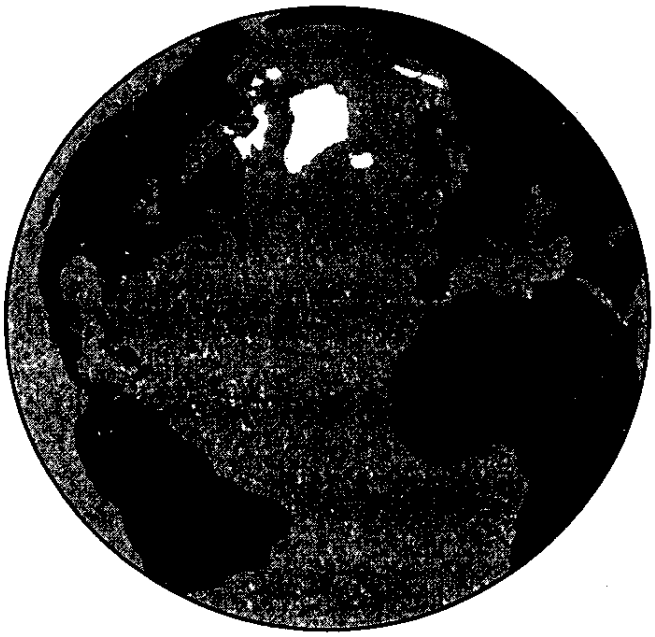
New Brunswick

Physical Geography 110
Portraits of a Planet



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Physical Geography 110
PORTRAITS OF A PLANET

TABLE OF CONTENTS

Rationale 1

General Course Objectives 3

Methodology 4

General Evaluation Strategies 5

Prescribed and Listed Materials 7

Course Content

Unit 1 10

Unit 2 11

Unit 3 13

Unit 4C 15

Unit 5C 16

Unit 6C 17

Unit 7C 18

Unit 4G 19

Unit 5G 20

Unit 6G 22

Audio-Visual Listings from Instructional Resources 24

Appendices

Appendix A - Lesson Plans & Ideas

Plan 1 i

Plan 2 ii

Plan 3 vi

Plan 4 vii

Plan 5 xi

Plan 6 xii

Plan 7 xv

Appendix B - Geoeducation in New Brunswick xviii

Physical Geography 110
PORTRAITS OF A PLANET

Rationale

What is the current state of the planet?
How did it get to be this way?
What is the long term future of planet earth and its passengers?

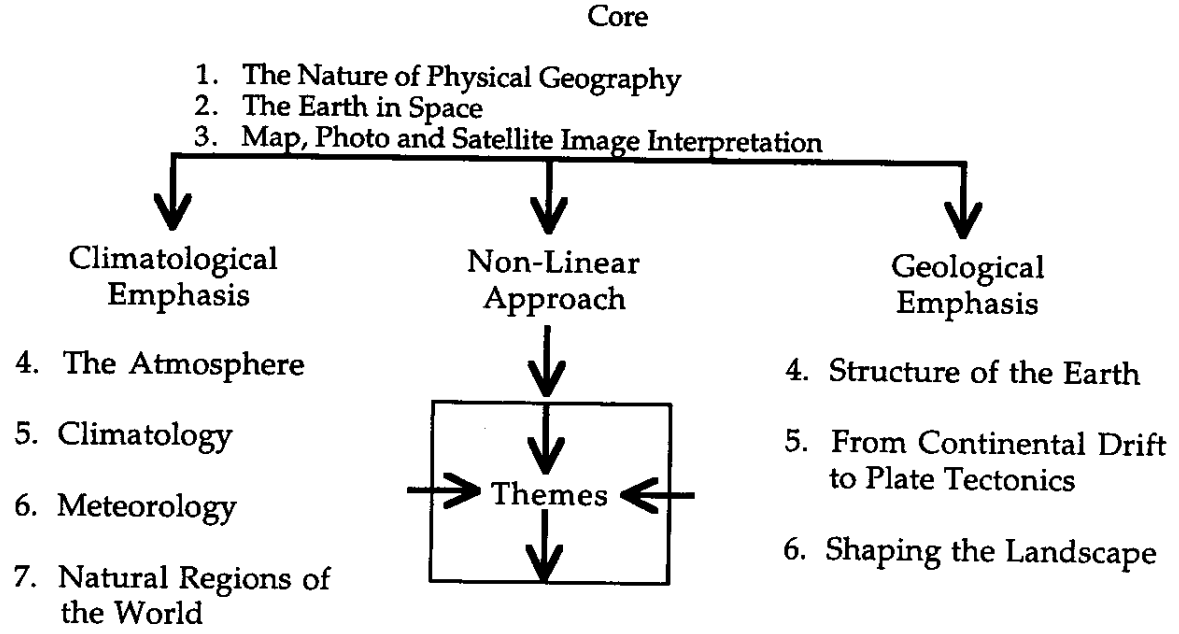
In answering these questions the student of physical geography will be involved in a wide variety of activities which will enhance the development and application of transferable skills. These skills will be drawn from mathematics, the sciences, language arts, computer studies and remote sensing.

Geography is the study of the relationships among all components of the environment. With our environment under siege, Physical Geography must teach that the relationship between the land and humanity works both ways. While geography has always concentrated on this, it bears emphasizing. Not only does the land influence people, but people have a dramatic impact on the land and all natural systems. Our students must come to realize that they must exercise good stewardship for the survival of the planet and the species. Course content should be selected so that students begin to understand the complex relationships that exist between their behaviour and the well-being of the natural world. A proactive, environmental approach to the teaching of Physical Geography 110 is inherent in the subject as well as an absolutely essential investment in the future.

The study of climatology and meteorology have clear connections to the way we lead our lives and are seldom taught without emphasis on their impact on people. It is easy to connect human behaviour with topics such as global warming and the depletion of the ozone layer; but it is equally important to examine the relationships between humanity and all other physical processes. Thus, physical geography provides an excellent context in which to develop an understanding of the environmental crises confronting our planet. The quest for sustainable development must rest upon comprehension of the interrelationships of the earth's physical systems and living communities.

Since the potential scope of a high school physical geography course is enormous, it is suggested that a core of geographical skills and content be introduced and that a sequence be used that stresses a climatological or geological emphasis. An alternative would be a study of themes based on elements of both climatology and geology. This non-linear approach would develop the important relationships of the varied topics within the subject.

An outline of this sequence is as follows.



Students should emerge from this course more knowledgeable and more competent in the skills of geography. They should have a greater awareness of the world around them and how it effects them and they effect it. Students should consider, individually and cooperatively, possible responses to pressing environmental issues which are fundamentally tied up with physical geography. The knowledge and skills acquired will help empower them as they struggle to maintain our habitat in the years to come.

General Course Objectives

Students will:

- practice reading and writing skills with particular emphasis on the language of geography.
- practice graphic and mathematical skills as they apply to geography.
- analyze and interpret thematic maps, topographic maps, air photos and satellite images.
- practice observation skills, the collection and classification of data and the development of hypotheses and generalizations based on this data.
- describe planetary systems and processes and identify their impact on people and the impact people have on these systems.
- describe past human behaviours which have put life at risk and identify ways in which individuals can act to protect and improve the quality of the environment.

Methodology

Teaching strategies should be varied especially in the long semestered period. Fortunately, geography lends itself to variety in the use of materials and teaching methods. A few possibilities are listed below. The use of:

- case studies provide a way of experiencing distant places vicariously.
- a library to develop and write reports, obtain current information and verify hypotheses.
- library research, research from visual materials and field work to provide experience in data collection, classification, organization and hypothesizing.
- numerical data to create graphs and diagrams .
- cooperative group learning methods to consider specific topics and aid in review. Such techniques allow students to pool their ideas and abilities and demonstrate that each has something to contribute to the activity. These experiences enhance self-esteem and provide experience in working together as may be required in the work place.
- map and air photo skills with a minimum of theory and a maximum of hands-on practice.
- local data to clarify the general concepts presented in the text, e.g. local weather information from school instruments or faxed from the local weather office.
- field work to provide practical experience, e.g the collection of mineral and rock samples or simple map making near the school. Both examples provide opportunities to work cooperatively while practising basic skills.
- simulations to illustrate processes, e.g. a stream table to demonstrate fluvial and marine activity.

General Evaluation Strategies

The wide variety of learning methodologies used in physical geography necessitate a variety of evaluation methods. Students can be marked on written material, map making, graphing and general illustrative techniques. Although the highest order of achievement may be the production of a synthesis or general overview, such a synthesis could be expressed in a written, visual or even a video form. This provides an opportunity to encourage students with different learning styles.

There are many hands-on activities suggested in this course. The evaluation of such activities can be broken down into several sections; for example, in producing a series of graphs based on a set of statistics:

a. how accurately has the student translated the material from a written to a visual format?
b. how visually pleasing is the end result?
c. how has the student demonstrated that he/she now has a grasp of the concepts being illustrated?

The final mark for the project should be a composite of such sub-sectional marks.

When tests are being designed it is important in geography, as in all subjects, to evaluate a variety of skills, e.g., ability to recognize, recall, organize, analyze, synthesize, evaluate and apply a variety of information. In geography however, it is especially important to emphasize the visual and spatial aspects of study. To this end, tests should usually include questions which are based on maps, diagrams and/or graphs. The activities and exercises referred to in this curriculum guide should be used as models to develop questions which test a variety of levels of learning.

It is important that evaluation should do more than just cover the information and skills learned in class. In order for awareness and understanding of their environment to occur, the ultimate goal of the teaching process must be to train students to apply the knowledge and skills they have acquired to constantly changing situations. They must, in other words, be trained to solve problems both in the real world as they experience it and from secondary sources such as maps, photographs, statistical tables and videos. Tests and assignments should, therefore, not be limited to reproducing factual information but should require the student to use this information in an informed way to demonstrate that he/she has achieved understanding as well as knowledge.

Suggested Teaching Times

CORE

Unit	Class Periods
1	3
2	12
3	20

CLIMATOLOGICAL EMPHASIS

Unit	Class Periods
4C	7
5C	13
6C	15
7C	10
	80

GEOLOGICAL EMPHASIS

Unit	Class Periods
4G	5
5G	20
6G	20
	80

Thematic Approach

Those following the non-linear approach must build a unit structure which totals 80 class periods of instructional time.

Prescribed and Listed Materials

Texts

Gary Birchall and John McCutcheon. Planet Earth: A Physical Geography. Toronto: 1993.

Walter G. Kemball. Geographic Understandings. Toronto: 1990.

Using the Core Text

The text Planet Earth presents physical geography through interlocking studies of the various components of the subject. This systems approach inevitably requires choices as to which concepts will be included in any particular study. The author has made his choice but recognizes others. Both teachers and students may wish to diverge from his plan, selecting their own sequence of concepts and content from the text. The latter is made possible through a comprehensive system of icons. It is strongly advised that users of the text become familiar with the chapter links and icons as shown on page five. A useful glossary is also included in the text.

Teacher Resource Package

John Smees. Planet Earth: A Physical Geography. Teacher's Resource Package. Toronto: 1993.

For each chapter of the text, this package provides: an introduction to content and concepts, background information relevant to the content, and comprehensive answers to the questions posed. This section is followed by blackline masters of the textual diagrams.

Transparencies

In addition to the text and resource package, there is an excellent set of colour transparencies to accompany this program. If they are not in your school, check the text and supplemental lists from the Department of Education.

Additional Teacher Resource Text

Gabler, Sage and Wise. Essentials of Physical Geography. Toronto: Harcourt Brace College Publishers/Sanders College Publishing, 1994. Updated edition. ISBN 0-03-098237-5.

This should be a basic reference work for all Physical Geography 110 teachers.

Supplementary Teacher Resource Texts

Tarbuck and Lutgens. Earth Science. 5th ed. Toronto: 1988. ISBN 0-675-20748-7. 1:T

Robert W. Christophersen. Geosystems. An Introduction to Physical Geography. New York: Macmillan College Publishing Company, 1994. 2nd ed. 1:T

Joyce Lundberg and R.W. Christophersen. Periglacial Processes and Landforms. Soils of Canada. A Canadian supplement to Geosystems. An Introduction to Physical Geography. 1:T

John H. Corbet. Physical Geography Manual. Dubeque, Iowa; Kendall/Hunt Publishing Company, 1988. 2nd ed. (This book is not metricated but is full of useful exercises and ideas.) 1:T

Richard M. Busch. Laboratory Manual in Physical Geology. New York: Macmillan Publishing Company, 1990. 2nd ed. 1:T

Ruth Y. Lebow. Study Guide for Earth Revealed. Introductory Geology. Dubeque, Iowa; Kendall/Hunt Publishing Company, 1992. (This is an excellent companion to the video series "Earth Revealed" which is available from Instructional Resources.) 1:T

Margaret A. Oosterman and Mark T. Schmidt, eds. Earth Science Investigations. Alexandria, Virginia: Americal Geological Institute, 1990.

West's Great Ideas for Teaching Geology. St. Paul: West Publishing Company (610 Opperman Drive, PO Box 64526, St. Pau. MN USA 55164-0526), 1992.

Other Materials

In addition to the prescribed text, teacher's guide and transparencies correlated with the text, the following materials are suggested.

Suggested basic requirements:

- slide collections
- slide projector
- videos, VCR and TV
- films, filmstrips and projectors
- overhead projector
- class sets of topographic maps, including one set of local area
- class sets of air photos
- class set of stereoscopes
- class set of The Canadian Oxford School Atlas, latest edition
- class set of Geographic Understandings (or a similar skills text)
- globes, including a large chalkboard globe
- raised relief wall map of the world
- class set of map skills texts (e.g., The Canadian Landscape: Map and Air Photo Interpretation, 3rd edition).

If using a climatological emphasis, the following items would be useful.

- samples of weather maps from the local weather office
- weather instruments:
    - thermometers or thermograph hygrometers
    - barometers or recording barograph

If using a geomorphological emphasis, the following items would be useful.

- class set of compasses
- collection of rocks and minerals
- stream table
- geological hammer

Regardless of which emphasis is being followed, a set of Geoffrey Lean, Don Hinrickson and Adam Marklam. Atlas of the Environment. (New York: Prentice Hall Press, 1990) would prove useful.

Use of computer programs related to physical geography would be appropriate. These might include:

- Top Map. This program uses a gam format to enhance understanding of contours and topographic maps. Available from Smythe Computer Software, 3273 Whispering Pine Road, Burlington, Ontario, L7M 2R4.
- Sim Earth: The Living Planet. Run the Earth and see if you can make it work! Based on James Lovelock's Gaia Hyposthesis. Maxis and Mill Wright, 1990. Distributed by Broderbund.
- E-Z Cosmos. Future Trends Software Inc., 1601 Osprey Drive, Suite 102, Desoto, Texas, 75115, USA. (3.5 disks)
- Geoscope. CD-ROM. An interactive global change encyclopedia. LMSOFT Headquarters, 1280 Bernard Street West, Suite 401, Outremont, Quebec, H2V 1V9. Fax: (514) 948-0511.
- The Theory of Plate Tectronics. CD-ROM. Tasa Graphic Arts Inc., 15 Nexus Lane, Tijeras, New Mexico, 87059, USA.

The usefulness of the software is enhanced if one has access to a **dataprojector** (overhead projector for the computer). With this device, the whole class can view the computer screen and participate in computer-based lessons.

Course Content

It is recommended that all teachers complete the first three units. The remaining units relate to a climatological and geological emphasis wherin choices will have to be made.

Unit 1: The Nature of Physical Geography

Key Question for Study: What is distinctive about the physical geographer's perspective on the world and methods of study?

Text Reference: Planet Earth, Chapter 1, pp. 1-14.

Objectives

Students will be able to:

1. appreciate the scope and purpose of physical geography.
2. identify key concepts of the subject.

Content Outline

1. What is Physical Geography?
   a. The Earth as Support System for Human Life
   b. Physical Geography as a Natural and Social Science

2. How do we study the subject?
   a. Systems Approach
   b. Geologic versus Historic Time
   c. The Constantly Changing Environment of the Earth

Field Work and Local Studies Ideas:

1. Use your school grounds to find an example of inter-relationships and systems in physical geography. (See text pp. 8-9).

Audio-Visual Resources[1]: The "Earth Revealed" series of video tapes includes some which are useful in this unit.

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Down to Earth	VH	92	H	30	MAGI	704142	
Geologic Time	VH	92	H	30	MAGI	704151	

Other materials available from Instrucational Resources are listed later in this document.

[1] Audio-visual materials are, where possible, listed in standard Instructional Resources format.

Unit 2: The Earth in Space

Key Question for Study: What are the earth's relationships to the other parts of the universe?

Text Reference: Planet Earth, chapters 2-3, pp. 15-48. There is also a useful section on the sun in chapter 7, secion 1, p. 120. The previous text, Inch and Stone's The Physical Environment, chapters 1 and 2, also provides useful enrichment information.

Objectives

Students will be able to:

1. understand the structure and relationship of various parts of the universe.
2. understand the size of the universe
3. explain various theories for the origin of the universe including the Earth.
4. appreciate and discuss the uniqueness of Planet Earth within the Solar System.
5. explain the relationships between earth movements and (a) time and (b) seasons

Content Outline

1. Structure of the Universe and Earth's Location in the Universe
2. The Origin of the Universe
3. The Solar System
4. Earth Movements and the Measurement of Location and Time
   a. The Progression of the Seasons
   b. Time and Time Zones
   c. International Date Line

Field Work and Local Studies Ideas

1. Organize an evening "star show" with telescopes and local astronomy buffs.
2. Have student observe, record and explain the phases of the moon.
3. Have students observe and identify the brightest objects in the night sky.
4. Ask students to observe and explain the time and position of sunrise and sunset. Keep records and compare results over time.
5. Determine the local time of solar noon. Keep records and compare results over time.
6. Determine the local angular measurement of the location of the sun at solar noon. Keep records and explain the results.

Audio-Visual Resources: The "Earth Revealed" series of video tapes includes one which is useful in this unit.

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Restless Planet, The	VH	92	H	30	MAGI	704143	

Other materials available from Instructional Resources are listed later in this document.

Unit 3: Map, Photo and Satellite Image Interpretation

Key Questions for Study: What methods does the geographer use to portray and model the physical environment?

How does the geographer interpret the world through the use of maps, air photos and satellite imagery?

Text Reference: Planet Earth does not have sections covering these topics. The basic reference for this essential unit is, therefore, Walter G. Kemball, Geographic Understandings, pp. 1-104. If this is not available, a similar map and photo skills book, such as Geolab, may be substituted. Local topographic maps should also be used for some exercises.

Objectives

Students will :

1. be able to interpret topographic maps, air photos and satellite images.
2. be able to draw simple sketch maps.
3. be able to understand the capabilities of modern technologies such as remote sensing to gather geographic information.
4. be aware of the application of these resources in daily life and in a variety of careers.

Content Outline

Topographic Map and Air Photo Interpretation

1. Latitude and Longitude

2. Topographic Maps:
   a. Symbols
   b. Grid System (4 and 6 figure references)
   c. Latitude and Longitude (minutes and seconds)
   d. Direction and Bearings
   e. Scale and Distance
   f. Computing Area
   g. Methods of Depicting Relief
   h. Contours
   i. Profiling (including calculation of vertical exaggeration)
   j. Intervisibility
   k. Gradient
   l. Sketch mapping

3. Air Photos and Satellite Imagery
   a. determining scales
   b. scale and distance
   c. use of colour
   d. use of texture
   e. use of pattern
   f. stereo pairs
   g. photo maps

h. remote sensing

Field Work and Local Studies Ideas

1. Sketch map the classroom, school or adjacent area.
2. Conduct a simple survey of the area around the school.
3. Conduct an orienteering meet to practice the use of bearings.
4. Draw a sketch map of the route between home and school. Compare to a local topographic map.
5. Determine latitude and longitude of a given location to the nearest 5 seconds using a local topographic map.
6. Calculate the distance between home and school using a topographic map.

Climatological Emphasis

Unit 4C: The Atmosphere

Key Questions for Study: What is the composition and structure of earth's atmosphere?

How does the sun heat the earth and its atmosphere?

Text Reference: Planet Earth, chapter 7, pp. 118-130 and chapter 16, sections 1 and 2, pp. 324-336.

Objectives

Students will be able to:

1. understand how solar radiation heats the atmosphere.
2. describe the characteristics of the various layers of the atmosphere.
3. explain how the solar radiation balance is achieved.
4. account for variations in global climates through geologic time.
5. describe and explain how human activities influence the global heat balance. Explain the processes which produce these changes.

Content Outline

1. Characteristics of the Earth's Atmosphere
   a. Layering of the Atmosphere
   b. Changes in Composition Through Time
   c. Continuing Atmospheric Change
      Case Study: Ozone Depletion

2. Solar Radiation - The Power for Climatological Systems
   a. Solar Radiation Balance
   b. Links Between Composition of the Atmosphere and Solar Radiation Balance
      Case Study: Global Warming

Field Work and Local Studies

1. Place a piece of black cloth and a piece of white cloth on a snow covered area. Observe and explain the results.

Unit 5C: Climatology

Key Questions for Study: Why are there regional variations in weather and climate?

Has the earth's climate changed through time?

What are the possible causes of past changes in the earth's climate?

What climatic changes may occur in the future?

Text Reference: Planet Earth, chapter 8, pp. 133-167

Objectives

Students will be able to:

1. distinguish between climate and weather.
2. identify and explain the factors which control climate.
3. explain the location and production of microclimates.
4. explain regional and chronological variations in world climate.
5. demonstrate an understanding of the underlying principles of climate classification.
6. produce and interpret various types of climate graphs.

Content Outline

1. The Difference between Climate and Weather
2. Climate Controls
   a. Pressure and Wind Systems
   b. Ocean Currents
   c. Water and Land Influences
   d. Altitude
   e. Mountain Barriers
   f. Local Influences (microclimates)
3. Climatic Changes through Geologic Time
4. Developing a Classification of World Climate Patterns

Unit 6C: Meteorology

Key Questions for Study: Why do local conditions from day to day?

How are these changes recorded, analyzed and used to forecast future trends?

Text Reference: Planet Earth, chapter 9, pp. 168-194 and chapter 15, sections 3 and 4, pp. 309-312.

Objectives

Students will be able to:

1. explain variations in weather with an emphasis on the local scene.
2. read a weather map and make simple predictions.
3. understand the development and impact of storms.
4. collect and record meteorological information.

Content Outline

1. The Ingredients of Weather and Their Measurement
2. Development and Impact of Global Weather Systems
3. Collection and Mapping of Weather Data
4. Interpretation of Weather Maps
5. Weather Forecasting

Field Work and Local Studies

1. Arrange a visit to your nearest weather station.
2. Use local weather maps and statistics for exercises.

Teaching Activities

Source: Geolab3

Lab 20 - "Atmospheric Humidity" - p. 41.
Lab 21 - "Lapse Rates - Wet and Dry" - p. 42.
Lab 24 - "Weather Maps - Map 2" - p. 48.

Unit 7C: Natural Regions of the World

Key Questions for Study: How do the world's natural systems interact to produce a variety of natural habitats?

Text Reference: Planet Earth, chapters 10 and 11, pp. 195-239 and selected studies from chapter 17, pp. 344-365.

Objectives

Students will be able to:

1. describe and explain some of the interacting natural systems of the Earth.
2. demonstrate the interrelationships among soil, vegetation and climate.
3. account for the global patterns of natural vegetation and soil.
4. evaluate the impact of human activities on natural environments.
5. explain the concept of sustainable development and develop strategies for informed use of global resources.

Content Outline

1. Interacting Cycles in the Ecosphere
   a. Hydrologic Cycle
   b. Biochemical Cycle
2. Major World Vegetation Biomes
3. Soil Systems
   a. Components and Properties of Soils
   b. Soil Formation
   c. Principles of Soil Classification
   d. Distribution of Soils
4. Case Studies of Threatened Environments: Implications for the Future

Field Work and Local Studies

1. Use a soil testing kit.
2. Use a soil auger to observe soil profiles.
3. Examine local micro-environments, e.g., south facing slopes, frost hollows, bogs.

Teaching Activities

Source: Geolab 3 - Lab 40 - "Tropical Rainforests - Future Wastelands" - p. 88.

Geological Emphasis

Unit 4G: The Structure of the Earth

Key Questions for Study: What is the internal structure of the earth?

How was our knowledge of that structure obtained?

Text Reference: Planet Earth, chapter 4, pp. 50-65

Unit Objectives

Students will be able to:

1. explain the source and consequences of the Earth's internal heat.
2. explain how knowledge of the earth's internal structure has been obtained.
3. describe the internal structure of the earth's interior and its significance.

Content Outline

1. The Earth's Internal Heat
2. Characteristics of the Earth's Interior
3. Acquiring Knowledge of the Interior

Audio-Visual Resources: The "Earth Revealed" series of video tapes includes one which is useful in this unit.

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Restless Planet, The	VH	92	H	30	MAGI	704144	

Other materials available from Instructional Resources are listed later in this document.

Unit 5G: From Continental Drift to Plate Tectonics

Key Questions for Study: Why do scientists believe that the earth's crust is in constant motion?

How have these motions influenced the nature of the earth's surface?

Text Reference: Planet Earth, chapters 5 and 6, pp. 66-117 and chapter 15, sections 5 and 6, pp. 313-317.

Objectives

Students will be able to:

1. understand the origin and diversity of rocks.
2. identify major rock types.
3. describe and account for the ongoing evolution of the earth's crust.
4. describe and account for the distribution of earthquakes, volcanoes, major mountain chains and ocean trenches.
5. assess the effects of earthquakes and vulcanism.

Content Outline

1. The Rock Cycle and the Classification of Rocks[2]
2. History of Continental Drift and Evidence which Led to this Concept
3. Plate Tectonic Theory
4. Impact of Plate Tectonics on Our Understanding of the Earth
   a. Plate Tectonics, Tectonic Processes and the Creation of Mountains and Ocean Trenches
   b. Disasters Caused by Plate Movements: Volcanoes and Earthquakes - Case Studies

Field Work and Local Studies

When possible, students should be given the opportunity to observe in the field the features they are studying in the classroom. For example, local rock structures and types could be examined. Local geological maps could also be analyzed in association with these observations.

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[2] Some teachers, particularly those working in an area with mining activity, may wish to supplement this unit with consideration of the impact of mining and the importance of mineral resources:

Rocks and Minerals

1. The Variety of Earth Materials
2. The Differences among Rocks and How these Differences Affect Their Utility
3. The Formation of Rocks and Minerals
4. The Formation of Deposits of Useful Mineral Resources
5. Mining Techniques for Different Types of Deposits
6. Consequences of Mining: Products versus the Environment

Teaching Activities

1. Geolab 3 - Lab 2, p. 6 - "South America - Plates Together"
2. The Canadian Landscape - "Koko Head, Hawaii" - p. 145, questions 1-4.

Audio-Visual Resources: The "Earth Revealed" series of video tapes includes many which are useful in this unit.

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Earth Structures	VH	92	H	30	MAGI	704144	
Sea Floor, The	VH	92	H	30	MAGI	704145	
Birth of a Theory, The	VH	92	H	30	MAGI	704146	
Plate Dynamics	VH	92	H	30	MAGI	704147	
Mountain Building	VH	92	H	30	MAGI	704148	
Earthquakes	VH	92	H	30	MAGI	704150	
Minerals: The Materials of Earth	VH	92	H	30	MAGI	704153	
Volcanism	VH	92	H	30	MAGI	704154	
Intrusive Igneous Rocks	VH	92	H	30	MAGI	704155	
Sedimentary Rocks: The Key to Past Environments	VH	92	H	30	MAGI	704158	
Metamorphic Rock	VH	92	H	30	MAGI	704159	
Living With Earth, Part 1	VH	92	H	30	MAGI	704166	
Living With Earth, Part 2	VH	92	H	30	MAGI	704167	

Other materials available from Instructional Resources are listed later in this document.

Unit 6G: Shaping the Land

Key Questions for Study: How has the earth's surface been modified by weathering, erosion and deposition?

How has the local landscape evolved?

Text Reference: Planet Earth, chapters 12, 13 and 14, pp. 240 - 300.

Objectives

Students will be able to:

1. identify, describe and explain the processes which shape the earth's surface.
2. demonstrate how these processes create specific landforms.
3. identify specific landforms on topographic maps and air photos.
4. identify and explain the origin of selected local landforms.

Content Outline[3]

1. Weathering and Mass Wasting
2. The Hydrologic Cycle and the Work of Running Water
3. Ground Water and Karst Landscapes
4. Ice Ages and the Work of Continental and Alpine Glaciers
5. Coastal Processes and Landforms
6. Arid Landscapes and Aeolian Landforms

Field Work and Local Studies

Field work SHOULD be organized in the local area.

1. See Appendix B on GeoEducation New Brunswick for a list of resource persons around the province.

2. Inspect your school for examples of weathering.

3. Conduct a gravestone survey and use death dates to compare the rate of weathering on various headstones. Be sure to take variations in rock type into account.

Teaching Activities

Local map studies should be conducted using local area topographic maps. Other studies can be found in Chevrier and Aitkens, Topographic Map and Air Photo Interpretation, if it is still available in your school. The table of contents and index of landforms/features mapped will identify particular landscapes of interest. Those listed below are particularly useful.

Bathurst, p. 99 - coastlines
Charlottetown, p. 89 - coastlines

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3 It is unlikely that all the content listed can be included. It is expected that teachers will make choices appropriate to the landscape of the local area.

Keswick, p. 48 - glacial landscapes
Wensleydale, p. 50 - Karst topography
Thompson Glacier, p. 50 - glacial landscapes
Death Valley, California, p. 68 - arid landscapes
Harrisburg, Pennsylvania, p. 75 - drainage patterns and fold mountains
Kicking Horse Pass, p. 32 - glacial landforms
Erik Harbour, p. 40 - glacial landforms

See also The Canadian Landscape. The 2nd edition has some good exercises on similar themes.

For obvious reasons of time, not all of these studies could be completed. Appropriate selections will have to be made.

Audio-Visual Resources: The "Earth Revealed" series of video tapes includes many which are useful in this unit.

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Weathering and Soils	VH	92	H	30	MAGI	704156	
Mass Wasting	VH	92	H	30	MAGI	704157	
Running Water 1: Rivers, Erosion and Deposition	VH	92	H	30	MAGI	704160	
Running Water 2: Landform Evolution	VH	92	H	30	MAGI	704161	
Groundwater	VH	92	H	30	MAGI	704162	
Wind, Dust and Deserts	VH	92	H	30	MAGI	704163	
Glaciers	VH	92	H	30	MAGI	704164	
Waves, Beaches and Coasts	VH	92	H	30	MAGI	704165	

Other materials are available from Instructional Resources are listed later in this document.

Audio-Visual Listings from Instructional Resources

EARTH REVEALED SERIES*

Title	Md	Yr	Aud	Mn	Code	Dstr	St Of
Down to Earth	VH	92	H	30	MAGI	704142	
Restless Planet, The	VH	92	H	30	MAGI	704143	
Earth's Interior	VH	92	H	30	MAGI	704144	
Sea Floor, The	VH	92	H	30	MAGI	704145	
Birth of a Theory, The	VH	92	H	30	MAGI	704146	
Plate Dynamics	VH	92	H	30	MAGI	704147	
Mountain Building	VH	92	H	30	MAGI	704148	
Earth Structures	VH	92	H	30	MAGI	704149	
Earthquakes	VH	92	H	30	MAGI	704150	
Geologic Time	VH	92	H	30	MAGI	704151	
Evolution Through Time	VH	92	H	30	MAGI	704152	
Minerals: The Materials of Earth	VH	92	H	30	MAGI	704153	
Volcanism	VH	92	H	30	MAGI	704154	
Intrusive Igneous Rocks	VH	92	H	30	MAGI	704155	
Weathering and Soils	VH	92	H	30	MAGI	704156	
Mass Wasting	VH	92	H	30	MAGI	704157	
Sedimentary Rocks: The Key to Past Environments	VH	92	H	30	MAGI	704158	
Metamorphic Rocks	VH	92	H	30	MAGI	704159	
Running Water 1: Rivers, Erosion and Deposition	VH	92	H	30	MAGI	704160	
Running Water 2: Landform Evolution	VH	92	H	30	MAGI	704161	
Groundwater	VH	92	H	30	MAGI	704162	
Wind, Dust and Deserts	VH	92	H	30	MAGI	704163	
Glaciers	VH	92	H	30	MAGI	704164	
Waves, Beaches and Coasts	VH	92	H	30	MAGI	704165	
Living With Earth, Part 1	VH	92	H	30	MAGI	704166	
Living With Earth, Part 2	VH	92	H	30	MAGI	704167	

* Permission to duplicate is available for many of the titles in this series. Check with Instructional Resources.

GEOGRAPHY TUTOR SERIES

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Map and Globe Terms	VH		H	20	THA	704115	
Types of Maps and Map Projection	VH		H	20	THA	704116	
Map Skills	VH		H	20	THA	704117	
Earth's Physical Features	VH		H	20	THA	704118	
Weather and Climate	VH		H	20	THA	704119	
Global Problems	VH		H	20	THA	704120	

WEATHER

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Above the Horizon	16	65	EJH	21	NFB	202265	
Atmosphere in Motion	16	73	JH	20	VEC	203388	
Climate Puzzle: Climate - Past, Present, Future	VHVB	88	JH	29	MAGI	702925	
Earth Science: Geology and Meteorology	LV	85	HUA		OD	460016	
In One Day (Fr. 210796)	16	67	EJH	18	NFB	202927	
Storms: The Restless Atmosphere	16	74	JHU	22	EBF	203213	
What Makes Clouds?	16	65	JHU	19	EBF	202544	
What Makes Rain? (Revised)	16	75	HU	22	EBF	203400	
What Makes the Wind Blow?	16	65	JHU	16	EBF	202543	

GEOLOGY

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Soil: An Introduction (2nd ed.)	VH	91	PEJ	12	BFA	703802	
Restless Earth (MacIntosh)	LV	92	EJH		NATG	460049	
Evolving Earth, The	VHVB	81	JHU	75	NFB	703206	
Blue Planet: Physical/Chemical Make-up	VHVB	88	JH	29	MAGI	702922	
Continents Adrift	16	77	JHU	15	CANL	203427	
Earth, The: Action of Rivers	16	70	JH	10	CORO	102153	
Earth: The Restless Planet	16	73	JHY	26	NATG	203115	
Earthquake: A Lesson in Disaster	16	71	JHU	13	VEC	203383	

GEOLOGY *(cont'd)*

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Earthquakes and Volcanoes (Revised)	16	77	EJH	13	BFA	201157	
Earthquakes in Canada (Fr. 710770)	VHVB	87	JH	15	EMRC	701514	
Five Billion Years	VHVB	81	EJH	7	NFB	700982	
Geological Survey of Canada (Fr. 71076)	VHVB	87	JH	12	EMRC	701510	
Glaciation	MM	68	JHA		NFB	500119	
Glaciation (Fr. 210602)	16	65	JH	14	NFB	202212	
Ground Water - The Hidden Reservoir	16	71	JHU	18	WILE	202809	
Heimaey Eruption	16	74	JHU	28	WATE	202993	
Lithoprobe (Fr. 710765)	VHVB	86	JH	7	EMRC	701511	
Living Machine: Continental Tectonics	VHVB	88	JH	29	MAGI	702921	
Living Machine: Plate Tectonics	VHVB	88	JH	30	MAGI	702920	
Living Ocean	VH	88	JHA	25	NATG	702614	
Oceanography: A Voyage of Discovery	16	70	EJH	20	UEVA	202718	
Our Dynamic Earth	16	79	JHA	23	NATG	203426	
Recent Ice Age, The	VHVB	90	HUA	26	AIM	702555	
Rise and Fall of the Great Lakes	VB	69	JH	17	NFB	700645	WE
River Landforms and Catchment Management	VH	87	JH	23	C-V1	702201	
Rivers at Work	16	70	JH	20	CARM	202890	
Rocks and Minerals	VHVB	77	EJH	16	VEC	701239	
Rocks that Form on the Earth's Surface	VHVB	64	JHU	16	MARL	701283	
Rocks that Originate Underground	VHVB	66	HU	23	MARL	701284	
Season of Fire	16	73	JHU	15	MARL	203235	
This Land	VHVB		JH	41	SHEL	700163	
Time, Lines and Events	16	65	H	19	CHUR	202224	
Treasures of the Earth	16	74	J	15	CHUR	203065	
Understanding Our Earth: Glaciers	16	77	EJH	11	CORO	102254	
Understanding Our Earth: How Its Surface Changes	16	77	EJH	12	CORO	102253	
Understanding Our Earth: Soil	16	77	EJH	12	CORO	102252	
Volcanoe: The Birth of A Mountain	16	79	JHA	24	VEC	203379	

MAP INTERPRETATION

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Surveys, Mapping and Remote Sensing Sector	VHVB	92	HUA	19	EMRC	703587	
Geoscience Mapping (Fr. 711449)	VHVB	91	HUA	5	EMRC	703321	
Contour Connection, The	VHVB	83	H	28	NFB	700646	
Exploring the World of Maps	MM	73	EJ		NATG	500199	
Map Projections in the Computer Age	16	78	JH	11	CORO	102286	
Mapping Canada: Astrolabs to Lasers	VHVB	86	JH	11	EMRC	701516	
Remote Sensing	VHVB	83	H	25	NSDE	700885	
To Make a Map	VHVB	77	JH	21	NFB	700739	
To Make a Map	16	77	JH	21	NFB	203327	

SPACE

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Asteroids, Comets and Meteorites	16	60	E	11	FILM	101733	
Big Bang and Beyond	VH	86	H	26	FFHS	702728	
Birth and Death of a Star	VB	71	JH	35	MARL	700320	
Comet Halley Returns	VB	85	EJH	15	CANL	700733	
Earth Science: Astronomy	LV	85	HUA		OD	460017	
Earth Science: Sun and Universe	LV	85	HUA		OD	460018	
Impact Earth	VHVB	88	JHA	30	CANL	701740	
Moon, The: A Giant Step in Geology	16	75	JH	24	VEC	203380	
Our Universe	VH	87	JH	18	C-V1	702200	
Planets of the Sun	16	74	EJH	9	MCI	102213	
Planets, The	LV	87	JH		NATG	460010	
Solar System	VHVB	78	JH	18	MARL	701285	
Solar System, The	16	78	JH	18	VEC	203381	
Space Science: Comets, Meteors, and Asteroids	VHVB	86	EJH	12	CORO	701631	
Space Science: Planets	VHVB	86	EJH	24	CORO	701630	
Space Stations: Scientific Uses, International Cooperation	VH	87	H	26	CANL	702769	
Space Stations: Yesterday's Dreams, To	VH	87	H	26	CANL	702768	
Space: Beyond Tomorrow	16	74	JHU	21	MCI	203012	

SPACE

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Sun, The: Earth's Star	VB	80	JH	20	NATG	701570	
Sun, The: Power for Our Solar System	VB	82	JH	46	CTRH	700269	
UFO's Are Real	VHVB	79	HUA	90	FOTO	700475	
Universe	VHVB	76	JHU	28	NASA	700443	
Universe (Fr. 210634)	16	60	JH	30	NFB	201559	
Universe, The: Beyond the Solar System	16	78	JH	18	VEC	203382	

ECOLOGY

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Rainforest: A Report from Costa Rica	VH		JH	26	DUCH	703766	
Global Warming: Slowing Global Warming	VH	89	JH	25	NVME	703643	
Habitat Turned Hothouse	VH	89	JHU	22	VEC	703619	
Amazing Vanishing Ozone, The	VH	89	JHU	22	VEC	703618	
Storm of Acid Snow, The	VH	89	JHU	22	VEC	703617	
How Fragile These Frozen Seas	VH	89	JHU	24	VEC	703616	
Our Environment	MI	90	JH		PERC	900060	
Acid Rain	VH	87	JHU	49	SCHO	701816	
Acid Rain: Requiem or Recovery	VHVB	81	HUA	27	NFB	700644	
Amazonia: Road to the End of the Forest	VH	89	H	97	CBC	702610	
Earth Science, Atmosphere	VHVB	77	JHU	15	NSDE	700110	
Earth Science: Earth Measurement	VHVB	77	JHU	15	NSDE	700109	
Earth Science: The Changing Earth	VHVB	77	JHU	15	NSDE	700108	
Earth Science: Water	VHVB	77	JHU	15	NSDE	700111	
Earth: Danger in the Air	VH	88	HUA	20	THA	702649	
Earth: Fragile Soil, The	VH	88	HUA	20	THA	702650	
Earth: Saving the Planet	VH	88	HUA	20	THA	702651	
Fate of the Earth: Impact of Man	VHVB	88	JH	29	MAGI	702933	
Gulf Stream	VHVB	80	JHU	28	NFB	700734	
Only One Atmosphere	VH	90	HUA	60	MAGI	702565	
Planet for the Taking, A (series)		85	HUA		CBC	S00265	
Race to Save the Planet (series)		90	HUA		MAGI	S00387	

ENVIRONMENTAL SCIENCE

Title	Md	Yr	Aud	Mn	Dstr	Code	St Of
Preserving Our Global Environment	VH		H			661213	g
Global Warming: Hot Times Ahead	VH		J,H			661150	g
Losing The Earth: Land Abuse & Soil Erosion	BK		J,H			661145	g
Our Endangered Atmosphere: Global Warming and Ozone Layer	BK		H			661144	g
Rainforest: Land Use Options For Amazonia	KT		H			661009	g
The State of the Earth Atlas	KT		J,H			661008	g
Climate Control: Can We Do It?	VH		J,H			660995	g
Rainforests: Proving Their Worth	VH		J,H			660955	g
Spaceship Earth: The Global Environment	VH		J,H			660942	g
Earth: The Changing Environment	VH		J,H			660941	g

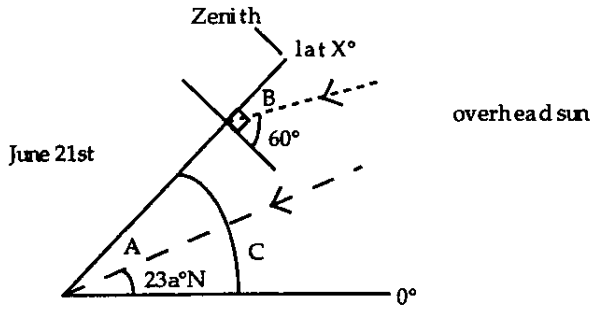
Appendices

Appendix A

Lesson Plans and Ideas

Plan 1

Calculation of Latitude if the Angle of the Midday Sun is Known



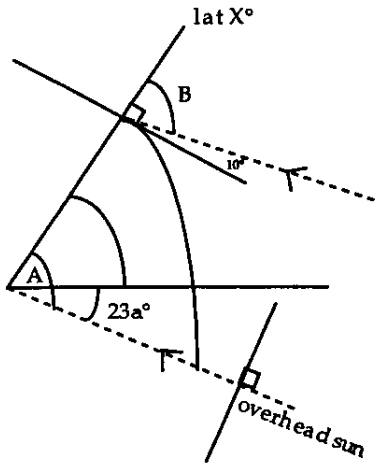
1. What is the latitude of place X if the angle of the sun at noon is 60° and the date is June 21st (northern hemisphere)?

   In the diagram angles A and B are like angles and equal 30°(60°+angle B=90°) so angle C=30°+ 23 1/2°=53 1/2°.

   The latitude of X is therefore 53 1/2°.

In a simple formula, latitude of X-90°-a°+latitude of overhead sun (when a°=observed angle of noonday sun and the sun is overhead in the same hemisphere),
e.g., 90°-60°+23 1/2°=53 1/2°.

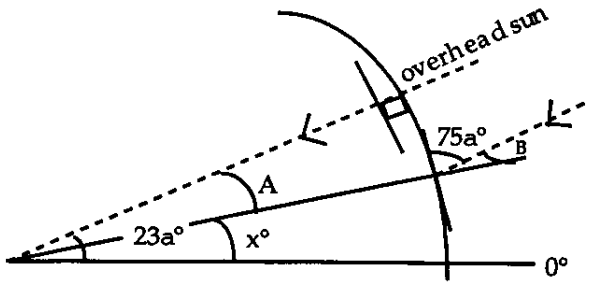
2. What is the latitude of place X if the angle of the sun at noon is 10° and the date is December 21st (northern hemisphere)?



In the diagram angles A and B are equal (like angles) but angle B + 10° = 90°, therefore angle B = 90° - 1°= 80°. Angle A also = 80° and so latitude X = 80° - 23 1/2° = 56 1/2° so latitude X is 56 1/2°N.

In a simple formula, latitude of X = 90° - a° - latitude of overhead sun (where a° is the observed angle of the sun and the sun is overhead in the opposite hemisphere).

3. What is the latitude of place X (in the northern hemisphere) if the angle of the sun in 75 1/2° and the date is June 21st?



In the tropics, the remaining formulae apply <u>except</u> for the days when the sun is seen on the poleward side of the observer.

In the diagram, angles A and B are like angles and are equal. Angle B ,75 1/2° = 90° so angle B = 90° - 75 1/2° = 14 1/2 °.
If angle A = 14 1/2°, angle X°)the latitude of place X° is 23 1/2° - 14 1/2° = 9° and <u>the latitude of X is 9°N</u>.

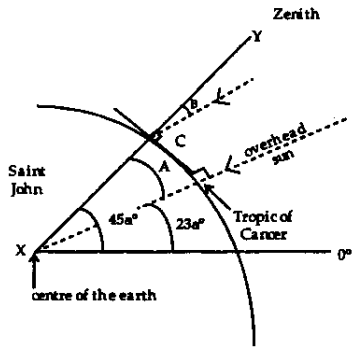
In a simple formula, when the sun is on the poleward side of an observer, the latitude will be <u>latitude of overhead sun - (90° - a°)</u> (when a° = the observed angle of the sun at midday).

Plan 2

Calculation of the Angle of the Midday Sun from a Known Latitude

June 21st

1. What is the angle of the sun at midday on June 21st at Saint John, N.B. (45 1/2°N)?

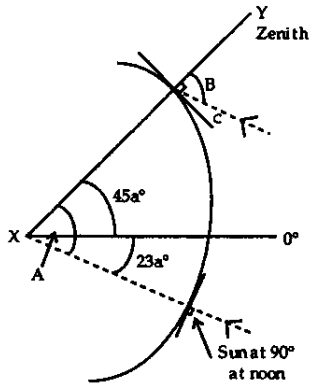


In the diagram, angle A and angle B are like angles and equal 45 1/2° - 23 1/2° = 22°.

The line X-Y forms a right angle to the horizon at Saint John, therefore, angle C = 90° - 22° = 68° at solar noon on June 21st. Thus, when the sun is directly overhead at the Tropic of Cancer, its parallel rays form an angle of 60° at noon in Saint John.

A simple formula can be derived from this example. When the sun is overhead in the same hemisphere as the observer, and when the observer is not located in the tropics, the angle of the midday sun equals 90° - latitude of the observer ¸latitude where the sun is overhead, e.g., for Saint John on June 21st, 90° - 45 1/2° + 23 1/2° = 68°.

2. What is the angle of the midday sun at Saint John (45 1/2°N) on December 21st?



In the December 21st diagram, line X-Y is at right angles to the horizon at Saint John while angles A and B are like angles and queal 45 1/2° + 23 1/2° = 69°. Angle C therefore = 90° - 69° = 21° and, therefore, the angle of the noon sun at Saint John is 21° on that day.

This can also be calculated from the formula angle of noon sun = 90° - latitude - latitude of

overhead sun where the sun is overhead in the opposite hemisphere from the observer and the observer is not in the tropics, e.g., for Saint John, 90° - 45 1/2° - 23 1/2° = 21°.

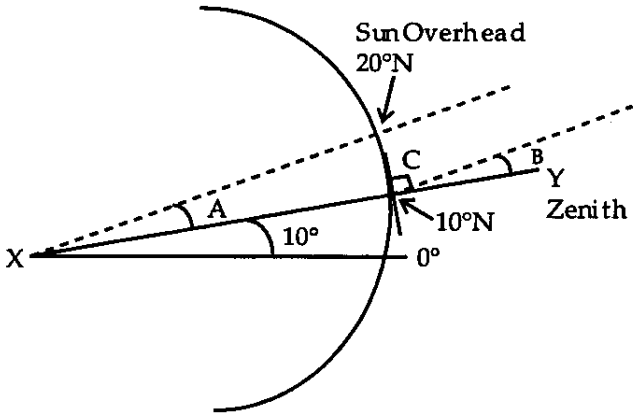
Thus, the angle of the sun in the sky at noon can easily be worked out for any day and for any latitude outside the tropics from the formula

90° - latitude - latitude of overhead sun.

The latitude of the overhead sun can be obtained from a set of tables or from page 25 of Inch and Stone, The Physical Environment.

3. What is the angle of the midday sun at 10° when the sun is overhead at 20°N?

In the tropics, the normal formulae apply except for the days when the sun is overhead at places on the poleward side of the observer, i.e., if the sun is overhead at a location in the same hemisphere as the observer but at a location further away from the equator than the observer.



In the diagram, line X-Y is at right angles to the horizon at 10°N, angles A and B are like angles and angle A = 20° - 10° = 10°; therefore, angle C = 90° - 10° = 80° and the sun is 80° above the horizon at 10°N.

Again, a simple formula can be derived. In these situations, the angle of the noonday sun is 90° - latitude of overhead sun + latitude of observer or 90° - 20° + 10° = 80°.

Exercise to Accompany Plans 1 and 2

1. Value 7. What is the angle of the sun in the sky at midday if the date is October 20th and you are at the following locations?

   a) 60°N b) 45°N c) 15°N d) 30°S
   e) 70°S f) 10°S g) 5°S

2. a) Value 1. What is the angle of the sun at midday at 30°N on March 6th?

   b) Value 2. What is the latitude if the sun is at 65° above the southern horizon on April 6th? (Northern Hemisphere)?

   c) Value 1. What is the angle of the sun at 70°N on December 13th at midday?

   d) Value 2. What is th angle of the sun at midday at 10°N?

      i) on June 13th ii) January 25th

   e) i) Value 1. What is the latitude if the sun is 81° above the northern horizon on June 13th (northern hemisphere)?

      ii) Value 1. Where else in the world will the sun be 81° above the horizon on that day? (latitude)

3. Value 10. What is: a) the highest possible angle in the sky for the midday sun
   b) the lowest possible angle in the sky for the midday sun at
   a) 45°N b) 66 1/2°N c) 90°N d) 23 1/2°N e) 0°?

4. Value 2. What <u>two</u> places in the world have the sun at 30° above the horizon at midday on June 21st? (Answer in latitudes).

Total Value = 26

<u>Answers:</u>

1. a) 20° b) 35° c) 65° d) 50° e) 30° f) 90° g) 85°

2. a) 54° b] 31°N c) -3° d) i) 77° ii) 61° e) i) 14°N ii) 32°N

3. a) high 68.5° low 21.5° b) high 47° low 0° c) high +23 1/2° low -23 1/2°
   d) high 90° low 43° e) high 90° low 66.5°

4. 83.5°N and 36.5°S

Plan 3

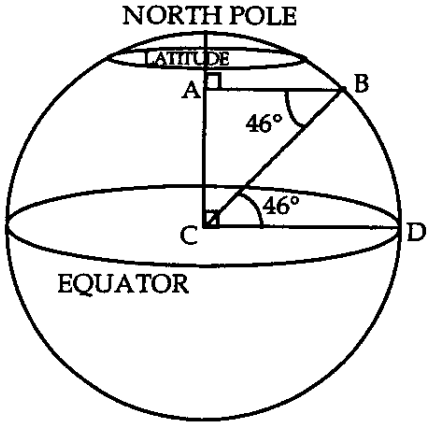
To Determine the Velocity of Earth Rotation at Your Latitude

Assume:
1. The Earth is a sphere (not an oblate sphere).
2. The circumference of Earth to be 40,000 km.

Resources:

1. Local topographic map - to determine local latitude (or use exercise to determine latitude if the angle of the midday sun is known).
2. Calculator with trig. function

Example - for latitude 46°N



Circumference of Sphere (C) = $2\pi r$; therefore radius of sphere ® = $C/2\pi$

If the circumference of Earth = 40,000 km, then radius (CD) = $40,000/2\pi$ km = 6366 km

AB is the radius for latitude 46°N

Cosine angle ABC = AB/BC; therefore AB = Cos angle ABC x AB

Angle ABC = Angle BCD (Alternate angles)

Therefore, AB = Cos 46 x 6366 km = 4422 km

Circumference at 46°N latitude = $2\pi r$ (where r = AB = 4422 km)

C(46°) = 4422 x 2π = 27, 785 km

Time for Earth's rotation = 24 hours.

Velocity = Distance/time

Therefore, velocity of point on latitude 46°N = 27, 785/24 kph = 1157.7 kph

Note: Angle ABC and angle BCD are alternate angles and will always be equal whatever the latitude. Thus two formulae are derived.

1. The length of the radius of any line of latitude is cosine latitude x radius of the Earth and the length of a line of latitude = 2π (cosine latitude x 6366).
2. The speed of rotation of any location on Earth = 2π (cosine latitude x 6366)/24 kph.

Exercises: Use the formulae to calculate the length of the latitude line and speed of rotation at:

Latitude	23 1/2°	(36681 km; 1528 kph)
Latitude	66 1/2°	(15949 km; 665 kph)
Latitude	89°	(698 km; 29 kph)

PLAN 4

Fredericton's Climate

Exercise:

Plot a circle graph to show the normal conditions of temperature, precipitation, sunshine, and wind direction.

Materials:

Annual Meteorological Summary, Fredericton, NB (attached); circle graph grid (attached)

Instructions:

Produce a neat, clear graph.
Colour may be used.
Indicate all scales.
Give the diagram a title.

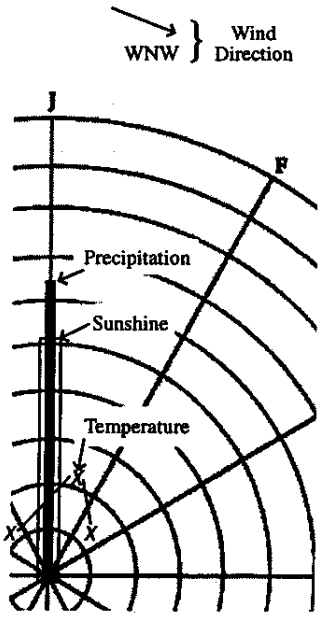
1. Temperature - Plot as a line graph.
   Plot value at mid-month position.
   x in mid-month position
   Make each division = 5°C. Assume the centre to be -20°C.

2. Precipitation - Plot as a bar graph.
   Make each division = 10 mm. Assume the centre to be 40 mm.

3. Sunshine - Plot as a bar graph.
   Make each division = 25 hours. Assume the centre to be 0 hours.

4. Wind Direction - Indicate at margin for month.

5. Describe and account for the patterns shown on the graph.



ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL
for/pour FREDERICTON (A), N.B. YEAR/ANNÉE 1984

METEOROLOGICAL DATA FOR THE YEAR/DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

NOTE: The following units are used throughout this summary -
Temperature: Degrees and tenths Celcius (°C)
Degree Day: Difference of Daily Mean Temperature from 18.0°C
Rain: Millimetres and tenths (mm)
Snow: Centimetres and tenths)cm)
Total Precipitation: Millimetres and tenths (mm)
Wind Speed: Kilometres per hour (km/h)
Wind Direction: Direction (true north) from which the wind is blowing.
Barometric Pressure: Kilopascals and hundredths (kPa)
Sunshine: Hours and tenths of bright sunshine.

AVIS: Unités Utilisées -
Température: Degrés et dixième Celsius (°C)
Degré Jour: Différence entre la température moyenne du jour et 18.0°C
Pluie: Millimetres et dixièmes (mm)
Neige: Centimetres et dixièmes (cm)
Précipitation Totale: Millimetres et dixièmes (mm)
Vitesse du vent: Kilomètres par heur (km/h)
Direction du vent: Direction (nord géographique) d'ou le vent souffle.
Pression Barométrique: Kilopascals et centièmes (kPa)
Insolation: Nombre d'heures et dixièmes d'insolation efffective

MONTH MOIS	TEMPERATURE/TEMPÉRATURE										DEGREE DAYS DEGRÉS JOURS	
	MEAN/MOYENNE			NORMAL/NORMALE			EXTREME/ÉXTRÈME					
	Maximum	Minimum	Monthly Mensuelles	Maximum	Minimum	Mean Moyennes	Maximum	Date	Minimum	Date	Below 18.0°C Au Dessous de 18.0°C	Normal Normale
JAN/JAN	-5.4	-16.3	-10.9	-3.8	-14.5	-9.2	4.9	25	-32.2	22	894.8	842.7
FEB/FÉV	1.4	-8.0	-3.3	-2.5	-14.2	-8.4	10.4	23	-24.6	10	618.7	745.2
MAR/MAR	-0.2	-10.0	-5.1	2.7	-7.5	-2.4	9.3	22	-27.1	9	717.1	633.0
APR/AVR	9.6	-1.6	4.0	9.4	-1.3	4.1	23.6	30	-6.3	2, 9	417.8	419.1
MAY/MAI	16.9	4.7	10.8	17.1	4.4	10.8	25.9	26	-2.1	7	222.2	229.0
JUN/JUIN	21.8	9.9	15.9	22.7	9.6	16.2	34.9	9	1.1	24	89.2	78.9
JUL/JUIL	26.1	13.9	20.0	25.7	13.0	19.3	32.7	2	8.3	26	8.1	20.3
AUG/AOÛT	26.2	14.3	20.3	24.6	11.9	18.2	33.4	5	6.8	26	14.0	37.0
SEPT/SEP	19.1	5.5	12.3	19.5	6.9	13.2	27.5	9	0.0	17, 22	172.2	153.0
OCT/OCT	13.8	1.3	7.6	13.1	1.9	7.5	20.0	11	-4.2	31	323.5	326.1
NOV/NOV	7.4	-2.4	2.5	5.9	-3.1	1.4	16.8	12	-10.8	9	463.8	497.5
DEC/DÉC	0.0	-10.8	-5.4	-1.5	-11.3	-6.5	9.2	17	-24.0	27	724.8	758.0
YEAR/ ANNÉE	11.4	0.0	5.7	11.1	-0.4	5.4	34.9	Jun/Juin 9	-32.2	Jan/Jan 22	4666.2	4739.8

PRECIPITATION/PRÉCIPITATIONS

MONTH MOIS	MONTHLY/MENSUELLES			NORMAL/NORMALE			EXTREME/EXTRÈME							
							RAIN/PLUIE				SNOW/NEIGE			
	Rainfall Hauteur De Pluie	Snowfall Hauteur De Neige	Total	Rainfall Hauteur De Pluie	Snowfall Hauteur De Neige	Total	6 Hrs	Date	24 HRS	Date	6 Hrs	Date	24 HRS	Date
JAN/JAN	16.4	108.6	108.7	40.7	63.9	103.3	3.8	24	7.4	7	14.2	31	32.0	31
FEB/FÉV	81.7	42.0	133.0	28.6	63.2	89.7	14.0	15	29.6	4	13.0	26	21.0	26
MAR/MAR	40.3	98.8	158.2	34.5	48.7	84.7	10.8	17	18.8	17	22.0	14	53.8	14
APR/AVR	101.8	14.3	115.5	57.4	21.5	79.9	21.2	16	37.4	16	5.0	21	5.4	8
MAY/MAI	127.9		127.9	82.1	1.1	83.1	11.0	29	27.0	29				
JUN/JUIN	166.1		166.1	85.0		85.0	15.4	26	45.9	26				
JUL/JUIL	141.0		141.0	88.8		88.8	19.4	5	30.4	5				
AUG/AOÛT	110.9		110.9	87.0		87.0	37.6	16	37.6	16				
SEPT/SEP	42.7		42.7	86.8		86.8	12.0	11	14.3	11				
OCT/OCT	39.2	TR	39.2	94.7	2.3	97.1	9.4	12	13.6	2	TR	5	TR	5
NOV/NOV	33.8	8.0	41.3	85.9	20.4	106.1	9.6	12	10.2	12	6.2	14	6.8	14
DEC/DÉC	32.0	61.2	103.9	53.0	69.3	117.8	11.0	10	18.4	6	11.4	6	11.8	6
YEAR ANNÉE	933.8	332.9	1288.4	824.5	290.4	1109.8	37.6	A 16	45.9	Jun 26	22.0	Mar 14	53.8	Mar 14

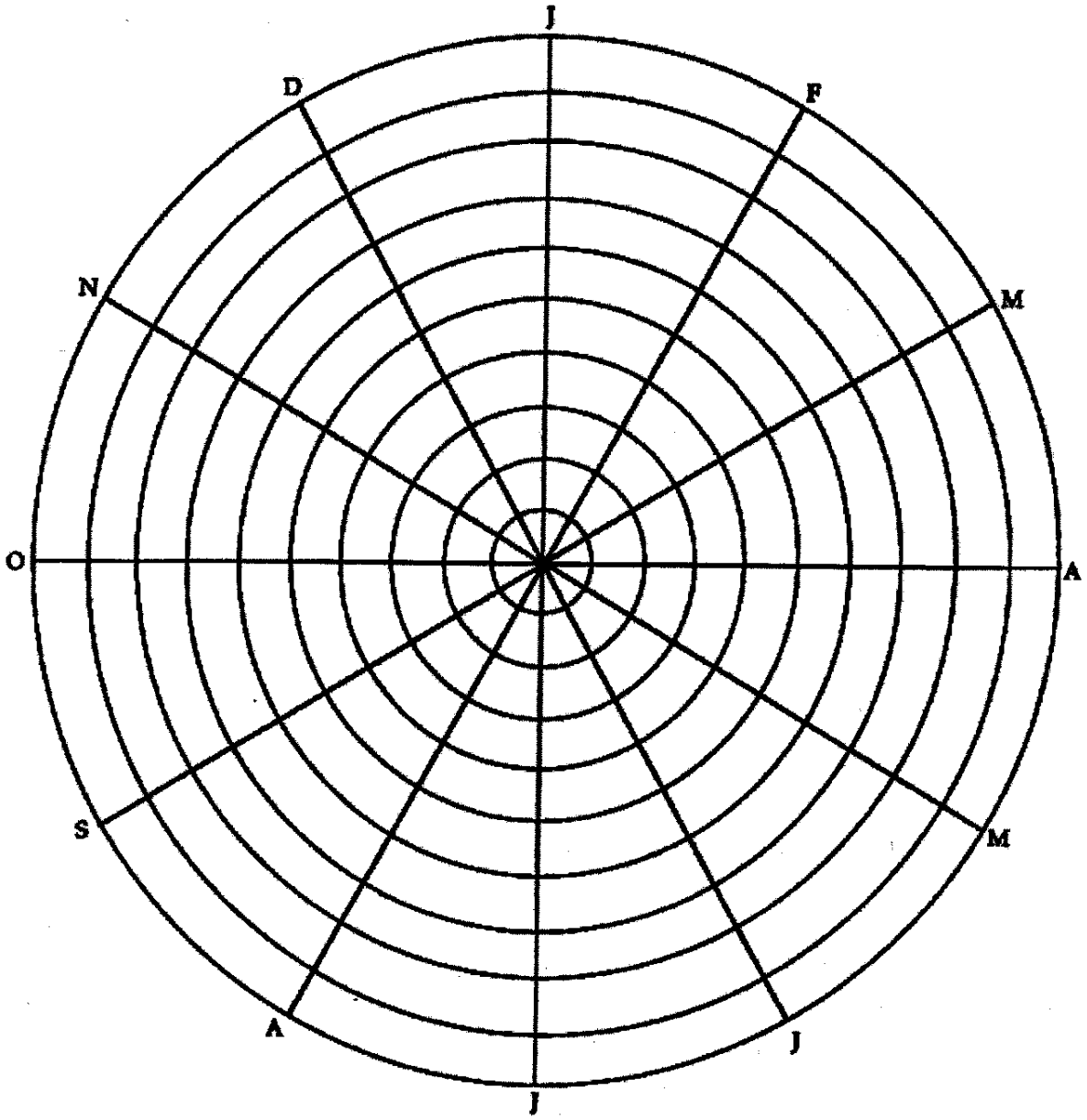
ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL
for/pour FREDERICTON (A), N.B. YEAR/ANNÉE 1984

METEOROLOGICAL DATA FOR THE YEAR/DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

MONTH MOIS	SUNSHINE/INSOLATION				WIND/VENT							
							NORMAL NORMALE		MAX FOR 1 MIN MAX POUR 1 MIN		HIGHEST GUST RAFALE MAXIMUM	
	DURATION IN HOURS DURÉE (NOMBRE D'HEURES)	PERCENTAGE OF POSSIBLE POURCENTAGE DU TOTAL POSSIBLE	NO. OF DAYS WITHOUT SUNSHINE NOMBRE DE JOURS SANS SOLEIL	NORMAL NORMALE	AVERAGE SPEED VITESSE MOYENNE	PREVAILING DIRECTION DIRECTION DOMINANTE	SPEED VITESSE	DIRECTION	DIRECTION AND SPEED DIRECTION ET VITESSE	DATE	DIRECTION AND SPEED DIRECTION ET VITESSE	DATE
JAN/JAN	101.7	36	10	106.6	8.4	W	14.6	WNW	NNE 44	31	W 72	26
FEB/FÉV	99.5	33	9	123.7	11.6	WNW	14.8	WNW	ENE 37	28, 29	WNW 57	9
MAR/MAR	141.1	38	9	140.4	17.1	W	16.0	WNW	NE 52	30	NNE 82	30
APR/AVR	151.0	37	11	154.0	16.2	NNE	14.8	WNW	NNE 43 S 37 NNE 37 NE 37 S 37	9	NNE 67	12
MAY/MAI	188.3	41	6	200.3	15.0	S	14.7	SSW	SSW, W 37	Svrl	W 63 NE	26
JUN/JUIN	213.0	45	7	205.9	13.3	SSW	13.6	SSW	SSW 33	18	56 WSW	2, 9
JUL/JUIL	243.4	51	3	232.9	11.9	SSW	12.3	SSW	WNW 37	2	56	24
AUG/AOÛT	202.0	46	6	221.2	9.7	SSW	11.6	SSW	WNW,	18	W 69 SSW	16
SEPT/SEP	207.3	55	1	167.3	11.9	SSW	12.0	SSW	NW 37	7, 24	52	1, 26
OCT/OCT	154.0	42	2	137.8	10.1	SSW	13.0	SSW	SVRL 32	7	W NW 59	5
NOV/NOV	130.1	46	7	94.9	12.2	WNW	13.4	WNW	NNW,	1	WNW 72	14
DEC/DÉC	94.7	35	11	93.4	11.9	W	14.3	WNW	WNW 37	4, 5 2, 12, 14 14, 25	NW 63 W 82	26
YEAR ANNÉE	1926.3	42	82	1878.4	12.4	SSW	13.8	WNW SSW	NE 52	Mar 30	NNE 82 W 82	Mar 30 Dec 26

MONTH MOIS	BAROMETRIC PRESSURE*/PRESSION BAROMÉTRIQUE[											
	STATION LEVEL/NIVEAU DE LA STATION						SEA LEVEL/NIVEAU DE LA MER					
	MEAN MOYENNE	Maximum Maximale	DATE	MINIMUM MINIMALE	DATE	NORMAL NORMALE	MEAN MOYENNE	Maximum Maximale	DATE	MINIMUM MINIMALE	DATE	NORMAL NORMALE
JAN/JAN	101.9	104.9	13	98.4	31	101.0	102.0	105.2	13	98.7	31	101.3
FEB/FÉV	101.2	103.4	13, 14	98.5	29	101.0	101.5	103.7	14	98.7	29	101.3
MAR/MAR	101.2	104.3	13	98.6	1	100.9	101.5	104.6	13	99.0	1	101.2
APR/AVR	101.2	102.7	5	99.6	25	101.0	101.5	102.9	5	99.9	25	101.3
MAY/MAI	101.0	103.0	29	99.2	5	101.1	101.3	103.3	29	99.4	5	101.4
JUN/JUIN	101.1	102.4	24	99.7	27	101.0	101.3	102.6	24	100.1	27	101.3
JUL/JUIL	100.9	102.2	29	99.6	12	101.0	101.3	102.4	29	99.9	12	101.3
AUG/AOÛT	101.2	102.3	12, 13	100.1	7	101.1	101.4	102.5	12	100.4	7	101.3
SEPT/SEP	101.5	103.0	8	99.4	20	101.4	101.7	103.3	8	99.7	20	101.6
OCT/OCT	101.8	103.4	31	99.6	4	101.3	102.1	103.6	31	99.8	4	101.6
NOV/NOV	101.3	103.7	1	99.4	30	101.2	101.6	103.9	1	99.7	30	101.5
DEC/DÉC	101.6	103.8	14, 27	98.1	7	101.4	101.8	104.1	27	98.4	7	101.4
YEAR ANNÉE	101.3	104.9	Jan 13	98.1	Dec 7	101.1	101.6	105.2	Jan 13	98.4	Dec 7	101.4

*1 Kilopascal = 0,29529 inches of mercury / 3,386 kilopascals = 1 inch of mercury
= 0,29529 pouces de mercure / 3,386 kilopascals = 1 pouce de mercure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PLAN 5

Comparison of Tornadoes and Hurricanes

	Tornadoes	Tropical Cyclones (Hurricanes)
1. Areas, Names, Numbers*	See map of North America	See world map
2. Labelled cross-sections (include dimensions)**	See diagram A.	See diagram B.
3. Conditions necessary for formation		
4. When do they occur? (months)		
5. Why at these times?		
6. What is the "trigger mechanism"?		
7. How long do they last? (units)		
8. How far do they travel?		
9. How fast is their forward motion?		
10. How fast are the winds?		
11. What determines their forward path?		
12. What is their source of energy?		
13. What is the average annual death toll in North America?		

* To be shown on outline maps

** Sketch diagrams based on information in text and from other sources

PLAN 6

Project Esteem Activity Sheet

Orbits

SUGGESTED GRADE LEVEL -- 9-12

OBJECTIVES

Students will:

1. examine the geometric properties of orbital shapes.
2. learn how to calculate the eccentricity of an elipse.
3. develop an appreciation for the true shape of planetary orbits.

ESTIMATED TIME FOR COMPLETING ACTIVITY -- 90 minutes

APPLICATIONS TO TECHNOLOGY AND SOCIETY

The activity demonstrates the true orbital shapes of all satellites.

PROCESSES ILLUSTRATED

Interpreting Data	Inferring
Using Numbers	Predicting

CLASS OF ACTIVITY -- Exploration

MATERIALS NEEDED

For each pair of students:

One sharp pencil
Two T-pins
A 25 cm length of strong thread
A piece of corrugated cardboard (9 x 12 in)
One metric ruler
A sheet of plain paper
Masking tape
Scissors

PROCEDURES

Have students do the following steps:

1. Use about 3 cm of masking tape to mount a sheet of paper on a piece of cardboard, by taping it at the corners.
2. With a ruler, draw a light line down the middle of the paper, the long way.
3. Take the piece of string you cut, form a loop by tying the ends together. (The loop should be about 11 cm long when held taut.)
4. Stick one pin into the center of the sheet of paper, on the line you drew and place the loop over the pin.
5. Insert the point of the pencil inside the loop and pull the loop snug.
6. Keeping the loop taut, draw a curve around the pin.

7. Label the pins' location with the letter A and label the curve with an A. (It is all right if the curve went off the edge of the paper.)

8. Remove the pin at location A.

9. Using two pins, stick one pin on each side of location A; both 1 cm from A and on the line. (The pins should be slightly tilted away from each other and should be about 2 cm apart.)

10. Label each of these pin hole positions on the paper with the letter B.

11. This time loop the thread over both pins. Insert the pencil point inside the loop, and while keeping the loop taut, go around both pins drawing a curve around these two centers.

12. Label this curve B. These two centers are called foci.

13. Repeat steps 4-8, each time moving the pin locations an equal distance from point A, until the loop will not stretch to the pin positions. (You should have 3 to 8 curved shapes drawn on your paper when you are finished.)

OBSERVATIONS

1. You should recognize the curve that you constructed first, labeled A, as a definite geometric shape. What is it called? What words would you use to describe its parts? Measure and calculate all the properties of curve A that you can. (Hint: Have you seen this shape in math class?)

2. Select any one of the other curves that you have constructed. Describe its shape. Measure all the parts of this curve that you can.

3. All the curves that you have constructed while using two pins are called ellipses. They represent the shape of the orbit of any gravitationally bound object. Examples would be the Earth orbiting the Sun or the space shuttle orbiting Earth. Which of your ellipses do you think best represents the true shape of the orbit of the Earth going around the Sun?

4. Which of your ellipses is the least "squashed"? Which is the most squashed? Describe the shape of those between least and most squashed.

5. By measuring your ellipse and performing a calculation we can find a number that will describe exactly how squashed your ellipse is. This number is called the ecentricity of the ellipse. Lets find the eccentricity of the ellipse that you measured in step 2 above. First, measure the distance between the pin holes you used to draw the ellipse. Next, measure the longest width of the ellipse. This distance should go through the two pin hole locations. Now, divide the distance between the pin holes (the foci) by the longest width of the ellipse. This distance should go through the two pinhole locations. Now, divide the distance between the pin holes (the foci) by the longest width of the ellipse (the major axis). Your answer should be carried out to two or three decimal places. The number you get is called the orbital eccentricity.

$$\text{ECENTRICITY} = \frac{\text{Distance between foci}}{\text{Length of major axis}}$$

6. Calculate the eccentricity of the other ellipses you constructed. Record all this information in an organized manner.

7. Look at each ellipse you constructed and its calculated eccentricity. Earth's orbit has an eccentricity = .017. Which of the ellipses that you constructed resembles Earth's orbit most closely? How does this answer compare with the prediction you made in number three.

8. Pluto and Mercury have the most eccentric (squashed) orbits of all of the planets, .248 and .206 respectively. Which of your orbits most resembles the orbits of Pluto and Mercury?

9. How would you explain, to a third grade class, the true shape of the orbit of a planet going around the Sun?

CREDITS

Presented at Project ESTEEM 1991 summer workshop by Michael Richard, Weymouth High School/Voc. Tech. High School, 1051 Commercial Street, East Weymouth, MA 02189

Horowitz, Irving L., Earth Science Investigations, Amsco School Publications Inc., 1973.

PLAN 7

Project Esteem Activity Sheet

Tombstone Geology

SUGGESTED GRADE LEVEL -- 7-12

OBJECTIVES

A geological field trip to a local cemetery will help students learn and reinforce many of the concepts they may learn in their rocks and minerals unit. The students will be able to:

- discover rock and mineral identification for themselves by using the skills learned earlier in labs and in discussions.
- use this knowledge to recognize and make observations about rock features.

ESTIMATED TIME FOR COMPLETING ACTIVITY -- 50 minutes

APPLICATIONS TO TECHNOLOGY AND SOCIETY

Economical geology
Interpretation of casual observations
Construction trades

PROCESSES ILLUSTRATED

Questioning	Interpreting Data	Observing
Indentifying Variables	Using Logic	Hypothesizing
Inferring	Classifying	Using Numbers
Predicting		

CLASS OF ACTIVITY -- Exploration, application, and extension

MATERIALS NEEDED

Nearby cemetery with a variety of headstones, tombstones, and monuments
Writing materials
Transportation

PROCEDURES

1. Familiarize your students with numerous samples of the rock they will see in the cemetery headstones, e.g., sandstone, marble, slate, and granite.
2. Have the students make a data collection chart that will help them gather the following information: date of trip, partners, name, and location of cemetery. Also encourage them to record data in other ways such as drawing maps, taking photos, and interviewing knowledgeable persons.
3. (teacher) Develop an assignment sheet ahead of time to evaluate progress. Make a general map for the students. The key to success on the trip it advance preparation.
4. On the assignment sheet, include questions that require students to use previously learned skills. Examples: Is this stone a rock or a mineral? Will stone A weather

faster than stone B and why? What forces could have caused this stone to become tilted?

5. Establish rules for safety and courtesy when visiting a cemetery. Be sure to obtain permission from the cemetery office before you arrive with your students.

EXTENSIONS

1. Have your students analyze their findings. Allow them to be creative and individual in their approach to summarizing what they have learned.
2. Encourage further thinking, generalizing or the application of a new knowledge with questions like these:
   - How do various rock types compare in durability?
   - How do local weather conditions affect weathering of headstones?
   - What factors might influence the choice of rock type for a tombstone?
   - Is there evidence of instances in which headstones were not placed on a grave at the time of death?
3. Use a video camera to make a documentary of the observations made at the cemetery. The micro lens on any recorder will show many details useful for documentation.
4. Travel to a stone mason to see the tools and skills needed to carve the stones.

CREDITS

Rick Norman, Lamesa School, PO Box 261, Lamesa, TX 79331

Appendix B

Geoeducation New Brunswick

Gwen L. Martin
• P.O. Box 153, Station A, Fredericton, N.B. E3B 4Y9 • 506/366-3079 •
• technical writing and editing • historical and scientific research • science education •

17 January 1994

Mrs. Cheryl Reid, District Superintendent
1077 St. George Blvd.
Moncton, NB
E1E 4C9

Dear Mrs. Reid:

Re: A New Geoscience Resource for New Brunswick Teachers

I am writing to inform you of a recently-organized geoscience education network for New Brunswick teachers. Its name is *GeoEducation New Brunswick (GENB)*. Your Department of Education's science consultant, Mark Holland, is aware of this initiative and supports our efforts.

GENB arose in response to repeated teacher requests for help in presenting geology and mining to their students. It comprises geologists, prospectors, palaeontologists and other geoscientists. Our people come from a variety of backgrounds: private consultants and prospectors, small and large mining companies, government departments and university geology departments. *GENB*'s purpose is to help teachers instruct and enthuse their students about the rocks, landforms, mines and geology of our province.

GENB is intended to function primarily as a telephone network. It can be used, for instance, by teachers wondering where to find a certain rock type, or how their local mine operates, or what it's like to work underground, etc. It will help teachers to locate comeone able to identify their students' rock or fossil discoveries. Some *GENB* members also are willing to donate their time to giving occasional class presentations or conducting field trips.

The underlying concept of our organization is to facilitate the initial contact between geologists and teachers - i.e., to help teachers meet the professionals in their region. Once that contact is made, we hope teachers will continue to call upon our *GENB* members, when necessary, and so encourage the development of a community-based network.

We would like to inform as many teachers as possible about *GENB*. To this end, could you please distribute a copy of the following pages to each school in your district? Many thanks for your help and interest in this matter.

Gwen Martin

Gwen Martin, Coordinator, *GENB*

GeoEducation New Brunswick

A Geoscience Education Hotline For Science and Social Studies Teachers

What Is GENB?

- *GeoEducation New Brunswick (GENB)* is a ***new geoscience hotline.***
- Our members are geologists, prospectors and other geoscientists.
- We're available to help you with geoscience units in your curriculum.

How Does GENB Work?

A Telephone Hotline

- Most GENB members can answer your earth science questions over the telephone hotline. Just check the list to see who specializes in what topic (we're not all fossil experts!), then phone the nearest member.

A Classroom Resource

- Some *GENB* members are available for occasional classroom visits or field trips. Please remember:
  - ◊ Arrange class visits at least three weeks ahead.
  - ◊ Specify your *grade level* and *class period length.*
  - ◊ Encourage your visitor to bring rock samples, fossils, etc.
  - ◊ Clearly define (if possible) the topic you want to be covered during the visit.

Questions, Comments or Problems?

- We're a new group, and genuinely want your feedback. Please write or call me anytime at: **Gwen Martin, *GENB* Coordinator, P.O. Box 153, Station A, Fredericton, New Brunswick, E3B 4Y9, (506) 366-3079**

Name	Location	Is Available For			Can Help You With These Topics				
* = available in French for French immersion or francophone classes		Telephone Calls	Class Visits	Field Trips	Rocks/ Minerals	Local Geology	Mining in New Brunswick	Prospecting and Mineral Exploration	Other
Robin Adair w 548-0123 h 548-1986	**Bathurst/ Beresford** *Noranda Exploration Co.*	OK	OK	OK	OK	OK	OK	OK	• dinosaurs • other fossils • volcanoes
Roger Albert* w 433-5455	**Sussex** *Potash Corp of Saskatchewan*	OK	-	-	-	-	-	-	• mining history of Sussex area
Dominique Bérubé* **w 547-2070** **h 548-5466**	Bathurst *Dept of Natural Resources & Energy*	OK	OK	OK	-	-	-	-	• coastline geology and bio-geography
Ken Burke w 453-4804 h 450-3166	**Fredericton** *University of New Brunswick*	OK	OK	-	-	-	-	-	• earthquakes • geophysics • environmental geology • can help with the geoscience computer network, *Internet*
Don Burton w 542-1612 h 548-3420	**Beresford/ Bathurst** *Dept of Natural Resources & Energy*	OK	OK	-	-	OK	OK	OK	-
Alain Caron* w 547-2070 h 547-8197	**Bathurst** *Dept of Natural Resources & Energy*	OK	OK	OK	OK	OK	-	-	-
Mark Connell w 433-5341 h 433-5341	Sussex ***Geosleuths***	OK	OK	OK	OK	OK	OK	-	
Bill Gardiner w 657-7239 h 433-5576	**Sussex/ Saint John** *Southfield Resources Ltd.*	OK	-	OK	OK	OK	OK	OK	• has large geo-science slide collection
Kerry Harris h 843-2417	Blackville ***Prospector***	OK	OK	OK	OK	-	OK	OK	• may have minneral kits available for purchase
Don Hattie w 536-0614 h 536-0614	**Sackville** *Geosleuths*	OK	OK	OK	OK	OK	OK	OK	• local fossils

Name	Location	Is Available For			Can Help You With These Topics				
* = available in French for French immersion or francophone classes		Telephone Calls	Class Visits	Field Trips	Rocks/ Minerals	Local Geology	Mining in New Brunswick	Prospecting and Mineral Exploration	Other
Jeff Hussey w 547-6030 h 546-6264	**Bathurst** *Brunswick Mining and Smelting*	OK	OK	OK	OK	-	OK	OK	-
John Langton w 547-2070	**Bathurst** *Dept of Natural Resources & Energy*	OK	OK	OK	-	OK	-	-	-
Lloyd Lemon w 457-3200 h 458-1585	**Fredericton** *Jacques Whitford*	OK	OK	-	-	-	-	-	• groundwater geology • environmental geology • geochemistry
David Lentz w 547-2070 h 548-8041	**Bathurst** *Geological Survey of Canada*	OK	OK	OK	OK	-	OK	-	• mineral fuels (coal/oil/gas)
Wayne Lockhart w 369-2204 h 369-2204	**Fredericton/ Boiestown/ Sussex** *Lockhart Exploration Services Ltd.*	OK	OK	OK	OK	-	OK	OK	-
Gwen Martin w 366-3079 h 366-3079	**Fredericton/ Harvey** *G.L. Martin & Associates*	OK	OK	OK	OK	-	OK	0	• building stones • mining history
William Luff w 547-6064 h 548-8284	**Bathurst** *Brunswick Mining & Smelting*	OK	OK	OK	OK	-	-	-	• mining history of northern NB • has videos and ore samples
Patrick Marr h 463-8287 w 463-8287	**Millville** *prospector*	OK	-	OK	OK	OK	-	-	• can demonstrate working as prospector
Bruce Miller w 546-4794 h 548-2362	**Bathurst** *Teck Corporation*	OK	OK	-	OK	-	-	-	• has fossil collection to show students
Randall Miller w 643-2361	**Saint John** *New Brunswick Museum*	OK	-	-	-	-	-	-	• fossils • can loan kit on global warming

Name	Location	Is Available For			Can Help You With These Topics				
* = available in French for French immersion or francophone classes		Telephone Calls	Class Visits	Field Trips	Rocks/ Minerals	Local Geology	Mining in New Brunswick	Prospecting and Mineral Exploration	Other
Arie Moerman w 622-2100 h 548-5162	**Newcastle** Heath Steele Mines	OK	-	-	OK	-	OK	-	-
Maurice Monahan w 839-2146 h 832-7626	**Sussex** *Potacan Mining Co.*	OK	OK	-	OK	-	OK	-	• has some ore samples and fossils for demonstration
Michael Parkhill w 547-2070 h 546-5768	**Bathurst** *Dept of Natural Resources & Energy*	OK	OK	OK	OK	OK	-	-	• glacial geology • earthquakes • landfill geology • has some ore samples and fossils for demonstration
David Plante w 857-3056 h 387-4870	**Moncton** *New Brunswick Mining Association*	OK	OK	-	-	-	OK	-	-
Gary Plewes h 854-5926 (best around 5-7 p.m.)	**Moncton** *geological technician*	OK	OK	OK	OK	-	-	-	• gives talk on Maritime minerals: where to find and how to idenfity them • has mineral kits available for purchase
Toon Pronk w 453-7947 h 451-1097	**Fredericton** *Dept of Natural Resources & Energy*	OK	OK	OK	OK	OK	-	-	• environmental geology • geochemistry • mineral fuels • has slides and videos
John Ross w 839-2146 h 832-3318	**Sussex** *Potacan Mining Co.*	OK	OK	-	OK	-	OK	-	-
Allen Seaman w 453-7939 h 459-7405	**Fredericton** *Dept of Natural Resources & Energy*	OK	OK	OK	-	-	-	-	• glacial geology
Ron Shaw w 453-2206 h 366-5437	**Fredericton/ Harvey** *Dept. of Nastural Resources & Energy*	OK	OK	-	-	-	OK	-	• mineral fuels (coal, oil and gas)
Jacques Thibault* w 547-2070 h 548-8847	**Bathurst** *Dept of Natural Resources & Energy*	OK	-	-	-	-	-	-	• glacial geology • peat bog history and formation • coastline geology

Name	Location	Is Available For			Can Help You With These Topics				
• = available in French for French immersion or francophone classes		Telephone Calls	Class Visits	Field Trips	Rocks/ Minerals	Local Geology	Mining in New Brunswick	Prospecting and Mineral Exploration	Other
Jim Walker w 547-2070 h 546-8210	**Bathurst** *Dept of Natural Resources & Energy*	OK	OK	OK	OK	OK	OK	-	• has slide collections
Tim Webb w 453-2206 h 459-6119	**Fredericton** *Dept of Natural Resources & Energy*	OK	OK	-	OK (non metallic minerals)	-	-	OK (non metallic mines)	• has samples available for demonstration
Ken Whaley h 363-5513 w 363-5513	**Fredericton** *exploration geologist*	OK	OK	-	OK	OK	OK	OK	• varied
Reg Wilson w 453-2206 h 472-1052	**Fredericton** *Dept of Natural Resources & Energy*	OK	OK	OK	OK	OK	OK	-	-