CURRICULUM GUIDE

Vocational Mining

(Interim Edition)

Curriculum and Vocational Education Sections
EDUCATION DIVISION
Northern Administration Branch
Department of Northern Affairs
and National Resources
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FOREWORD

The course in Vocational Mining outlined herein is unique in that it is a first attempt in a Territorial school to offer a practical course in vocational mining. It is also unique in that the substance of the course has been built from the suggestions and advice offered by outstanding figures in the mining industry who served on a sub-committee of a local Vocational Advisory Committee.

In a publicly supported school system the substance of the courses of study should meet certain criteria. The most important of these is that each course arises from and reflects the setting in which it is applied. A further criterion is that it possesses meaning and validity for those who follow it. The first of these criteria has been most amply met; the second has still to be tested. This outline is an interim edition which will be revised as experience dictates.

If there be justification for the offering of any vocational training it must certainly follow that training in a field which constitutes the basic industry of the area is fundamental to vocational training in that area. The two-year course here outlined is the first step toward the eventual offering of a four-year program which will provide that practical training most useful for young men entering the mining industry.

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Chief, Education Division.

NORTHWEST TERRITORIES

VOCATIONAL EDUCATION MINING COURSE

1961-62

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TABLE OF CONTENTS

PART		PAGE
I.	FOREWORD	1
II.	GENERAL AIMS	2
III.	COURSE OVERVIEW	2
IV.	COURSE IMPLEMENTATION	4
V.	METHODS OF INSTRUCTION	4
VI.	COURSE OUTLINES	7
	Year One	7
	Year Two	10
	APPENDICES	18
	References	18
	Films and Filmstrips	19
	Teaching Aids	20
	Equipment	20

II. GENERAL AIMS OF THE VOCATIONAL MINING COURSE

1. To develop a broad understanding of the mining industry and the employment opportunities in it.
2. To provide some graduates of the Sir John Franklin School with the practical skills and knowledge which will prepare them for initial employment in the mining industry.
3. To develop in the graduates of the Vocational Mining Course, those attitudes towards work that mine management seeks: industry, honesty, reliability, punctuality, pride in workmanship, willingness to follow instructions, and the desire to learn.
4. To provide the means of making the academic program more functional.

III. COURSE OVERVIEW

The organization of the four-year vocational mining program is based on the following assumptions:

1. That all male vocational students entering the Sir John Franklin School should learn something about the mining industry.
2. That graduates of the Vocational Mining Course should have attained at least a grade nine academic level.
3. That graduates of the Vocational Mining Course should be in a position to compete for employment.
4. That the general course approach is desirable, provided that the course is flexible enough to permit some specialization for students with aptitude and interest.
5. That the Assay Office in Yellowknife will be used for certain parts of the Vocational Mining Course.

6. That local mines will contribute to the Vocational Mining Course through providing opportunities for field trips, and through the provision of resource personnel.

In the light of the basic assumptions stated above, the Vocational Mining Course is organized as shown below:

Year 1 (Part of Total Orientation Program)

Woodwork	Sheet Metal	Mechanics	Welding	Driving	Mining
					- Job Opportunities - Mine Safety - Hand Tools - Machines and Equipment - Assaying - Milling - Surveying - Prospecting

Year 2 (no Options)

Exploration	Appraisal and Assaying	Mine Mechanics and Maintenance	Mine Operator
- Geology - Minerals - Prospecting	- Appraisal of mining property - Sampling - Assaying	- Mining Machine shop - Electricity - Maintenance of equipment - Hydraulics - Compressed air - Pipe fitting - Track work	- Operation of machines and equipment - Mine timbering - Explosives and blasting

Year 3 (no Options)

Exploration and Assaying	Mine Mechanics and Maintenance

Year 4 (Some Specialization)

Exploration and Assaying	or	Mine Mechanics and Maintenance

N.B. Details of Year 3 and Year 4 not yet determined.

IV. COURSE IMPLEMENTATION

During the 1962-63 school year, all first-year male vocational students in the Sir John Franklin School take the general Orientation Program, a part of which provides the introductory portion of the Vocational Mining Course. In addition, second-year male vocational students will be introduced to mining by taking those parts of the year one Vocational Mining Course which are related to their training in Carpentry and Mechanics.

During the 1963-64 school year, all second-year vocational students, who have selected the mining program will take the year two Course. Furthermore, some third-year vocational students may elect to take the Mine Mechanics and Mine Operator sections of the year two Mining Course.

V. METHODS OF INSTRUCTION

This course of studies is a printed document provided for the Sir John Franklin School. It contains an outline of the work for each year of the Vocational Mining Program, and sets forth objectives and suggestions for the guidance of instructors and school administrators. This course of studies should be distinguished from the curriculum, which is really the implementation of the course of studies. Through the methods of instruction employed, the curriculum will be shaped.

The following notes are intended to be suggestive, rather than prescriptive:

1. Demonstrations

Demonstrations may be used to good advantage:

1) when there is an element of danger, as for example,

when teaching the unit on explosives;

2) when the class is large, and the space is limited;

3) when the procedure is more complicated than usual;

4) when expendable material is in short supply.

Demonstrations in which the instructor and his class combine their efforts are most useful. Students can help to assemble the necessary materials and equipment, assist in the actual demonstration, and arrive at conclusions.

2. Field Trips

Field trips to local mines, to the Assay Office, to the Mine Rescue Station, and to the Mining Recorder's Office, and to other places of interest should be an integral part of the vocational mining program. Seeing and investigating actual mining operations is one of the best ways to develop interest and to impart information.

A field trip requires careful preparation. The instructor should give careful thought to the best ways of helping his students to observe and understand what they see. Of course, arrangements with appropriate officials should be made well in advance.

When the class returns to the school, the door is open wide for extensive follow-up work. The information and materials gathered on the excursion should be consolidated; discussion and the search for more information follows naturally.

3. Community Resources

The mining instructor in Yellowknife has a wealth of resources close at hand-- the equipment in the school, the rocks in

the school yard, the offices nearby, and the mines themselves. Furthermore, in Yellowknife there are people, who by virtue of their training, occupation, experience and demonstrated interest in the Vocational Mining program can make a valuable contribution to the mining course. An occasional visit to the class from such people is a source of enrichment on which the instructor should draw when a good opportunity arises.

4. Reading

The instructor's responsibility here is to know sources of appropriate reading materials available to his class, and then to encourage his students to read widely. In the selection of appropriate reading materials related to the content of the mining course, the instructor should work closely with the teacher who has his students for the Accelerated Academic Upgrading Program.

Reading assignments should have a definite purpose:

1) to discover answers to questions,
2) to find information for reports,
3) to verify conclusions,
4) to satisfy curiosity.

5. Audio-visual Aids

Because of the academic background of vocational students enrolled in the Sir John Franklin School, the use of a wide variety of audio-visual teaching aids is highly recommended. Carefully selected films, filmstrips, maps, charts, pictures, models, and tapes properly used, can make a vital contribution to the effectiveness of instruction.

VI. COURSE OUTLINES

The stated time allotments and topical outlines which follow are intended to be suggestive rather than prescriptive. It is hoped that instructors will modify the courses to meet the needs of students of varying interests and aptitudes, and that the course will be realistically related to job opportunities in the mining industry in Canada.

1. Year One: Orientation Course Outline

Time Allotment:

Ninety-six hours (approximately 1/6 of the total time for Vocational Orientation)

Specific Objectives:

1. Informational: To present an overview of the mining industry and the wide range of employment opportunities in it.
2. Vocational: To develop some initial interests in a more detailed study of mining during the second year.

Unit I: Job Opportunities In The Mining Industry

Topic	Notes
1. The working force in a mine: (a) underground workers (b) surface workers 2. Methods of payment and wages earned: (a) "contract" workers (b) "company time" workers	Through a field trip to a local mine, develop a broad understanding of job classification, wages, qualifications, and opportunities for advancement. Supplement field trip by discussion and suitable audio-visual aids.

Unit II: Mine Safety

Topic	Notes
1. Common accidents in metal mining 2. Support of excavations: (a) checking condition for the underground openings; use of scaling bar. (b) checking the condition of the timbers; signs of pressure-squeezing, bending, splitting. 3. Ventilation and dust control 4. The importance of good lighting: (a) the electric cap lamp (b) lamp house and servicing 5. Miner's clothing. 6. Safety laws and regulations: (a) handling of explosives (b) blasting (c) manways (d) mine plans (e) signals (f) fire precautions 7. The value of First Aid training.	Stress that nearly all hazards of metal mining are due to unsafe practice or to careless conduct. Point up the need for careful workmanship, e.g. timbering. Emphasize the importance of knowing and observing the regulations. (There is no place for the beginning miner who is a menace to himself and others.) Show and discuss appropriate safety films. Visit the local Mine Rescue Station.

Unit III: Hand Tools

Topic	Notes
1. Hand tools used in the mining industry: (a) pick and shovel (b) axe (timbering) (c) hand-held hammer drill (d) scaling bar	Give students the opportunity for some experience in using these hand tools.

Unit IV: Mining Machines and Equipment

Topic	Notes
1. Drills: Diamond, rock 2. Mucking machine 3. Slushers and scrapers 4. Tugger hoists 5. Ore cars 6. Electric locomotives	Develop an understanding of the function of these machines and equipment and of the work involved in their operation. These machines should be seen in actual operation. Supplement by appropriate audio-visual aids.

Unit V: Assaying

Topic	Notes
1. Definition of assaying. 2. Job opportunities in assay work.	Field trip to the local Assay Office.

Unit VI: Milling

Topic	Notes
1. Definition of milling. 2. Job opportunities in milling.	Organize a field trip to a local mine to observe the milling operations. Supplement by appropriate audio-visual aids.

Unit VII: Surveying

Topic	Notes
1. Definition of mine surveying 2. Duties of a mine surveyor's assistant: (a) assisting with measuring (b) care of tapes (c) care in handling instruments (d) holding levelling rods (e) rough carpentry; e.g. building tripod signals for topographic surveys.	If possible, observations of a surveyor at work. Supplement by suitable films.

Unit VIII: Prospecting

Topic	Notes
1. Equipment and methods used by the prospector. 2. The mine Recording Office	A brief prospecting field trip to observe equipment and methods. Visit to Mine Recording Office. Show and discuss appropriate films.

2. Year Two: Vocational Mining Course Outline

Time Allotment:

Four hundred eighty hours (5 half-days per week)

Specific Objectives:

1. A more serious and detailed study of the major mining operations for students who have demonstrated an interest and aptitude for mining.
2. To reach some tentative decisions with respect to selection of students for some specialized training in the fourth year.

Medical Examination:

Before being registered for the year-two program, students will be required to submit evidence of having met the medical standard recommended by the Vocational Advisory Committee.

Section I: Exploration

Unit I: Geology

Topic	Notes
1. The Earth and earth's crust: - the earth as a planet in the solar system. - revolution and rotation of the earth - composition: the core, the crust	Relate to the Accelerated Academic Upgrading Program in science
2. Changes in the earth: - constructional changes: deposition of sediments; mountain building by uplift, faulting, or folding. - destructional changes: disintegration by changes in temperature and wedging; decomposition; erosion.	Use appropriate films, filmstrips and other audio-visual aids.
3. Classification and recognition of rocks: - igneous rocks: general characteristics. - sedimentary rocks; general characteristics	Lab practice in identification of rocks.

- metamorphic rocks; general characteristics 4. Rocks tell the story of the earth: - layer, formation, epoch, era - estimated life span of different eras	Rock collections and study of local samples.

Unit II: Minerals

Topic	Notes
1. Minerals and crystals: - definition of a mineral - definition of a crystal	
2. Physical qualities of minerals: - structure; lustre; translucency; color; streak; hardness; tenacity; fracture, cleavage, and parting; fluorescence; magnetism; taste; feel; specific gravity.	Lab work
3. Identification of common minerals	Lab work
4. Types of mineral deposits: - metallic mineral deposits	
5. Common ore minerals	

Unit III: Prospecting

Topic	Notes
1. Map reading: - topographical maps - geological maps	Take part in an organized prospecting field trip.
2. Searching for minerals: - the need for experience - kinds of information needed and where to obtain	
3. Clues to a favorable area	
4. Preparation for the search: - selecting a companion - determining method of transportation - clothing - food - equipment - service methods	
5. The search: - reconnaissance of the area - clues to the discovery of valuable minerals in an area	

- special detectors: magnetic compass, dip needle, Geiger counter, ultra-violet lamps. 6. Maps, records, and samples: - sketch mapping: pace and compass method, grid and offset method, information to be included. - the diary or field notebook - samples: grab samples, chip samples. 7. Staking and recording claims: - prospecting license - acts and regulations - the staking map - four post method of staking	Utilize the resources of the Mining Recorder's Office.

Section II: Appraisal And Assaying

Unit I: Appraisal of Mining Property

Topic	Notes
1. Geology of the locality 2. Type of deposit 3. Topographical conditions	Observation at a local mine if possible.

Unit II: Mine Sampling

Topic	Notes
1. Map of the workings 2. Methods of taking samples 3. Appliances used: hammer, chisel-ended picks, pointed pick, air hammer, rock drill, moils. 4. Weight of sample from each cut 5. Sequence of operations in taking samples 6. The need for trustworthy men on the sampling crews--"salting"	Observation, demonstration, and field work. Supplement by suitable audio-visual aids.

Unit III: Assaying

Topic	Notes
1. Fire assaying: - fusion: "pot fusion" and "scorification" - cupellation - parting	Demonstration and lab work in Assay Office

Section III: Mine Mechanics And Maintenance

Unit I: Mining Machine Shop

Topic	Notes
1. Hand tools: - uses and application - care and preservation - safety practice 2. Drilling: - power hand drills - floor and bench power drills - drilling tools - methods of supporting work 3. Threading: - type of threads - uses - external threading 4. Tapping 5. Grinding: - abrasives and grinding wheels - safety practice 6. Welding 7. Soldering 8. Elementary blacksmithing: forge work and tempering	Shopwork Relate to vocational offerings in the Mechanics and Welding courses.

Unit II: Mine Electricity

Topic	Notes
1. Fundamentals of electricity: - electricity as a flow of electrons - current and amperes - resistance and ohms - laws of resistance - voltage	Relate to science course in Accelerated Academic Upgrading Program.

- Ohm's Law - electric circuits 2. Applications of electrical power to mining 3. Wiring 4. Cable splicing 5. Care and operation of electric motors	Shopwork

Unit III: Maintenance

Topic	Notes
1. Bearings: - care and storage - types - use and application - how to remove	Shopwork
2. Shimming: - types - stock - application	Relate to vocational offerings in the Mechanics course.
3. Lining shafts: - by means of measurement - use of indicator, center finder	
4. Removing studs: - types of removers - parts and nomenclature	
5. Cleaning parts: - buffing - filing - solvent	
6. Lubrication: - functions of lubrication - application of lubrication oils: hand oiling, drop feed, felt pad, splash system, pressure system - application of grease - handling and storing lubricants	
7. Simple adjustments to machines	

Unit IV: Hydraulics

Topic	Notes
1. Force and pressure 2. The hydraulic system 3. The hydraulic pipes and fittings	Relate to science course in Accelerated Academic Upgrading Program.

4. Hydraulic hose 5. Hydraulic hose couplings and fittings 6. Principles of operation of hydraulic pumps 7. Hydraulic motors	Shopwork

Unit V: Compressed Air

Topic	Notes
1. Principles of compression 2. Types of air compressors 3. Capacities of air compressors 4. Cooling devices 5. Transmission of compressed air 6. Mining applications	Relate to science course in Accelerated Academic Upgrading Program. Shopwork

Unit VI: Pipe Fitting

Topic	Notes
1. Measuring pipe 2. Cutting pipe 3. Reaming and threading 4. Installing and aligning fittings 5. Cutting and bending copper pipe	Shopwork Relate to vocational offerings in Plumbing Course.

Unit VII: Track Work

Topic	Notes
1. Track construction: - grades - curves - alignment - gauge - rails, ties, and accessories - switches	Provide the opportunity for some practical experience in construction

Section IV: Mine Operator

Unit I: Operation of Machines and Equipment

Topic	Notes
1. Drills: - Diamond - rock 2. Mucking machine 3. Slushers and scrapers 4. Tugger hoists 5. Ore cars 6. Electric locomotives	Provide the opportunity to operate various mining machines.

Unit II: Mine Timbering

Topic	Notes
1. Nature of pressure on mine timbers: - minor pressure - major pressure	Shopwork
2. Choice of timber: - age and texture - desirable qualities in mine timber	Relate to vocational offerings in the Carpentry course.
3. Storage and preservation of timber: - cutting and storing - need for preservation - destructive agencies - standard preservatives - application of preservatives - susceptability of timber to treatment	
4. Strength of timber: - crushing loads - timber used as posts - timber used as stulls	
5. Cribs: - crib building - shaft sets - mill holes - chutes - manways	
6. Auxiliary supports for roof: - expansion-bolt method	
7. Hints for timbermen	

Unit III: Explosives and Blasting

Topic	Notes
1. Action of explosives	Stress safety precautions
2. Classification of explosives: - blasting powder - pellet powder - dynamites	Demonstrations, supplemented films
3. Factors in selecting an explosive: - strength - fumes - density	
4. Selection of firing equipment: - safety fuse - blasting caps - electric detonators - delay electric blasting caps and ignitors	
5. Priming, charging, and firing: - high explosive charges - loading and tamping - firing shots - handling misfires	
6. Physical conditions governing effective blasting: - effect of free faces in mining - amount of explosive	

APPENDIX I

REFERENCES

BOOKS

1. Canadian Legion Educational Service Vocational Course Booklets, obtainable from Department of Veteran's Affairs, Ottawa.

Mining, Text booklet No. 1	Rocks and Minerals
Mining, Text booklet No. 2	Prospecting
Mining, Text booklet No. 3	Practical Mining
Mining, Text booklet No. 4	The Business of Prospecting and Mining

2. Canadian Industries Limited. Blasters' Handbook, C. I. L. Explosives Division, Montreal.
3. American Red Cross. Abridged Textbook of First Aid (Miners' Edition)
4. Alberta Department of Education, Provincial Institute of Technology, and Art, Department of Correspondence Instruction. Mine Surveying Course.
5. Moore, E.S. Elementary Geology For Canada.
6. Lang. Prospecting In Canada (Geological Survey of Canada)
7. Pough. A Field Guide To Rocks and Minerals (Thomas Allen)
8. Bush, H. The Story of Minerals (Longmans, Green)
9. Parker, B.M. Stories Read From The Rocks (Copp Clark)
10. Mustard, R.A. Fundamentals of First Aid (St. John Ambulance Course)

MIMEOGRAPHED MATERIALS

1. Saskatchewan Government Correspondence School Grade XII Geology

2. Irwin - Prospectors' Course Outline (Education Division, Department of Northern Affairs and National Resources)

3. St. Patrick's High School, Yellowknife. Mining Course Outline

APPENDIX II

FILMS AND FILMSTRIPS

1. Canadian Industries Limited Film Library, P.O. Box 10, Montreal, Quebec
   1. Blasting Vibrations (color-sound-25 minutes)
   2. Rescue Breathing (color-sound-21 minutes)
   3. Blasting Cap (color-sound-13½ minutes)
   4. Before the Blast (color-sound-10 minutes)

2. Visual Instruction Division, Department of Extension, University of Alberta, Edmonton.
   1. Great Canadian Shield (color-sound-11 minutes)
   2. Gold (b & w-sound-11 minutes)
   3. Gold from Gravels (b & w-sound-31 minutes)
   4. Milling and Smelting the Sudbury Nickel Ores (color-sound-54 minutes)
   5. Mining for Nickel (color-sound-45 minutes)
   6. Minerals from the Mountains of the West (filmstrip)

3. National Film Board
   1. Riches of the Earth (color-sound-17 minutes)
   2. Iron from the North (b & w-sound-20 minutes)
   3. The Modern Prospector (b & w-sound-15 minutes)
   4. Normetal (b & w-sound-18 minutes)
   5. People on the Rock (Rankin Inlet Film)

4. Education Office, Fort Smith
   1. The Ontario Hard Rock Miner
   2. Mining Occupations
   3. The Story of Mountains
   4. The Story of Volcanoes
   5. Iron Ore
   6. Careers in Metal Mining (filmstrip)
   7. Our Earth Is Changing (filmstrip)
   8. How Rocks are Formed (filmstrip)
   9. The Story of the Earth We Find in Rocks (filmstrip)
   10. Face of the Land (filmstrip)
   11. Maps of Canada Mineral Areas (filmstrip)

5. International Nickel Company
   A number of good films on mining.

6. Directory of Geoscience Films - $1.00

American Geological Institute,
2101 Constitution Ave., N.W.,
Washington 25, D.C.

APPENDIX III

TEACHING AIDS

1. A set of mineral chips consisting of 35 specimens of minerals. Price $1.00 per set, postage prepaid, from: The Geological Survey, Department of Mines, Ottawa.

2. A set of rock chips similar to the above may also be obtained from: The Geological Survey, Department of Mines, Ottawa. Price, $1.00 per set.

3. Collection of rocks, stones, and geological specimens obtained locally.

4. Geological maps may be obtained free from: The Map Distribution Office, Department of Mines and Technical Surveys, Ottawa.

5. Air Photos for the Northwest Territories may be viewed and ordered from the Geological Survey of Canada Office in Yellowknife.

APPENDIX IV

EQUIPMENT

The following is a preliminary list of equipment which will be required for the vocational course in mining at Sir John Franklin School:

Picks

Shovels

Axes

Hammers - Double Jack 8#

Hammers - Spalling

Scaling bars

Gads

Hand wood augers

Jack knives

Prospectors picks

Grub hoes

Hammers - Single jack 3#

Gold pans

Rock chisels

Rock moils

Canvas sample bag

Canvas sample sheet

Iron or steel mortar and pestle

Sieves

Brunton compass

Tape - 50' or 100' metallic

Picket lens

Streak plates

Magnet

Map cases

Protractors and scales

Drill steel for hand drilling

Pipe wrenches - 18"

Pipe cutter - hand operated

Pipe threaders - hand operated

Victaulic pipe groovers - hand operated

Mine car - 1 ton or 1½ ton side dump

Mine car - Granby

Rails - 20# or 30# with fish plates & bolts

Track turnouts (notches) 20# or 30# rail

Track crosscovers - 20# or 30# rail

Supply of pipe - mainly 1", 2", 4"

Blasting lead wire

Powder bags

Portable gasoline percussion drill (1)

Drill steel for above

Packsack diamond drill (1)

Pump - air driven - pump type (1)

Pump - air driven - piston (1)

Pump - electric - centrifugal (1)

Portable compressor - 300 cfm. minimum (1)

Air cylinder for chute gates, etc. (1)

Jackhammers (3)

Air legs (3)

Stoper drills (3)

Sinker (2)

Leyner drill (1)

7' Bar and arm for above (1)

2' to 10' drill steel for above drills - Tungsten carbide tip (6 sets)

Tungsten carbide bit grinder (1)

Diamond drill - air operated (1)

Diamond drill - gasoline operated (1)

Mucking machine (1)

1" Air hose in 50' lengths (6)

1" Air hose in 10' lengths for lubricators (6)

Air line lubricators (6)

½" water hose in 50' lengths (6)

Mine fan - air operated (1)

Mine fan - electric - axial flow (1)

Mine fan - electric - centrifugal (1)

Small battery locomotive - Mancha type (1)

Jim Crow for 20# or 30# rails (1)

Tugger hoist with cable (1)

Slusher hoist with scraper and cable (1)

Blasting galvanometer (1)

Blasting machine - generator type (1)

Blasting switch - C.I.L. type (1)