGS IN GENERAL METALS
AT SHUMWAY JUNIOR HIGH SCHOOL
IN VANCOUVER, WASHINGTON

A Research Paper
Presented to
the Graduate Faculty
Central Washington State College

In Partial Fulfillment
of the Requirements of the Degree
Master of Education

by
Waldemar R. Schlonga

July 1964

THIS PAPER IS APPROVED AS MEETING
THE PLAN 2 REQUIREMENT FOR THE
COMPLETION OF A RESEARCH PAPER.

Wilhelm Bakke

FOR THE GRADUATE FACULTY

ACKNOWLEDGMENTS

The writer wishes to extend sincere appreciation to Mr. Wilhelm Bakke for his criticisms, encouragement, and guidance in the preparation of this paper. Appreciation is also extended to Mr. George L. Sogge who served as advisor during the writer's graduate program.

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CHAPTER I

GENERAL EDUCATION AND INDUSTRIAL ARTS

The junior high school has been and very likely will continue to be a changing type of secondary education organization. In the fifty-four years since its origin, this uniquely American school has endeavored to fulfill its responsibility of providing young adolescents with a general education.

I. GENERAL EDUCATION

The junior high school provides the adolescent with a learning environment to meet his varying needs. This provision is based on the fundamental doctrines of democracy. The "Ten Imperative Needs of Youth" (11:9) and the "Ten Developmental Tasks of Adolescence" (8:111-147) form the framework of general education and give uniqueness to the junior high school. As there is no single answer to how the school will meet these needs and tasks, and as no two communities are alike, it is vital to re-examine the educational programs of the junior high school.

II. INDUSTRIAL ARTS

The junior high school industrial arts programs have also witnessed many changes in the past fifty-four years and will likely continue to change. Today, industrial arts has

become a recognized part of general education. It is therefore obligated to help prepare the adolescent for living and working in a technological society and to give an introductory understanding of American industry.

Its mission then is two-fold: it introduces students to the world of industry and technology, and it guides them in terms of vocational interests and abilities (6:29).

The following four purposes are basic to industrial arts education.

1. To develop in each student an insight and understanding of industry and its place in our society.
2. To discover and develop student talents in industrial-technical fields.
3. To develop problem solving abilities related to the materials, processes, and products of industry.
4. To develop in each student skill in the safe use of tools and machines (1:4-5).

It is the intention of junior high school industrial arts programs to: (1) provide many exploratory experiences, (2) provide program flexibility to meet individual interests, (3) provide opportunity for experiences in a personnel system, and (4) provide related information about industrial occupations. The aim is to accomplish these intentions through learnings that lead to desirable behavioral changes.

Purpose of the study. The purpose of this study is to develop a guide for expansion of course offerings in the general metals program at Shumway Junior High School in Vancouver, Washington. This will be attempted through a

comparison of the present program with that indicated by present literature of recognized leaders in industrial arts education and others.

Limitations of the study. This study is limited to the general metals program at Shumway Junior High School. The woodworking, industrial arts crafts and mechanical drawing programs are as complete and broad as is now possible in the present curricular structure.

CHAPTER II

REVIEW OF LITERATURE

There are several types of industrial arts shop organizational patterns in junior high schools. Each has a definite area of activities and reflects a particular community's educational system in its particular way. These types are (1) the comprehensive general shop, (2) the general shop and (3) the unit shop. The first named is broader in content than the last which is specialized.

The comprehensive general shop. The comprehensive general shop organization was reported to have more students enrolled than any other type (3:30). Literature indicated the comprehensive general shop and the general shop were capable of fulfilling the purposes of industrial arts and the junior high school (1:13, 3:42, 4:32, 5:112). The desired extent of exploratory experiences determine which type will be chosen. John L. Feirer and John R. Lindbeck (6:29) caution us to remember, ". . . the industrial arts program is characterized by breadth, rather than depth, of skill and understanding."

Comprehensive general shop content. The activities of the comprehensive general shop program are numerous and varying depending upon the type of facilities, the purpose it serves in the particular school and community, the student schedule patterns, the school enrollment, and the staff. The subject

areas of the content may include (1) general drawing, (2) general woodworking, (3) general metal, (4) general crafts, (5) graphic arts, (6) power mechanics, and (7) electricity. This multiplicity of activity defines the comprehensive general shop. A general shop will confine activity to one area; ie., general metal. A unit shop will further confine activity to one phase of one area; ie., sheet metal.

No one definite pattern of industrial arts being an elective or a required class could be established for the junior high school. There is an indication of industrial arts being more likely required in Grades 7 and 8 and elective in Grade 9 (6:30-32, 14:38). It was reported, "Industrial arts is usually part of the required curriculum at the junior high school level" (3:12), though no compilations were given to support the statement.

General metals content. Five sources (1, 3, 6, 9, 13) showed common agreement in seven areas of content for general metals. These areas were found to be: (1) art metal, (2) bench metal, (3) forging, (4) foundry, (5) metal machining, (6) sheet metal, and (7) welding. Three sources stated specifically these areas of content were in junior high school general metals program (1:28, 3:57, 6:32). There was no indication by Silvius and Curry whether they were directing their suggestions to the junior high school level.

Implementing these content areas in the general metals program vary from school to school and community to community. The purpose of the junior high school in the school district's educational program, the purpose of industrial arts in the junior high school program, and the purpose of general metals in the industrial arts program are determinants of the implementation.

Students in the industrial arts program at the junior high school level are guided through a series of exploratory experiences. Two to six semesters may be used for exploratory courses (1:14).

There exists an extremely broad spectrum of organizational patterns for implementation of such programs. One can find programs ranging from two to five fifty-minute periods per week, to one hundred-minute blocks of time weekly (6:30).

Table I shows Feirer's and Lindbeck's breakdown of a typical junior high school general metals program in a comprehensive general shop (6:31-32).

This is only one of many possible plans for implementation. The implications are clear: broad exploratory experiences will precede basic experiences. Actual construction activities will not be possible in all phases of general metals and then, will be limited to hand tool operations. Only minimum orientation and basic skill instruction with related information may be accomplished. This will call for all the teacher's ingenuity in using visual aids and instructional procedures. In such a program the film, projected slide, overhead projections, demonstration, reference library

TABLE I
ALLOWANCE FOR GENERAL METALS

Grade		Weeks
7	in 18 weeks	3
8	in 18 weeks	6
9	in 18 weeks	18

and resource person become invaluable. Practice pieces, rather than the project, may be utilized for teaching basic skills with the student applying these skills to a creatively designed project involving several areas of study.

Space requirements. Space allocations for the industrial arts shops have an effect on the industrial arts program. Therefore, the general metals program is affected. This effect may be more than teachers realize.

There was a noted lack of a standard square-foot-per-student ratio in the school building planning guides. We in industrial arts tend to think of the square-foot-per student ratio based on the number of students we have in our classes. Architects and boards of directors tend to think in terms of the total school enrollment when calculating this ratio. They recognize industrial arts classes usually have $1/4$ to $1/3$ fewer students per class than academic classes. They are also guided or restrained by state regulatory measures attached to the matching monies.

A range from forty square feet per student minimum to seventy-five square feet maximum was found as the ratio, depending upon the type of shop (7, 12). A number of guides listed no square feet per student ratio for industrial arts shops.

Industrial arts sources, on the other hand, using the basis of students per class, usually had higher ratios for general or comprehensive general shops. One of the earliest,

Wilbur, had eighty square feet per student as the minimum for general shops. One of the latest, the A.C.I.A.T.E. yearbook (2:59) had seventy-five square feet per student as the minimum and one hundred twenty-five square feet per student as the desirable ratio for the junior high school comprehensive general shop.

These differences have a subtle influence on the intended program and the actual program after the facilities are constructed unless there is active communication during the planning stages. The building must serve the program, not the reverse.

Learning experiences. The junior high school general metals learning experiences are broad and exploratory in as many as possible of the content areas that can be housed efficiently in the shop. This is essential if the previously mentioned purposes of the junior high school, industrial arts, and general metals are to be met. Again, Feirer and Lindbeck (6:33), the latest-dated source, will show in the following listing the representation of present literature concerning learning experiences in basic metalwork.

1. Laying out with scribe, combination square, center punch, dividers, and hammer.
2. Shearing sheet metal with snips and cold chisels.
3. Studying mathematics for [calculating and measuring] areas, perimeters, circumference, volume, weight, gauges.
4. Learning metal identification.

5. Studying types of saws and blades.
6. Forming threads with taps and dies.
7. Bending metal by hand or box and pan brake.
8. Soldering copper and tinfoil.
9. Riveting metals.
10. Studying types of casting metals.
11. Studying types and applications of simple seams and folds.
12. Studying solders, fluxes, and their applications to copper and tinfoil.

A synopsis of the metalworking learning experiences from the A.V.A. guide gives a more traditional listing (3:58-61).

1. Project design
2. Project planning
3. Measuring with various devices
4. Layout methods
5. Cutting procedures
6. Methods of making holes
7. Bending
8. Shaping and forming
9. Heat treating
10. Smoothing methods
11. Cutting threads
12. Assembly methods
13. Decorating methods
14. Finishing methods
15. Cleaning and care of equipment

Equipment and tools. Certain equipment and tools are necessary in the general metals program. They will limit or broaden the learning experiences of the student in his general metals activities. They will limit or broaden his project construction procedures. They will limit or broaden teacher

demonstrations and the experiment or research activities of the inquisitive student. In other words, one must know the extent of the program before choosing the equipment and tools.

Appendix A on page 26 is a list of recommended equipment and tools arranged according to the general metals content areas. Industrial Arts in Utah (10:119-155) served as the source in selecting the basic equipment and tools needed for these content areas.

CHAPTER III

THE PRESENT PROGRAM

Industrial arts is a definite part of the general education program on an elective basis in Shumway Junior High School's curriculum. Enrollment is not open, at this time, to seventh grade students. Eighth and ninth grade students may elect either the general shop class or the mechanical drawing class for one semester in the eighth grade or for one year in the ninth grade. Each shop class meets for a fifty-five minute period daily in a comprehensive general shop facility. This facility is divided into two rooms.

The beginning ninth grade shop students arrive in class with any of four possible eighth grade elective experiences in industrial arts as in Table II. This range of possible experiences has a definite effect on the ninth grade program. It must be planned for--sometimes as many as half of the students in a class will not have had the benefit of eighth grade general shop experiences.

General metals content. The general shop class encompasses activities in woodworking, industrial arts crafts, and general metals. The previously mentioned limit of this study necessitates clarification of the present breadth of the general metals program. The program includes activities in art metal, bench metal, forging, limited foundry and sheet metal.

TABLE II
POSSIBLE EIGHTH GRADE
INDUSTRIAL ARTS EXPERIENCES

Student	Mechanical Drawing	General Shop
A	none	none
B	one semester	none
C	none	one semester
D	one semester	one semester

General metal space provisions. The total comprehensive general shop area comprizes approximately 4,000 square feet. The general shop class uses 3,000 square feet; the mechanical drawing class uses 1,000 square feet. These figures do not include auxiliary spaces or rooms. There are ample work stations for a single class. Analysis of the facility will follow in Chapter IV.

General metals learning experiences. The school year 1960-1961 was a year of industrial arts curriculum study in the Vancouver school district. The presentation of learning experiences is listed verbatim from the contribution of Shumway Junior High School to that portion of the study.

Eighth grade general shop (ferrous and non-ferrous)

1. To be able to use the common metalworking tools.
2. To be able to layout, cut, form and finish small projects in metal.
3. To make riveted or soldered metal joints.
4. To learn the safe operation of:
 - a. belt sander
 - b. drill press
 - c. jig saw
 - d. buffers
 - e. gas furnaces
 - f. grinders
5. To do accurate measuring.
6. To shape metals.
7. To heat, anneal and heat treat with the gas furnace.
8. To do elementary foundry work with lead or aluminum.

Ninth grade general shop (art, bench and sheet metals)

1. Learn the types of metals.
2. Learn the [use of] common metalworking tools.
3. Learn to layout, cut, form, and finish simple metal projects.
4. Learn the use and precautions in using the gas furnaces for heating, melting and annealing metals.
5. Learn to use the metal vises, anvils, stakes, bar folder, universal rotary, slip roll and bender.
6. Learn to solder and rivet sheet metal, and emboss metal foil.

In general

1. Learn to make and use working drawings of projects.
2. Learn and practice the safety rules for all equipment and tools.
3. Learn to use all hand tools available.
4. Learn to spell the names of equipment and tools and refer to them correctly.
5. Learn to develop good work habits and procedures in the care and use of equipment, materials and tools.
6. Learn to apply design and function principles in project planning.

General metals equipment and tools. The listing of recommended equipment and tools for the general metals program will be found in Appendix A page 26. The series of marks (x) shows the equipment and tools presently used. An analysis by comparison will follow in the next chapter.

CHAPTER IV

ESTABLISHING A GUIDE FOR EXPANSION

The general metals program has been shown as a functioning part of industrial arts general education at Shumway Junior High School. This curriculum is based on the comprehensive general shop organization. This organization is defined as one that exhibits broad exploratory experiences for the junior high school student. These experiences are representative of industry.

The general education commitment precludes limiting industrial arts instruction to manipulative-construction activities alone. Industrial arts, as a subject area in our schools, should use as its points of departure all phases of our industrial life which can be dealt with in a school shop or laboratory. These several points of departure--that is, the materials, tools and processes of industry; science and invention applied to industry; the social and economic contributions of industry; and, the human relations patterns fostered by industry--define the scope of the industrial arts program (3:11).

The fact that eighth and ninth grade students are the only students electing industrial arts limits the chances they have for exploratory experiences in the general metals portion of the industrial arts offerings while in junior high school.

General metals content. The content areas of the general metals program, in Table III page 17, are compared to the content areas found most often in literature. There are two areas lacking in the present program--metal machining and welding.

TABLE III
GENERAL METAL CONTENT AREAS

Present	Recommended
Art metal	Art metal
Bench metal	Bench metal
Forging	Forging
Foundry (limited)	Foundry
Sheet metal	Metal machining
	Sheet metal
	Welding

It should be pointed out that this is true of all junior high schools in Vancouver. These two content areas are reserved for the senior high school industrial arts program in the vocational shops at Clark College (junior college) and at the separate senior high schools. If metal machining and welding were to be included in the junior high school general metals program, it would require a change in district policy and reorganization of that program.

General metals space provisions. A comparison of room areas in square feet with the various recommended areas is warranted (2:59).

The square-feet-per-student ratio of 115 square feet is between the "adequate" 100 square feet and "desirable" 125 square feet recommended. Storage facilities of 775 square feet are very satisfactory as is the finish room space of 160 square feet. The office space is the "desirable" amount of 170 square feet, while the classroom is exactly the "minimum" of 400 square feet. Space provisions meet the "desirable" ratio for one class, with the exceptions noted. Work stations are adequate with a 2:1 ratio.

General metals learning experiences. Upon examination of the lists on pages 9 and 10 in Chapter II, and pages 14 and 15 in Chapter III, it appears the learning experiences of the present program are meeting recommendations for an exploratory general metals program at the junior high school level. This

does not mean all students studying general metals apply each learning experience to the construction of a project. Demonstrations and visual aids are used to give instruction and related information in these areas.

The limited foundry content area noted in Table III, page 17, deserves clarification. Any student's learning experiences that involved the pouring of molten metal (aluminum) did so with the use of metallic molds to cast the guards for a hunting knife or gaff hook. This foundry activity should be expanded to include sand casting, according to literature encountered in this study.

General metals equipment and tools. An analysis of Appendix A page 26 will show the equipment and tools needed to expand the offerings of the general metals program. Two content areas are complete--bench metal and sheet metal. Two items are needed to complete the forging area. Four items are needed to complete the art metal area. Foundry activities appear to be decidedly in need of expansion as thirteen items are necessary to complete exploratory learning experiences. These experiences relate to the study of sand casting, a basic industrial process.

Appendix B page 29 lists the needed items in the arranged order giving the prices from current catalogs.

The expenditures for these items are:

art metal	\$34.90	
forging	12.45	
foundry	<u>23.45</u>	
	\$70.80	Total

The total amount is deemed necessary to expand present course offerings in the general metals program.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Industrial arts is basically satisfying its purposes in general education at Shumway Junior High School. This does not infer that the program should continue without periodic examination of its content.

Conclusions. The general metals program is fulfilling the multiple-activity structure of a junior high school comprehensive general shop, with three exceptions: art metal, forging and foundry. The offerings in art metal and forging are more complete than the offerings in foundry. Experiences in engraving, doming and raising of art metals are incomplete. Forging experiences need reinforcing. The foundry area of experiences should be expanded to include sand casting.

The space provisions are adequate for present needs. Several categories contain the "desirable" square feet ratio recommended by cited authority--several contain more square feet.

Recommendations. In view of the purposes of industrial arts in general education, this guide may be followed to expand the general metals program at Shumway Junior High School. This expansion should provide for broader experiences in art metal, forging and foundry activities.

It is recommended that a means be established to provide this expansion on a limited scale if district funds are not available this year to provide the necessary equipment and tools. This could be accomplished through the preparation of a priority listing and distributing purchases over several years.

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APPENDIX

APPENDIX A

GENERAL METALS EQUIPMENT AND TOOLS

Art metal	item	have (x)
	art metal stakes	X
	ball bearing back center	X
	chasing hammer	X
	dapping die	
	dapping punches	
	forming hammer	X
	graver set	
	jeweler's saw	X
	mallets	X
	needle files	X
	planishing hammer	X
	pieces of lead	X
	pieces of pipe	X
	raising hammer	
	sand bags	X
	spinning chucks	X
	spinning lathe	X
	spinning rest	X
	spinning tools	X
	tree stump	X
	wood blocks	X
Bench metal	ball peen hammer	X
	bender	X
	bunsen burner	X
	center punch	X
	cold chisel	X
	cross peen hammer	X
	dividers	X
	drill press	X
	file card	X
	files, set of	X
	hack saw	X
	heating oven	X
	machinist's square	X
	machinist's vise	X
	monkey wrench	X
	prick punch	X
	set of dies	X
	set of high speed drills	X
	set of taps	X
	steel rule	X

Forging	item	have (x)
	anvil	x
	gas furnace	x
	hardy	x
	lead hammer	x
	monkey wrench	x
	sledge	
	solid punches	x
	tongs - curved	
	flat	x
	pick up	x
Foundry		
	asbestos gloves	x
	bellows	x
	bench rammer	
	brushes	x
	bulb sponge	
	crucible	x
	crucible tongs	x
	draw pin	
	dust bag	
	flasks	
	gas furnace	x
	gate cutter	
	lifter	
	moulding board	
	riddle	
	skimmer	x
	slick and oval	
	square trowel	
	strike bar	
	venting wire	
Sheet metal		
	ball peen hammer	x
	bar folder	x
	box and pan brake	x
	dividers	x
	file, smoothing	x
	hand drill	x
	hand groover	x
	hollow punch, set	x
	mallet	x
	pliers	x
	rivet set	x
	screwdriver	x

Sheet metal
(Cont.)

item	have (x)
scriber	x
scroll snip	x
setting down hammer	x
slip roll	x
soldering copper	x
soldering furnace	x
solid punches	x
stakes	x
steel rule	x
straight edge	x
straight snips	x
try square	x
universal rotary	x

APPENDIX B

COST OF EQUIPMENT AND TOOLS NEEDS

Art metal	Item	Cost
	dapping die	\$12.50
	dapping punches	8.20
	graver set	9.95
	raising hammer	<u>4.25</u>
	Total	\$34.90
Forging		
	sledge	\$ 4.75
	tongs - curved	<u>7.70</u>
	Total	\$12.45
Foundry		
	bench rammer	\$ 2.70
	bulb sponge	4.55
	draw pin	mfg.
	dust bag	mfg.
	flasks	mfg.
	gate cutter	3.05
	lifter	3.05
	moulding board	mfg.
	riddle	2.80
	slick and oval	3.35
	square trowel	3.95
	strike bar	mfg.
	venting wire	mfg.
	Total	<u>\$23.45</u>
	Grand Total	<u>\$70.80</u>