Senior 1

Cluster 1: Reproduction

Overview

Reproduction is an essential biological mechanism for the continuity and diversity of species. In this cluster, students

- compare sexual and asexual methods of reproduction.
- learn how the human reproductive system functions.
- describe the major stages of human development from conception to birth.
- recognize that the nucleus of a cell contains genetic information and is responsible for the transmission of traits from one generation to the next.
- analyze single trait inheritance in humans
- discuss factors that may change a cell's genetic information, including environmental factors.
- address a current biotechnology issue using the knowledge they have gained.

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-01 Illustrate and explain the process of mitotic cell division in plants and animals.

Include: chromosomes, mitosis, cytoplasmic division, cell cycle.

GLO: D1, E1, E2

S1-1-02 Observe and explain the dynamic nature of cell division.

GLO: C2, D1, E3

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
GLO: C2, C5, C8 (ELA: S1: 3.3.4)

S1-0-5a. Select and use appropriate methods and tools for collecting data or information.
GLO: C2; TFS: 1.3.1

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia.
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-6a. Interpret patterns and trends in data, and infer and explain relationships.
(ELA: S1: 3.3.1) GLO: C2, C5;
TFS: 1.3.1, 3.3.1

SUGGESTIONS FOR INSTRUCTION

(2-1/2 HOURS)

➢ Entry-Level Knowledge

Students have studied cells in Grade 8, and should be familiar with

- the following vocabulary: cell membrane, nucleus, cell wall, chromosomes.
- the use of microscopes to observe and compare the general structure and function of plant and animal cells.

➢ Notes for Instruction

Explain how cell division occurs in single plant and animal cells. Be sure to identify and explain the role of the chromosomes, cell membrane, cell wall, cytoplasm, and nucleus in the process. Use models, diagrams, or videos to demonstrate the process of cell division.

Caution: Students are NOT to memorize the names of the stages of mitosis (i.e., interphase, prophase, metaphase, anaphase, telophase), but should understand that it is a continuous, dynamic process.

➢ Student Learning Activities

Laboratory Activity S1-0-2c, 5a, 5c

Students complete a lab activity involving observation of plant and/or animal cell division.

Visual Displays S1-0-5c

Students use a variety of charts, videos, overheads, CD-ROMs, and websites to illustrate cell division. (See Appendix 1.1)

Teacher Demonstration S1-0-6a

Set up a series of slides showing a variety of stages of cell division. Students

- observe structures that are included in the stages (i.e., chromosomes, nuclei, nuclear membrane, cell wall [in plant cells], cell membrane [in animal cells]).
- describe the differences among the structures in the slides.

Collaborative Teamwork S1-0-4e

Students work in small groups to write mitosis limericks. For example:

There once was a cell named Tigger,
Who said “I can’t get any bigger.
My growth has to quit.
It is time to split.
So the new cells can grow with vigour.”

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- place pictures of single cells in various stages of cell division in the correct order.
- complete a Compare and Contrast or Concept Relationship frame listing the similarities and/or differences between cell division in plant and animal cells.
- write a description of the events of cell division.
- draw diagrams outlining the events of cell division.

Laboratory Report S1-0-2c, 5a, 5c

Students prepare a report outlining the events of cell division, and the similarities and differences between cell division in plant and animal cells. (See Appendices 5.5 and 5.6)

(continued)

Suggested Learning Resources

Science 9

5.5 Cell Division, p. 150

5.6 Activity: Observing Cell Division, pp. 154–55

BLM 5.5a Phases of Cell Division

TSM-3 Cooperative Learning

TSM-6 Graphic Organizers

Sciencepower 9

1.2 Understanding the Cell Cycle, p. 17

Investigation 1-C: Observing Mitosis in Plant and Animal Cells, pp. 20–21

BLM 1-14 Steps of Mitosis

BLM 1-15 Typical Cell Cycle

BLM 1-16 Cell Growth And Division

Appendices

1.1 Blackline Master Mitotic Cell Division

1.2 Blackline Master Meiotic Cell Division

5.5 Lab Report Assessment

5.6 Observation Checklist — Scientific Inquiry

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION (2-1/2 HOURS)
Students will... (continued) **S1-1-01** Illustrate and explain the process of mitotic cell division in plants and animals. Include: chromosomes, mitosis, cytoplasmic division, cell cycle. GLO: D1, E1, E2 **S1-1-02** Observe and explain the dynamic nature of cell division. GLO: C2, D1, E3	➢ **Student Learning Activities (continued)** **Journal Writing S1-0-2c, 7e** Students imagine that they are miniaturized to microscopic size. They hitchhike a ride on a chromosome in a cell that divides, and describe what they see during the process. Students propose events or circumstances that could affect the rate of cell division (e.g., poor nutrition, cancer). Students use a Compare and Contrast or Concept Relationship frame to distinguish between cell division in plant and animal cells. (See *SYSTH*, pages 10.15, 13.5) **Visual Displays S1-0-2c, 5c** Students work individually or in small teams to draw and/or label diagrams or create posters, concept maps, information technology presentations, or models showing the events of cell division. Students draw their own reference cell, labelling the components they know are involved in cell division.

Suggestions for Assessment

Visual Displays S1-0-2c, 5c

Students work individually or in small teams to prepare visual displays of the events of cell division or the similarities and differences between plant and animal cell division.

The displays may include:

- posters
- diagrams
- information technology presentations
- concept maps
- models

Journals

Assess journal entries using a Journal Evaluation form. (See Senior Years Science Teachers' Handbook [*SYSTH*], page 13.21)

Student Demonstration S1-0-2a, 2e, 7e

Students choose objects to demonstrate the process of mitosis (e.g., pieces of wool, coloured marshmallows, pieces of pipe cleaner, or anything they find useful for the activity), and present their demonstration to the class. (See Appendix 5.2)

Suggested Learning Resources

SYSTH

10.15 Building a Scientific Vocabulary

11.20 Developing Scientific Concepts Using Graphic Displays

11.26 Laboratory Report Online

13.5 Writing to Learn Science

13.21 Writing to Learn Science

Laboratory Safety

Science Safety: A K–S4 Resource Manual for Teachers, Schools, and School Divisions, Manitoba Education and Training, 1997
Available online @ www.edu.gov.mb.ca/metks4/docs/support/scisafe

Be safe! A health and safety reference for Science and Technology Curriculum, Science Teachers' Association of Ontario, 1998
Available online @ http://www.stao.org/

Appendices

5.2 Rubric for the Assessment of Class Presentations

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-03 Describe various types of asexual reproduction that occur in plant and animal species.

Examples: fission, budding, sporulation, vegetative propagation, regeneration…

GLO: D1, E1

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia.
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(2 HOURS)

➢ Entry-Level Knowledge

Students have studied the difference between unicellular and multicellular organisms in Grade 8, but have not examined reproduction.

➢ Notes for Instruction

Most students will have some life experience with asexual reproduction. Encourage them to share their experience with the class through guided discussion or question and answer. Different methods of vegetative reproduction will be studied in greater detail in outcome S1-1-04.

➢ Student Learning Activities

Collaborative Teamwork S1-0-4e

Students use a Jigsaw or Roundtable to learn about the various types of asexual reproduction.

Expert Groups: Each student group investigates one form of asexual reproduction (regeneration, budding, sporulation, fission, vegetative propagation), and then shares its findings with the rest of the class. (See *Success for All Learners*, Chapter 5)

Visual Displays S1-0-2c, 5c

Students draw diagrams or create posters describing various types of asexual reproduction. (See Appendix 1.3)

Students complete Three-Point Approach frames to demonstrate their understanding of vocabulary. (See *SYSTH*, page 10.9)

Journal Writing S1-0-7e

Students reflect on ways in which the process of regeneration may be useful to humans. (See *SYSTH*, Chapter 13)

Students prepare a glossary of new words and their meanings for quick reference.

Students reflect and respond to the following questions:

- How has your understanding of reproduction changed since the beginning of this unit?
- What new questions do you have about reproduction?
- What new discoveries in this cluster surprise you?

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- identify examples of asexual reproduction based on their observations of microscope slides, pictures, or diagrams.
- describe different types of asexual reproduction.
- differentiate among alternative forms of asexual reproduction.
- explain why cutting individual starfish into pieces will increase the starfish population.

Visual Displays S1-0-2c, 5c

Students or student groups prepare visual displays of the various types of asexual reproduction. The displays may include:

- posters
- diagrams
- information technology presentations

Journals

Assess journal entries using a Journal Evaluation rubric. (See *SYSTH*, page 13.21)

Teacher Background

Some examples of organisms that use various methods of asexual reproduction include:

- *regeneration:* starfish, planaria
- *budding:* sponges, hydra
- *sporulation:* bread mould, wheat rust
- *fission:* amoebas, bacteria
- *vegetative propagation:* poplars, strawberries

Note: Reproduction refers to the processes by which a new generation of cells or multicelled individuals is produced. Sexual reproduction requires meiosis, formation of gametes, and fertilization (with the exception of parthenogenesis. Asexual reproduction refers to the production of new individuals by any mode that does not involve formation of gametes.

Suggested Learning Resources

Science 9

5.4 The Importance of Cell Division, p. 148

5.8 Reproduction and Cell Division, p. 159

6.5 Regeneration, p. 186

6.9 Cloning, p. 194

TSM-3 Cooperative Learning

Sciencepower 9

1.3 The Cell Cycle in Your Body, p. 24

1.4 Asexual Reproduction In Bacteria, Protists, Fungi, and Animals, p. 29

Investigation 1-D: Be a Biologist: Assess Asexual Reproduction, pp. 31–36

1.5 Asexual Reproduction In Plants, pp. 24–25

BLM 1-23 Investigation 1-D: Be a Biologist: Assess Asexual Reproduction

BLM 1-24 Mitosis and Cell Division in an Amoeba

BLM 1-25 Asexual Reproduction Crossword

Appendices

1.3 Blackline Master Types of Asexual Reproduction

SYSTH

3.7 Cooperative Learning and Science

10.9 Building a Scientific Vocabulary

13 Writing to Learn Science

Success for All Learners

5 Flexible Grouping

5.3 Individual, Small-Group, and Whole-Class Work

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-04 Investigate and describe agricultural applications of asexual reproduction.

Examples: cloning, cuttings, grafting, bulbs…

GLO: A5, B1, B2, D1

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4b. Demonstrate work habits that ensure personal safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, emergency equipment.
GLO: B3, B5, C1, C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5a. Select and use appropriate methods and tools for collecting data or information.
GLO: C2 TFS: 1.3.1

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia.
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7a. Draw a conclusion that explains the results of an investigation.
Include: cause and effect relationships, alternative explanations, supporting or rejecting the hypothesis or prediction.
(ELA: S1: 3.3.4) GLO: C2, C5, C8

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Notes for Instruction

Students will have varying degrees of experience with the applications of asexual reproduction. Research projects and group presentations could be used to expose students to a wide variety of agricultural applications.

➢ Student Learning Activities

Guest Speaker: Invite a local gardener, greenhouse or nursery worker, or agricultural research station employee to give a presentation and/or demonstration on this topic. Students prepare questions in advance of the visit. Questions may include:

- What background/experience/education is required to do the presenter's job?
- What is a "day-in-the-life" of a gardener, greenhouse worker, or agricultural research station employee like?
- What applications of asexual reproduction does the presenter utilize? Why?

Laboratory Activity S1-0-2c, 4b, 5a, 5c

Students perform a lab in which they clone plants using a variety of methods.

Field Trip: Visit a local greenhouse, nursery, or agricultural research station for a tour related to this topic. Students discuss how they will prepare for the tour. Preparations may include:

- obtaining a still camera and film or video camera to record sights seen during the tour.
- preparing a list of questions to ask the tour guide.

Student Research S1-0-2a, 2c, 5c

Students or student groups research the agricultural applications of asexual reproduction, including

- grafting
- runners
- cloning
- bulbs
- cuttings
- tubers
- tissue culture

Collaborative Teamwork S1-0-4e

Students use a Jigsaw or Roundtable to learn about the various agricultural applications of asexual reproduction. (See *Success for All Learners,* Chapter 5)

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- differentiate among the various methods of vegetative propagation (i.e., cuttings, grafting, etc.).
- identify when each method of propagation is used.
- describe, with the use of examples, agricultural applications of asexual reproduction.
- predict reasons why a farmer would use vegetative propagation instead of sexual reproduction with seeds.

Laboratory Report S1-0-2c, 5a, 5c, 7a

Students prepare a report outlining the methods used to clone plants and their success or failure. (See Appendices 5.5 and 5.6)

Research Report S1-0-2a, 2c, 5c

Working individually or in small groups, students investigate an agricultural application of asexual reproduction, and prepare

- written reports
- oral presentations
- posters
- pamphlets
- information technology presentations

(See Appendix 5.3)

(continued)

Suggested Learning Resources

Science 9

6.7 Producing Plants Without Seeds, p. 190

6.8 Investigation: Cloning from Plant Cuttings, pp. 192–93

6.9 Cloning, p. 94

BLM 6.7 Plant Reproduction: Concept Map

TSM-3 Cooperative Learning

Sciencepower 9

1.5 Asexual Reproduction in Plants, p. 36
Investigation 1-E: Clone a Plant, pp. 37–40

BLM 1-26 New Plants from Cuttings

BLM 1-28 New Plants from Roots

BLM 1-29 New Plants from Stems

BLM 1-30 New Plants from Layering

BLM 1-31 New Plants from Grafting

Success for All Learners

Chapter 5 Flexible Grouping

SYSTH

11.26 Laboratory Report Outline

Appendices

5.3 Rubric for the Assessment of a Research Project

5.5 Lab Report Assessment

5.6 Observation Checklist — Scientific Inquiry

(continued)

PRESCRIBED LEARNING OUTCOMES
Students will...
(continued) **S1-1-04** Investigate and describe agricultural applications of asexual reproduction. *Examples: cloning, cuttings, grafting, bulbs…* GLO: A5, B1, B2, D1

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ **Student Learning Activities (continued)**

Journal Writing

Students reflect on and respond to the following questions:

- What are the possible risks associated with the agricultural applications discussed in this unit?
- Do you think farmers and gardeners will have a broader choice of plants and animals to grow/raise in the future? Explain.
- What are the advantages of asexual reproduction applications for the food industry? For medicine? For the horticulture industry?

Class Discussion: Discuss the ethical issues arising from cloning and grafting. (See *Success for All Learners*, page 7.3)

Suggestions for Assessment

Journals

Assess journal entries using an assessment rubric such as the template in *SYSTH*, page 13.21.

Suggested Learning Resources

Success for All Learners

7.3 Structuring Whole-Class Discussions

SYSTH

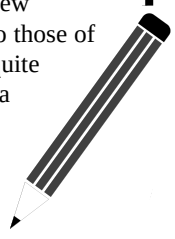
13.21 Writing to Learn Science

Teacher Background

Some examples of asexual reproduction used in agricultural applications include:

- *cuttings:* African violets, geraniums, begonias, grapes
- *grafting:* apple trees, rose bushes. Grafting consists of joining a portion of the plant you wish to increase (the scion) to the chosen root system (the stock). The join is bound with tape to allow adhesion.
- *bulbs:* garlic, onions, gladiolas
- *runners:* strawberries, spider plants
- *tubers:* potatoes, dahlias
- *cloning:* plants (seedless watermelons and oranges) A new plant produced by cloning has chromosomes identical to those of the parent plant from which it came. Cloning plants is quite easy and is now done on a large scale in a lab by using a technique called *tissue culture*.

Asexual reproduction of plants is also called vegetative propagation.



PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-05 Illustrate and explain the production of male and female gametes by meiosis in plants and animals.

GLO: D1, E1, E2

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Entry-Level Knowledge

In Grade 8, students were exposed to the use of microscopes and the structure and function of some cell parts, such as the cell membrane, cytoplasm, nucleus, and chromosomes.

➢ Notes for Instruction

Emphasize that meiosis involves chromosome number reduction prior to sexual reproduction so that the chromosome number of the species is maintained. Review the following terms: meiosis, diploid, homologous, haploid, gametes, and zygote.

Caution: Students are not expected to memorize the names of the stages of meiosis. It is important that they understand the purpose and products only.

➢ Student Learning Activities

Class Discussion S1-0-7e

Students speculate why meiosis is important, and what would happen if meiosis did not occur prior to sexual reproduction.

Visual Displays S1-0-2a, 2c, 5c

Students label diagrams or create posters illustrating the production of male and female gametes by meiosis. (See Appendix 1.2)

Information Technology: A variety of charts, video, overheads, websites, and CD-ROMs can be used to illustrate meiosis.

Journal Writing S1-0-2c

Students read a description of sexual reproduction for one specific plant species and for one specific animal species and compare the two processes using a tabular format.

Have students complete a Concept Frame or Concept Overview to aid in their understanding of meiosis.

Student Research S1-0-2a, 2c, 5c

Students research the advantages and disadvantages of parthenogenesis (the development of an unfertilized egg into an adult animal without fusion with sperm). Parthenogenesis occurs in many insects, such as bees, wasps, aphids, lice, some ants, and other microscopic animals. See *SYSTH*, pages 14.7–14.15, for strategies and format suggestions.

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- place pictures of single cells in various stages of meiosis in the correct order.
- write a description of the events of meiosis.
- draw diagrams outlining the events of meiosis.

Visual Displays S1-0-2c, 5c

Students or student groups work to prepare visual displays of the events of meiosis. The displays may include:

- posters
- diagrams
- information technology presentations
- concept maps
- models

Students choose from five different sets of objects to represent the process of meiosis (e.g., plastic building blocks, pipe cleaner pieces, bingo chips, pieces of coloured wool) and present the process to the class. (See Appendix 5.2)

Journals

Assess Journal Entries using an assessment rubric similar to that in *SYSTH*, page 13.21.

SUGGESTED LEARNING RESOURCES

Science 9

7.2 Meiosis, p. 206

BLM 7.2 Stages of Meiosis

TSM-6 Graphic Organizers

Sciencepower 9

2.1 Understanding the Basis of Sexual Reproduction, p. 46
Investigation 2-A: Meiosis: The Power of Reduction, pp. 48–50

BLM 2-9 How Do the Number of Chromosomes in Body Cells and Sex Cells Compare?

BLM 2-0 Sex Cells — A Different Story

BLM 2-11 Key Events in Meiosis

BLM 2-12 The Steps of Meiosis

BLM 2-15 Formation of Sperm and Egg

BLM 2-16 Sex Cell Summary

Appendices

1.1 Blackline Master
Mitotic Cell Division

1.2 Blackline Master
Meiotic Cell Division

5.2 Rubric for the Assessment of Class Presentations

SYSTH

11.20 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

14.7 Technical Writing in Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-06 Compare and contrast the function of mitosis to that of meiosis.

Include: diploid cells, haploid cells.

GLO: D1, E1

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION

(1 HOUR)

➢ Notes for Instruction

Emphasize that mitosis is for the purpose of asexual reproduction, growth, and tissue repair. Meiosis involves chromosome number reduction prior to sexual reproduction so that the chromosome number of the species is maintained. (See Appendices 1.1 and 1.2)

➢ Student Learning Activities

Journal Writing S1-0-2c

Students complete a Compare and Contrast or Concept Relationship frame outlining the similarities and/or differences between the functions and processes of mitosis and meiosis. (See *SYSTH*, pages 10.15, 11.19)

Visual Displays S1-0-2a, 5c

Students draw the life cycle of their favourite animal, illustrating which parts of the cycle come from meiosis and which parts come from mitosis. (See *SYSTH*, page 11.37)

Collaborative Teamwork S1-0-4e

Students use a Think-Pair-Share or Roundtable to compare and contrast meiosis and mitosis. (See *SYSTH*, pages 9.5, 10.6)

Debate: Students debate whether meiosis or mitosis is more efficient and advantageous. Divide the class into two — one half to defend each process. Stress the importance of basing arguments on scientific facts rather than personal opinion. (See *SYSTH*, page 4.19)

You may wish to distribute copies of Appendix 1.4 to students in advance of the debate.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- complete a Compare and Contrast frame outlining the similarities and differences between the functions and processes of mitosis and meiosis.
- explain the difference between haploid and diploid cells. A Concept Relationship frame could be used.

Visual Displays S1-0-2c, 5c

Students draw the life cycle of their favourite animal, identifying which parts of the cycle come from meiosis and which parts come from mitosis. The displays may include:

- posters
- diagrams
- information technology presentations

Discussion and/or Journals: Encourage reflection and discussion on the debate. Use the following questions to inspire participation:

- What surprising points were raised during the debate?
- Do you think there is a right or wrong answer to the question? Explain.
- What valid facts were used to support their arguments?
- Summarize the arguments given by each team.

Suggested Learning Resources

Science 9

7.2 Meiosis, p. 206

TSM-3 Cooperative Learning

Sciencepower 9

2.1 Understanding the Basis of Sexual Reproduction, p. 46

BLM 2-3 How Is Meiosis Different from Mitosis?

BLM 2-14 Compare Mitosis and Meiosis

Appendices

1.1 Blackline Master
Mitotic Cell Division

1.2 Blackline Master
Meiotic Cell Division

1.4 Blackline Master
Advantages and Disadvantages of Sexual and Asexual Reproduction

SYSTH

4.19 Science — Technology — Society — Environment Connections

9.5 Tapping into Prior Knowledge

10.6 Building a Scientific Vocabulary

10.15 Building a Scientific Vocabulary

11.19 Developing Scientific Concepts Using Graphic Displays

11.20 Developing Scientific Concepts Using Graphic Displays

11.37 Developing Scientific Concepts Using Graphic Displays

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-07 Compare sexual and asexual reproduction in terms of their advantages and disadvantages for plant and animal species.

GLO: D1, E1

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION
(1 HOUR)

➢ Entry-Level Knowledge

In Grade 8, students were made aware that reproduction is a characteristic of all living things. They also have an understanding of the differences between sexual and asexual reproduction from previous learning outcomes in the unit.

➢ Notes for Instruction

Students suggest reasons why organisms may use one method of reproduction or the other and attempt to explain the rationale for their choice. Appendix 1.4 may be used for background information.

➢ Student Learning Activities

Journal Writing S1-0-7e

Students predict the effects of a new disease that affects all seedless and seeded varieties of oranges.

Students complete a Compare and Contrast or Concept Relationship frame comparing the advantages and disadvantages of sexual and asexual reproduction. Students may also prepare a Concept Map illustrating the relationship between sexual and asexual reproduction. (See *SYSTH*, pages 10.15, 10.22, 10.24, 11.19)

Collaborative Teamwork S1-0-4e

Students work in small teams to identify situations in which one form of reproduction may be more advantageous than another. A Listen-Think-Pair-Share format could be used. (See *SYSTH*, page 10.6)

Case Study (S1-0-2c): Students investigate organisms that can reproduce sexually and asexually (e.g., the jellyfish, poplar tree, etc.), and discuss findings using the following questions:

- What are the advantages of a jellyfish being able to use either method of reproduction?
- Which method of reproduction would be most advantageous for a lone poplar tree in a field? Explain.
- Which method of reproduction would be most advantageous for a poplar tree in a dense forest? Explain.
- Name other organisms that are capable of reproducing sexually and asexually, and comment on the environments in which they live.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- complete a Compare and Contrast or Concept Relationship frame comparing asexual and sexual reproduction in terms of their advantages and disadvantages for plant and animal species.
- describe situations in which one form of reproduction is more advantageous than others.
- prepare a Concept Map illustrating the relationship between sexual and asexual reproduction.
- determine whether given examples represent asexual reproduction or sexual reproduction.

Debate/Discussion/Journals

Divide the class into two — one half representing sexual reproduction, and one half representing asexual reproduction. Debate the advantages and disadvantages associated with each type of reproduction. Stress the importance of using scientific facts and not personal opinion. (See *SYSTH*, page 4.19)

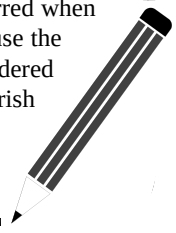
Discuss the outcome of the debate. Students then summarize the arguments presented by both teams and reflect on any new information that they learned from the debate in their journals.

Journals

Assess journal entries using *SYSTH*, page 13.21.

Teacher Background

Sexual reproduction results in genetic variation within a species, whereas asexual reproduction produces genetically identical offspring. The Potato Famine in Ireland in the 1840s occurred when a fungus attacked the potato, a primary food source. Because the potato plants were clones, the lack of genetic variation rendered them all susceptible to the blight. As a result, millions of Irish starved to death, while others fled to Canada, the United States, and Australia.



Suggested Learning Resources

Science 9

7.1 Reproductive Strategies, p. 202

7.5 Reproduction of Plants for Food, p. 212

TSM-3 Cooperative Learning

TSM-6 Graphic Organizers

Sciencepower 9

2.2 Sexual Reproduction in Animals, p. 51

2.3 Sexual Reproduction in Plants, p. 60

Appendices

1.4 Blackline Master: Advantages and Disadvantages of Sexual and Asexual Reproduction

SYSTH

4.19 Science — Technology — Society — Environment Connections

10.6 Building a Scientific Vocabulary

10.15 Building a Scientific Vocabulary

10.22 Building a Scientific Vocabulary

10.24 Building a Scientific Vocabulary

11.19 Developing Scientific Concepts Using Graphic Displays

11.20 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

Success for All Learners

7.3 Structuring Whole-Class Discussions

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-08 Investigate and explain adaptations of plant and animal species which enhance reproductive success.

Examples: appearance, behaviour, number of gametes or offspring, chemical cues…

GLO: D2, E1, E2

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5; TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ Notes for Instruction

A wide variety of adaptations exist, ranging from mating patterns and methods of fertilization/pollination to increase the chance of survival of offspring. Students should be made aware of some of the adaptations (e.g., appearances, behaviour, chemical cues, etc.).

➢ Student Learning Activities

Class Discussion S1-0-7e

Students use a Roundtable format to identify ways in which plants and animals increase their chance of reproductive success. Initial examples, such as insects that produce many eggs, may need to be provided. (See *Success for All Learners*, page 7.3)

Field Trip: Students visit a park, wildlife refuge, or wilderness area to identify ways in which plant and animal species enhance their reproductive success. Students discuss ways in which they will make observations, note locations, gather and record findings, etc.

Guest Speaker: Invite a local hunter, conservation officer, or zoologist to give a presentation on this topic. Students prepare questions in advance of the visit. Questions may include:

- What adaptations are you aware of that improve reproductive success?
- What strategies are used to maintain plant and animal populations in this area?
- What effect does captivity have on reproductive success?

(continued)

Suggestions for Assessment

Written Quiz/Test

Students

- complete a matching quiz where one column contains the names of organisms, and the other column contains a list of reproductive strategies.
- explain how courtship behaviours and mating calls could aid in species recognition.
- describe adaptations of plant and animal species that enhance reproductive success.

The review questions generated by the students could be used for the quiz/test.

(continued)

Suggested Learning Resources

Science 9

7.1 Reproductive Strategies, p. 202

8.1 Survival and Development of Organisms, p. 232

BLM 7.4 Ontario — A Pollen Paradise

TSM-3 Cooperative Learning

Sciencepower 9

2.2 Sexual Reproduction in Animals, p. 51

2.3 Sexual Reproduction in Plants, p. 60

2.4 The Value of Variation, p. 92

Success for All Learners

5.1 Flexible Grouping

7.3 Questioning and Discussion Strategies

PRESCRIBED LEARNING OUTCOMES
Students will...
(continued) **S1-1-08** Investigate and explain adaptations of plant and animal species which enhance reproductive success. *Examples: appearance, behaviour, number of gametes or offspring, chemical cues…* GLO: D2, E1, E2

SUGGESTIONS FOR INSTRUCTION
(2 HOURS)

➢ **Student Learning Activities (continued)**

Student Research S1-0-2a, 2c, 5c

Students research adaptations that enhance reproductive success, such as

- behaviour (e.g., parental care of offspring)
- appearance (e.g., flower or bird colours)
- mating calls (e.g., elk bugling)
- chemical cues (e.g., flower scents, pheromones)
- courtship behaviour (e.g., ruffed grouse)
- number of offspring produced (e.g., insects)
- number of gametes produced (e.g., fish)

A variety of sources, including the Internet, can be used to gather information. Word processing and desktop publishing software can be used for report writing.

Collaborative Teamwork S1-0-4e

Students use a Jigsaw to learn about the adaptations of plant and animal species that enhance reproductive success. (See *Success for All Learners*, page 5.9, and *SYSTH*, pages 3.19, 3.20)

Class Discussion

The following question could be used to initiate a class discussion:

Which reproductive strategy do you think is the most efficient?

Journal Writing

Students reflect and respond to the following questions:

- Why is reproduction essential to life?
- Which reproductive strategy did you find most interesting, and why?
- Which reproductive strategy did you find to be most efficient, and why?

Students generate and share a list of review questions with their peers.

Suggestions for Assessment

Research Report S1-0-2a, 2c, 5c

Students or student groups investigate a specific adaptation and prepare

- written reports
- oral presentations
- posters
- pamphlets
- information technology presentations
- dramatic presentations
- multimedia presentations

(See Appendix 5.2)

Journals

Assess journal entries using *SYSTH*, page 13.21.

Suggested Learning Resources

SYSTH

3.19 Cooperative Learning and Science

3.20 Cooperative Learning and Science

13.21 Writing to Learn Science

Success for All Learners

5.9 Jigsaw: A Cooperative Learning Strategy

Appendices

5.2 Rubric for the Assessment of Class Presentations

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-09 Describe the structure and function of the male and female human reproductive systems.

Include: role of hormones.

GLO: D1, E1, E2

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-3b. Identify probable mathematical relationships between variables.
Examples: relationship between current and resistance...
GLO: C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-6a. Interpret patterns and trends in data, and infer and explain relationships.
(ELA: S1: 3.3.1) GLO: C2, C5;
TFS: 1.3.1, 3.3.1

S1-0-7a. Draw a conclusion that explains the results of an investigation.
Include: cause and effect relationships, alternative explanations, supporting or rejecting the hypothesis or prediction.
(ELA: S1: 3.3.4) GLO: C2, C5, C8

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(3 HOURS)

➢ Entry-Level Knowledge

Students have not studied the structure and function of the male and female reproductive systems in previous science courses; however, some students may have been introduced to this topic in Health Education classes. Consult with a teacher responsible for Physical Education/Health Education to plan instruction.

➢ Notes for Instruction

Check for prior knowledge, noting emerging student conceptions and comfort levels. Use a Question Box to accept anonymous requests for clarification or information and answer these questions in class. Consult with a teacher responsible for Physical Education/Health Education on how to approach these questions.

Note: Approach the topic from an anatomical and physiological perspective only. Stress the use of the correct terminology. Use a Sort and Predict activity as a vocabulary warm-up/review.

➢ Student Learning Activities

Prior Knowledge Activity: From a diagram of the male and the female reproductive systems, students identify as many structures as they can.

Class Discussion S1-0-7e

Students discuss the importance of reproduction and speculate about the necessity of the survival of an individual or a species.

Students discuss the differences and similarities between human males and females. A KWL frame could be used. (See *SYSTH*, page 9.8)

Visual Displays S1-0-2c, 5c

Students label diagrams or create posters showing the locations of the male and female reproductive structures. Students can also draw diagrams illustrating how hormones regulate the male and female reproductive systems.

Collaborative Teamwork S1-0-4e

Students use a Jigsaw to learn about the male and female structures and functions. (See *Success for All Learners*, page 5.3)

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- label diagrams including the functions of the parts of the male and female reproductive systems.
- describe how the male and female reproductive systems are regulated by hormones.
- create and/or complete crossword puzzles of terms related to the topic.
- interpret graphs to determine the role of hormones in regulating the menstrual cycle.

(continued)

Suggested Learning Resources

Science 9

7.6 Sex Cell Development in Males, p. 214

7.7 Sex Cell Development in Females, p. 216

7.8 Case Study: Hormones and the Reproductive Cycle, pp. 220–21

BLM 7.7 Cross-Section of Female Reproductive System

TSM-3 Cooperative Learning

TSM-6 Graphic Organizers

Sciencepower 9

3.1 Reproductive Systems, p. 80

Investigation 3-A: How Do We Know What Ovarian Hormones Do?, p. 87

Investigation 3-D: Interpreting Hormonal Cycles, pp. 102–04

BLM 3-3 Does the Canada Lynx Go Through Puberty?

BLM 3-4 Effects of Testosterone on Target Tissues

BLM 3-5 Sperm Development

BLM 3-6 Egg Development in the Ovary

BLM 3-7 Effects of Hormones During Stages of the Menstrual Cycle

BLM 3-9 Female Hormone Levels

BLM 3-10 Investigating Amenorrhea

BLM 3-11 Review Key Terms

BLM 3-12 What Happens after Menopause?

(continued)

PRESCRIBED LEARNING OUTCOMES
Students will...
(continued) **S1-1-09** Describe the structure and function of the male and female human reproductive systems. Include: role of hormones. GLO: D1, E1, E2

SUGGESTIONS FOR INSTRUCTION
(3 HOURS)

➢ **Student Learning Activities (continued)**

Journal Writing S1-0-2c

Students complete Concept Frames, Concept Overviews, Compare and Contrast charts, a Word Cycle, or Three-Point Approach to demonstrate their understanding of the concepts and vocabulary. (See *SYSTH*, pages 10.9, 10.15, 10.21, 11.23)

Visual Displays

Students use a variety of charts, videos, overheads, and CD-ROMs to illustrate the male and female reproductive system, and the role that hormones play in their regulation.

Laboratory Activity S1-0-5c, 6a, 7a

Students interpret the role of hormones in the menstrual cycle.

Journal Writing

Students reflect on and respond to the following questions:

- What are the major differences between the male and female reproductive systems?
- What did you learn that was completely new to you?
- What new findings were most surprising to you and why?
- What questions do you still have regarding the reproductive system?

Article Analysis: Students use an Article Analysis frame to analyze texts that discuss new advances in reproduction technology. (See *SYSTH*, pages 11.30, 11.41)

Suggestions for Assessment

Visual Displays S1-0-2c,5c

Working individually or in small groups, students prepare visual displays of the parts of the male and female reproductive systems, their functions, and hormonal control. The displays may include:

- posters
- diagrams
- information technology presentations
- concept maps

Laboratory Report S1-0-3b, 5c, 6a, 7a

Students prepare a report about the role of hormones in the menstrual cycle. Word processing, spreadsheet, and desktop publishing software can be used.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.19)

Suggested Learning Resources

SYSTH

9.8	Tapping into Prior Knowledge
10.9	Building a Scientific Vocabulary
10.15	Building a Scientific Vocabulary
10.21	Building a Scientific Vocabulary
11.20	Developing Scientific Concepts Using Graphic Displays
11.23	Developing Scientific Concepts Using Graphic Displays
11.30	Developing Scientific Concepts Using Graphic Displays
11.41	Developing Scientific Concepts Using Graphic Displays
13.21	Writing to Learn Science

Success for All Learners

5.3	Individual, Small-Group, and Whole-Class Work
6.20	Prior Knowledge Strategies

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-10 Outline human development from conception through birth.

Include: X and Y chromosomes, zygote, embryo, fetus.

GLO: D1, E1, E2, E3

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-6a. Interpret patterns and trends in data, and infer and explain relationships.
(ELA: S1: 3.3.1) GLO: C2, C5;
TFS: 1.3.1, 3.3.1

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Entry-Level Knowledge

Students have not studied human development from conception to birth in previous science courses; however, students may have been introduced to this topic in Health Education classes. Consult with a teacher responsible for Physical Education/Health Education.

➢ Student Learning Activities

Visual Displays S1-0-2a, 2c

Students label diagrams or create posters outlining human development. A timeline can also be created to show events from the fertilization of an egg to birth. Students can develop their own personal timeline of development by working backward from their birthdate.

Students use a variety of charts, videos, overheads, and CD-ROMs to illustrate human development.

Journal Writing S1-0-2c

Students use a Word Cycle or Three-Point Approach to develop an understanding of concepts and vocabulary. Students use a KWL framework to describe what they know, want to know, and have learned. (See *SYSTH*, pages 10.21, 10.22, 9.24)

Guest Speaker: Invite a public health nurse to give a presentation on this topic. Students prepare questions in advance of the visit. Questions may include:

- What education/experience/background is required to do your job?
- What sorts of tasks do you perform in the course of your workday?
- How would you explain human development to a client?

Collaborative Teamwork S1-0-4e

Students use a Jigsaw to learn about the stages of human development from conception to birth. Student groups research the developmental changes that an embryo undergoes during one of each of the nine months or during one of the trimesters. Following the investigation, students share their findings with the class.

Laboratory Activity S1-0-5c, 6a

Students complete an activity on fetal/embryonic development. (See Appendix 1.5)

Journal Writing S1-0-7e

Students prepare a glossary of new words for quick reference.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- create a timeline outlining the stages of human development.
- differentiate among the terms zygote, embryo, and fetus.
- label diagrams of the stages of human development.
- write an essay describing the events of human development.

Visual Displays S1-0-2a, 2c, 5c

Students or student groups prepare visual displays of human development from conception to birth. The displays may include:

- posters
- diagrams
- information technology presentations
- concept maps
- models
- timelines
- events chain

Laboratory Report S1-0-5c, 6a

Students prepare a lab report about fetal/embryonic development. Word processing, spreadsheet, and desktop publishing software can be used.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, pages 9.9, 9.24, 11.26, 11.33, 14.11)

Teacher Background

Teachers should focus on outlining the major events of human development. An exhaustive treatment of the learning outcome is not required. Review the following prior to teaching this section: zygote, diploid, cleavage, as well as the developmental stages of an embryo.

Suggested Learning Resources

Science 9

8.4 Activity: Eggs and Embryonic Development, pp. 240–41

8.5 Human Conception And Pregnancy, p. 242

8.8 The Human Embryo, p. 250

8.10 Birth, p. 254

BLM 8.5 Path of a Fertilized Egg

BLM 8.10a Four Stages of Labour

Sciencepower 9

3.2 Pregnancy, p. 91

3.3 Differentiation and Birth, p. 95
Investigation 3-C:
Fetal Development, p. 99

BLM 2-19 Development of the Human Embryo

BLM 3-13 Inner Space Is the Limit

BLM 3-15 Early Stages of Human Development

BLM 3-16 Investigation 3-C

BLM 3-17 Critical Periods

BLM 3-19 Create a Human

Appendices

1.5 Blackline Master
Human Development

SYSTH

9.9, 9.24 Tapping into Prior Knowledge

10.21, 10.22 Building a Scientific Vocabulary

11.26, 11.33 Developing Scientific Concepts Using Graphic Displays

14.11 Technical Writing in Science

Success for All Learners

5.3 Flexible Grouping

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-11 Observe, collect, and analyze class data of single trait inheritance.

Examples: hand clasping, earlobe attachment, tongue rolling...

GLO: C2, D1

S1-1-12 Differentiate between dominant and recessive traits.

Include: genotype and phenotype

GLO: D1, E1, E2

Skills and Attitudes Outcomes

S1-0-1a. Propose questions that could be tested experimentally.
(ELA: S1: 3.1.2) GLO: C2

S1-0-1b. Select and justify various methods for finding the answers to specific questions.
(Math: S1: A-1) GLO: C2

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-3a. State a testable hypothesis or prediction based on background data or on observed events.
GLO: C2

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

SUGGESTIONS FOR INSTRUCTION

(3 HOURS)

➢ Entry-Level Knowledge

Students have not previously studied genetics and heredity but may be familiar with the inheritance of some traits such as eye colour.

➢ Notes for Instruction

Outcomes S1-1-11 and S1-1-12 can be learned together.

Discuss examples of human dominant and recessive traits, including:

- eye colour: brown = dominant, blue = recessive
- chin shape: cleft = dominant, smooth = recessive
- earlobes: free = dominant, attached = recessive

See Appendix 1.6 for additional traits.

Use diagrams/overheads to show that dominant traits are identified with upper case letters and recessive traits with lower case (e.g., dimples = D, no dimples = d). Differentiate between genotype and phenotype. Demonstrate how the DD or Dd genotype produces the dimple phenotype, and the dd genotype results in the non-dimple phenotype.

Use Punnett squares to predict the results of single trait crosses. See the Appendix for additional activities. Be sensitive when discussing traits inherited from biological parents, because several students may be adopted or may not have contact with their natural parents.

➢ Student Learning Activities

Class Discussion S1-0-7e

Students use a KWL chart to activate prior knowledge. Students discuss the importance of the study of genetics and what they would like to learn about genetics. Students discuss how traits are inherited from parents (e.g., Are traits "blended," or can brown-eyed parents have a blue-eyed child? What is the role of sexual reproduction in the process? Why do some traits "skip a generation?"). (See *SYSTH*, Chapter 9)

Journal Writing S1-0-6a

Students list the traits they have that closely resemble and/or differ from those of their siblings or other relatives. Students speculate on why some traits are similar while others are different.

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- complete a Compare and Contrast or Concept Relationship frame to demonstrate their understanding of the terms genotype and phenotype, dominant and recessive. (See *SYSTH*, pages 10.24, 11.20)
- solve genetics problems using Punnett squares (e.g., if both parents and one son can roll their tongues [a dominant trait], why is it that their daughter cannot roll her tongue [a recessive trait]?).
- complete a Word Cycle relating the terms: DNA, chromosomes, genes, genotype, traits, dominant, recessive, and phenotype. Assess the logic of the relationships between the terms in the cycle.
- describe the resulting offspring by completing a Punnett Square indicating the phenotype of both parents.
- consider each example from a list of traits and characteristics and classify it as being either acquired, innate, or innate AND acquired.

(continued)

Suggested Learning Resources

Science 9

TSM-3 Cooperative Learning

TSM-6 Graphic Organizers

Sciencepower 9

Ask an Expert, pp. 144–45

Project: Secret Faces, p. 147

BLM 2-1 Observing Human Characteristics

BLM 2-2 Which Traits are Most Common?

BLM 2-3 How Organisms Get Their Traits

BLM 2-4 All in the Family

BLM 2-5 Mendel's Work with Peas

BLM 2-6 Albino Offspring in Plants

BLM 2-7 Explaining Mendel's Work

BLM 2-8 Concept Mapping Heredity

Appendices

1.6 Blackline Master
Human Traits — Punnett Squares

SYSTH

Chapter 9 Tapping into Prior Knowledge

10.24 Building a Scientific Vocabulary

11.20 Developing Scientific Concepts Using Graphic Displays

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-1-11 Observe, collect, and analyze class data of single trait inheritance.

Examples: hand clasping, earlobe attachment, tongue rolling...

GLO: C2, D1

S1-1-12 Differentiate between dominant and recessive traits.

Include: genotype and phenotype

GLO: D1, E1, E2

Skills and Attitudes Outcomes

S1-0-6a. Interpret patterns and trends in data, and infer and explain relationships.
(ELA: S1: 3.3.1) GLO: C2, C5;
TFS: 1.3.1, 3.3.1

S1-0-6b. Identify and suggest explanations for discrepancies in data.
Examples: sources of error...
(ELA: S1: 3.3.3) GLO: C2

S1-0-6c. Evaluate the original plan for an investigation and suggest improvements.
Examples: identify strengths and weaknesses of data collection methods used...
GLO: C2, C5

S1-0-7a. Draw a conclusion that explains the results of an investigation.
Include: cause and effect relationships, alternative explanations, supporting or rejecting the hypothesis or prediction.
(ELA: S1: 3.3.4) GLO: C2, C5, C8

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION
(3 HOURS)

➢ **Student Learning Activities (continued)**

Laboratory Activity S1-0-4e, 5c, 6a, 6b, 6c

From a list of dominant and recessive traits in humans, students observe and record selective traits in classmates and determine their genetic expression.

Using a prepared list of dominant and recessive facial features, students flip two coins to derive the genotypes of the traits. Students then determine the phenotype expression of each trait, and draw the portrait of their "baby." Have students analyze family and construct a pedigree (See Appendix 1.10)

Journal Writing S1-0-2c

Students identify the meanings of new words, and keep a personal glossary for quick reference at the back of their journals.

Students complete Compare and Contrast or Three-Point Approach frames to demonstrate their understanding of vocabulary. (See *SYSTH*, pages 10.9, 10.15, and 10.22)

Collaborative Teamwork S1-0-1a, 1b, 3a

Students work in teams to solve single trait genetics problems. (Emphasize the ability of genetics to predict outcomes. For example, if brown eye colour in humans is dominant over blue, can two blue-eyed parents have a brown-eyed child?)
(See Appendices 1.7, 1.8, and 1.9)

Case Study: Students complete missing data from a genealogical table (either a fictional or real-life scenario).

SUGGESTIONS FOR ASSESSMENT

Laboratory Report S1-0-5c, 6a, 6b,7a

Students

- analyze class data of a variety of single inheritance traits and prepare a report of their findings. Spreadsheet and word processing software can be used.
- prepare portraits of their "babies." Assess portraits on the basis of phenotype accuracy when compared to the genotypes obtained from coin tosses.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

SUGGESTED LEARNING RESOURCES

Appendices

1.7 Student Learning Activity
Single Trait Inheritance Problems

1.8 Student Learning Activity
Genetics — Punnett Squares

1.9 Student Learning Activity
Vocabulary Review on Genes

1.10 Student Learning Activity
It Runs in the Family

SYSTH

10.9, 10.15, 10.22
Building a Scientific Vocabulary

13.21 Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-13 Describe the relationships among DNA, chromosomes, genes, and the expression of traits.

Include: genetic similarity among all humans.

GLO: A2, D1, E1, E2

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION
(1 HOUR)

➢ Entry-Level Knowledge

Students are familiar with chromosomes and traits from previous learning outcomes in this cluster, and will be accustomed to the term genes.

➢ Notes for Instruction

Activate prior knowledge by asking students what comes to mind when they hear the terms DNA and gene. Have students suggest definitions of these terms and how they are related to chromosomes and the expression of traits. Use examples such as dimples in the discussion. A KWL frame could be used. (See *SYSTH*, pages 9.8–9.9 and 9.24)

Introduce some of the ways scientists can compare DNA between different people and/or different species (e.g., DNA fingerprinting).

➢ Student Learning Activities

Visual Displays S1-0-2c, 5c

Students draw and label diagrams or build models showing the relationship among DNA, chromosomes, genes, and the inheritance of traits.

Journal Writing S1-0-2c, 7e

Students reflect on the following metacognitive questions:

- How does the new knowledge compare to what I used to think?
- How can I make sure that I can remember this?

Students complete a Concept Map or Three-Point Approach to demonstrate their understanding of vocabulary and concepts. (See *SYSTH*, pages 9.6 and 10.9)

Students describe the importance of methods that enable scientists to compare genetic material. Students reflect and respond to questions such as:

- Why is it important or advantageous to be able to compare genetic material?
- In what ways can this information help us?

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- describe the relationship among DNA, chromosomes, and genes.
- label a diagram of the relationship among DNA, chromosomes, and genes.
- complete a Word Cycle using the terms DNA, genotype, dominant, chromosome, phenotype, gene, recessive, trait, and inheritance. Assess the connections made between the terms.
- construct a Concept Map to show the relationship among DNA, chromosomes, genes, and the expression of traits. Words from the previous learning outcomes, such as genotype, inheritance, and so on, can be included.

Visual Displays S1-0-2c, 5c

Assess student diagrams/models according to the relationship shown among DNA, chromosomes, and genes.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Suggested Learning Resources

Science 9

6.1 The Genetic Material, p. 176

TSM-3 Cooperative Learning

TSM-7 Graphic Organizers

Sciencepower 9

4.2 The Importance of DNA, p. 114

Investigation 4-A: Extracting DNA from Onions, p. 115

SYSTH

9.6, 9.8, 9.24	Tapping into Prior Knowledge
10.9, 10.15	Developing Scientific Concepts Using Graphic Displays
13.21	Writing to Learn Science

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-14 Explain the inheritance of sex-linked traits in humans and use a pedigree to track the inheritance of a single trait.

Examples: colour-blindness, hemophilia…

GLO: D1, E1, E2

Skills and Attitudes Outcomes

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-3c. Plan an investigation to answer a specific scientific question.
Include: materials, variables, controls, methods, safety considerations.
GLO: C1, C2

S1-0-4a. Carry out procedures that comprise a fair test. Include: controlling variables, repeating experiments to increase accuracy and reliability of results.
GLO: C1, C2; TFS: 1.3.1

S1-0-4e. Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise.
(ELA: S1: 3.1.3, 5.2.2) GLO: C2, C4, C7

S1-0-5a. Select and use appropriate methods and tools for collecting data or information.
GLO: C2; TFS: 1.3.1

S1-0-5c. Record, organize, and display data using an appropriate format.
Include: labelled diagrams, graphs, multimedia
(ELA: S1: 4.1.1, 4.1.2) GLO: C2, C5;
TFS: 1.3.1, 3.2.2

S1-0-6a. Interpret patterns and trends in data, and infer and explain relationships.
(ELA: S1: 3.3.1) GLO: C2, C5;
TFS: 1.3.1, 3.3.1

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Entry-Level Knowledge

Students are familiar with gametes and chromosomes from previous learning outcomes in the cluster.

➢ Notes for Instruction

To introduce sex-linked traits, survey the class to determine how many students know someone who is colour-blind. Then ask how many of these colour-blind people are male and how many are female. Ask why that may be. Make the distinction between autosomes and sex-linked chromosomes. Use overheads or diagrams to show how sex-linked genes are identified with letters (e.g., X^BX^b or X^bY). Ask students to predict gamete genotypes of traits carried on the sex chromosomes. Students then predict how recessive sex-linked traits are expressed using examples such as red-green colour-blindness. Examine the implications of males carrying one gene and females carrying two genes of a sex-linked trait. (See Appendix 1.11)

➢ Student Learning Activities

Journal Writing S1-0-2c, 6a, 7e

Students speculate on how the gene for hemophilia was acquired by Queen Victoria of England. (Note: The lives of European royalty are well documented, and it has been noted that there is no history of hemophilia in the British royal family prior to Queen Victoria.) Students use a Concept Frame or Overview to develop an understanding of sex-linked inheritance. (See *SYSTH*, pages 11.20–11.22)

Collaborative Teamwork S1-0-4e

Students work in teams to solve problems related to the inheritance of sex-linked traits. Students predict the passage of the hemophilia gene in Queen Victoria's children and grandchildren with the use of a pedigree.

Students explain the transmission of the passage of a unique hereditary trait or disease from preceding to present generations of a familiar family.

Laboratory Activity S1-0-3c, 4a, 5a, 5c

Students gather and analyze class data using colour-blindness test charts (available in many biology texts). (Approximately one male in 10 and one female in 100 have red-green colour-blindness.)

Student Research S1-0-4e

Students research the inheritance of sex-linked traits among historical figures.

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Test/Quiz

Students

- describe the inheritance of sex-linked traits.
- solve sex-linked inheritance problems.
- use a pedigree to track the inheritance of a single trait.
- complete a Compare and Contrast or Concept Relationship frame demonstrating their understanding of autosomal and sex-linked inheritance. (See *SYSTH*, pages 10.24, 11.20, 11.35)
- suggest appropriate symbols for various dominant and recessive genes.

Visual Displays S1-0-2c, 5c

Students prepare charts showing possible genotypes of a sex-linked trait and the phenotypes produced for both men and women.

Laboratory Report S1-0-3c, 4a, 5a, 5c

Students analyze the class colour-blindness data and prepare a report of their findings. Spreadsheet and word processing software can be used.

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

Teacher Background

Sex-linked traits are recessive, carried on the X-chromosome. As a consequence, the fact that males carry one gene and females carry two genes causes certain traits to be expressed more often in males than in females. Examples of sex-linked traits are: red-green colour blindness, Duchenne muscular dystrophy, and hemophilia.

Suggested Learning Resources

Science 9

TSM-3 Cooperative Learning

Sciencepower 9

BLM 2-3 How Organisms Get Their Traits

BLM 2-4 All in the Family

Appendices

1.11 Student Learning Activity Making Sense of Sex-Linked Traits

SYSTH

10.15 Building a Scientific Vocabulary

11.20 Developing Scientific Concepts Using Graphic Displays

13.21 Writing to Learn Science

Teacher Resources

Biology textbooks can provide additional information

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-15 Investigate and describe environmental factors and personal choices that may lead to a genetic mutation or changes in an organism's development.

Examples: fetal exposure to alcohol, overexposure to sunlight, toxins, hormone mimics, food additives, radiation…

GLO: B1, B3, D1, D2

Skills and Attitudes Outcomes

S1-0-1d. Identify stakeholders and initiate research related to an STSE issue.
(ELA: S1: 3.1.4, 4.4.1) GLO: C4

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3;
Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6;
TFS: 1.3.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-3d. Summarize relevant data and consolidate existing arguments and positions related to an STSE issue.
(ELA: S1: 1.2.1, 3.3.1, 3.3.2) GLO: C4;
TFS: 2.3.1, 4.3.4

S1-0-5d. Evaluate, using pre-determined criteria, different STSE options leading to a possible decision.
Include: scientific merit; technological feasibility; social, cultural, economic, and political factors; safety; cost; sustainability.
(ELA: S1: 3.3.3) GLO: B5, C1, C3, C4;
TFS: 1.3.2, 3.2.3

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

S1-0-8g. Discuss social and environmental effects of past scientific and technological endeavours.
Include major shifts in scientific world views, unintended consequences.
GLO: B1

S1-0-9f. Demonstrate personal involvement and be proactive with respect to STSE issues.
GLO: B5, C4

SUGGESTIONS FOR INSTRUCTION

(1-1/2 HOURS)

➢ Entry-Level Knowledge

Students have not previously studied causes of genetic mutations or changes in development; however, they may have some prior knowledge gathered from life experience or the media.

➢ Notes for Instruction

Discuss the importance of lifestyle choices students make to their health and development. Ask them if they know what kinds of materials can cause mutations and what precautions can be taken to minimize their own personal risk of an increased rate of mutation. (See Appendix 1.12)

➢ Student Learning Activities

Journal Writing S1-0-2c, 7e

Students complete a KWL chart to activate their prior knowledge. (See *SYSTH*, pages 9.8–9.9)

Students reflect in writing on how their lifestyle choices may have an impact on their own health and the health of others (e.g., poem, story, diary entry, song, etc.).

Students complete a fact- or issue-based article analysis of a current newspaper or magazine article related to the topic.

Guest Speaker: Contact the Canadian Cancer Society or a Public Health Nurse to give a presentation on the topic. Students prepare questions in advance of the visit. Questions may include:

- What environmental factors are known to cause cancer?
- What lifestyle choices are known to cause cancer?
- What are the leading types of cancer suffered by Canadian men/women?

Class Discussion S1-0-1d, 3d, 5d, 9f

Students debate the ethical dilemma surrounding fetal alcohol syndrome. Potential divergent values include the infringement on mothers' rights and the welfare of the fetus.

(continued)

Suggestions for Assessment

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Student Research

Students

- identify substances that may cause genetic mutations.
- identify substances that may cause changes in development.
- identify potentially harmful environmental factors and individual choices over which they have some control.
- describe preventative measures they may take to reduce the risk of genetic mutations or changes in development.
- complete a fact- or issue-based article analysis of a current newspaper or magazine article related to the learning outcome. (See *SYSTH*, pages 11.30, 11.40)
- write a newspaper article outlining current research and findings related to the topic.

(continued)

Suggested Learning Resources

Science 9

6.2 DNA, Mutations, and Cancer, p. 180

6.3 Activity: Lifestyle and Cancer, pp. 182–83

6.4 Investigation: Inhibiting Cell Division, pp. 184–85

8.9 Explore an Issue: Fetal Alcohol Syndrome, pp. 252–53

TSM-3 Cooperative Learning

TSM-9 Debating

Sciencepower 9

1.3 The Cell Cycle in Your Body, p. 24

3.3 Differentiation and Birth, p. 95
Investigation 3-D: Public Education Campaign pp. 102–04

BLM 1-20 Estimated New Cases and Deaths for Selected Cancer Sites by Sex, Canada 1999

BLM 1-21 Factors that Affect Development of Cancer

BLMG-39 Internet Research Tips

BLMG-40 Internet Research Worksheet

SYSTH

9.8 Tapping into Prior Knowledge

11.30, 11.40 Developing Scientific Concepts Using Graphic Displays

(continued)

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION (1-1/2 HOURS)
Students will...	
(continued) **S1-1-15** Investigate and describe environmental factors and personal choices that may lead to a genetic mutation or changes in an organism's development. *Examples: fetal exposure to alcohol, overexposure to sunlight, toxins, hormone mimics, food additives, radiation…* GLO: B1, B3, D1, D2	➢ **Student Learning Activities (continued)** **Student Research S1-0-2a, 2c, 8g** Students research possible environmental factors that may lead to genetic mutation or changes in development. For example: • fetal exposure to alcohol • overexposure to sunlight • toxins • carcinogens • food additives • hormone mimics • pollution • pesticides A variety of information sources, including the Internet, can be used. Word processing and desktop publishing software can be used to prepare reports.

Suggestions for Assessment

Research and Reporting S1-0-2a, 2c, 8g

Students or student groups investigate a lifestyle choice or environmental factor that may cause a mutation or developmental change, and prepare

- written reports
- oral presentations
- posters
- pamphlets
- information technology presentations
- cartoon/comic books
- newspaper articles
- dramatic presentations
- multimedia presentations

(See Appendix 5.2)

Teacher Background

A mutation is a change in the genetic material (DNA) of a cell. Mutations may occur in any cell of the body and may be the result of one or several unpredictable factors. If the mutations affect the reproductive cells, they can be passed from one generation to the next. Mutations that affect other cells of the body are not inheritable. Many cancers are caused by such mutations.

Not all mutations are harmful. Many have no effect, or cause slight, harmless changes (e.g., blue eye colour in humans). Occasionally, mutations arise that are beneficial to organisms. Many such beneficial mutations can also be the result of genetic engineering, where a specific mutation is acquired in a lab and repeated many times over. Some bacteria may have developed resistance to antibiotics in this manner.

Suggested Learning Resources

Appendices

1.12 Student Learning Activity Mutations

5.2 Rubric for the Assessment of Class Presentations

Other Resources

Consult the Internet, print, and electronic media for current information related to this topic (e.g., Canadian Cancer Society pamphlets and website). See Learning Resources and Links section of the Science website at http://www.gov.mb.ca/curricul/K-S4curr/science/

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-16 Investigate Canadian and international contributions to research and technological development in the field of genetics and reproduction.

Example: Human Genome Project

GLO: A3, A4, B1, B2

Skills and Attitudes Outcomes

S1-0-2a. Select and integrate information obtained from a variety of sources.
Include: print and electronic sources, specialists, and other resource people.
(ELA: S1: 3.1.4, 3.2.3;
Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6;
TFS: 1.3.2, 4.3.4

S1-0-2b. Evaluate the reliability, bias, and usefulness of information.
(ELA: S1: 3.2.3, 3.3.3) GLO: C2, C4, C5, C8;
TFS: 2.2.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms.
Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources.
(ELA: S1: 3.3.2) GLO: C2, C4, C6;
TFS: 2.3.1, 4.3.4

S1-0-7e. Reflect on prior knowledge and experiences to develop new understanding.
(ELA: S1: 4.2.1) GLO: C2, C3, C4

S1-0-8c. Describe examples of how scientific knowledge has evolved in light of new evidence, and the role of technology in this evolution.
GLO: A2, A5

S1-0-8d. Describe examples of how technologies have evolved in response to changing needs and scientific advances.
GLO: A5

S1-0-8e. Discuss how peoples of various cultures have contributed to the development of science and technology.
GLO: A4, A5

S1-0-9a. Appreciate and respect that science and technology have evolved from different views held by women and men from a variety of societies and cultural backgrounds.
GLO: A4

SUGGESTIONS FOR INSTRUCTION

(2 HOURS)

➢ Notes for Instruction

Take advantage of current research and technological developments available in both print and electronic media. (See Suggested Learning Resources)

➢ Student Learning Activities

Collaborative Teamwork S1-0-2a, 2b, 8c, 8d

Student groups clip relevant newspaper and magazine articles and search the Internet for accurate information to create a scrapbook. Groups then annotate the articles, stating the connection to the cluster and the background knowledge needed to understand the article.

Students complete a fact- or issue-based article analysis of a current newspaper or magazine article related to the topic. (See *SYSTH*, pages 11.30, 11.40)

Journal Writing S1-0-2c, 7e

Students prepare a glossary of new words for quick reference.

Student Research S1-0-2a, 2c, 8e, 9a

Students research Canadian and international contributions in the field of genetics and reproduction such as

- Human Genome Project
- in vitro fertilization
- cystic fibrosis research
- genetic engineering
- fetal alcohol syndrome
- gene therapy
- fertility drugs
- genetically modified food

Information can be gathered from a variety of sources. Word processing and desktop publishing software can be used to prepare reports.

Class Discussion: The themes of several popular movies and books are centred on the advantages of different human mutations (e.g., X-Men). Students reflect on which human mutations would be possible and/or desirable, and then discuss whether or not the Human Genome Project should be used for these purposes, giving justification for their opinions.

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- describe the Human Genome Project, and suggest reasons why it is important for our understanding of human genetics.
- use a Compare and Contrast frame to differentiate between science and technology in terms of their purpose, procedures, and products. (See *SYSTH*, pages 10.15, 10.24)
- complete a fact- or issue-based article analysis of a current newspaper or magazine article related to Canadian and international contributions. (See *SYSTH*, pages 11.30, 11.40)
- write a newspaper article outlining current research and findings related to the learning outcome.

Research Report S1-0-2a, 2b, 2c

Working individually or in small groups, students investigate a particular contribution, and prepare

- written reports
- oral presentations
- posters
- pamphlets
- information technology presentations
- cartoon/comic books
- newspaper articles

(See Appendix 5.2)

Journals

Assess journal entries using a Journal Evaluation rubric. (See *SYSTH*, page 13.21)

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

6.1 DNA: The Genetic Material, p. 176

6.9 Cloning, p. 198

7.5 Reproduction of Plants for Food, p. 212

8.6 Human Reproductive Technology, p. 244

BLM 6.5 Isolation and Growth of Stem Cells

BLM 6.9a Cloning Using a Fertilized Nucleus

BLM 6.9b Cloning by Embryo Splicing

BLM 6.9c Cloning Using a Somatic Cell

BLM 8.6a Fertility Drugs

BLM 8.6b Intrauterine Insemination

BLM 8.6c In Vitro Fertilization

BLM 8.6d Embryo Transfer

TSM-3 Cooperative Learning

Sciencepower 9

4.1 Biotechnology, p. 110

4.2 The Importance of DNA, p. 114

4.3 Biotechnology and the Human Body, p. 122

4.4 Biotechnology in Agriculture, p. 127

4.5 Biotechnology in the Environment, p. 132

BLM 4-10 Method for Cloning Mammals

BLM 4-13 Reading the Human Blueprint

BLM 4-15 Making Biotech Corn

(continued)

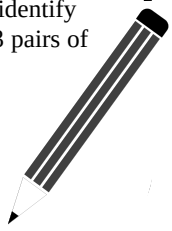
PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION (2 HOURS)
Students will...	
(continued) **S1-1-16** Investigate Canadian and international contributions to research and technological development in the field of genetics and reproduction. *Example: Human Genome Project* GLO: A3, A4, B1, B2	

SUGGESTIONS FOR ASSESSMENT

SUGGESTED LEARNING RESOURCES

Teacher Background

The Human Genome Project is an ambitious endeavour to identify and sequence the 3.2 billion base pairs that compose the 23 pairs of human chromosomes. Completion of this project will revolutionize research in the areas of gene therapy and the correction of genetic defects and illnesses.



Sciencepower 9 (continued)

BLMG-39	Internet Research Tips
BLMG-40	Internet Research Worksheet

SYSTH

10.15	Building a Scientific Vocabulary
10.24	Building a Scientific Vocabulary
11.20, 11.30	Developing Scientific Concepts Using Graphic Displays
11.40	Developing Scientific Concepts Using Graphic Displays
13.21	Writing to Learn Science

Other Resources

Consult the Internet, print, and electronic media for information on current research and technological developments in the field of genetics and reproduction. See Learning Resources and Links section of Science website at http://www.gov.mb.ca/curricul/K-S4curr/science/

Appendices

5.2 Rubric for the Assessment of Class Presentations

PRESCRIBED LEARNING OUTCOMES

Students will...

S1-1-17 Discuss current and potential applications and implications of biotechnologies including their effects upon personal and public decision making.

Include: genetic engineering, cloning, Human Genome Project, DNA fingerprinting.

GLO: B1, B2, C4, C8

S1-1-18 Use the decision-making process to address a current biotechnology issue.

GLO: C4, C6, C7, C8

Skills and Attitudes Outcomes

S1-0-1c. Identify STSE issues which could be addressed. GLO: C4

S1-0-1d. Identify stakeholders and initiate research related to an STSE issue. (ELA: S1: 3.1.4, 4.4.1) GLO: C4

S1-0-2a. Select and integrate information obtained from a variety of sources. Include: print and electronic sources, specialists, and other resource people. (ELA: S1: 3.1.4, 3.2.3; Math: S1-B-1, 2; TFS 2.2.1) GLO: C2, C4, C6; TFS: 1.3.2, 4.3.4

S1-0-2b. Evaluate the reliability, bias, and usefulness of information. (ELA: S1: 3.2.3, 3.3.3) GLO: C2, C4, C5, C8; TFS: 2.2.2, 4.3.4

S1-0-2c. Summarize and record information in a variety of forms. Include: paraphrasing, quoting relevant facts and opinions, proper referencing of sources. (ELA: S1: 3.3.2) GLO: C2, C4, C6; TFS: 2.3.1, 4.3.4

S1-0-2d. Review effects of past decisions and various perspectives related to an STSE issue. *Examples: government's, public, environmentalists', and First Nations' positions on hydroelectric development; religious, social, and medical views on genetic screening...* (ELA: S1: 3.2.2) GLO: B1, C4; TFS: 1.3.2, 4.3.4

S1-0-3d. Summarize relevant data and consolidate existing arguments and positions related to and STSE issue. (ELA: S1: 1.2.1, 3.3.1, 3.3.2) GLO: C4; TFS: 2.3.1, 4.3.4

S1-0-8d. Describe examples of how technologies have evolved in response to changing needs and scientific advances. GLO: A5

SUGGESTIONS FOR INSTRUCTION

(2-1/2 HOURS)

➢ Entry-Level Knowledge

Students may be familiar with biotechnologies from previous outcomes, and from the media. K–8 students will also have experienced the design process, but may not have any experience with the formal decision-making process.

➢ Notes for Instruction

Outcomes S1-1-17 and S1-1-18 can be taught/learned together.

Take advantage of current biotechnology issues that are available in both print and electronic media.

Guide students through the steps of the Decision-Making Model. (See *Senior 1 Science Framework*) Model the process, guide students, and provide opportunities for practice. Keep it simple to start. (See Appendix 1.13) Other Senior 1 clusters will provide more opportunities for decision making.

➢ Student Learning Activities

Journal Writing S1-0-1c, 1d, 2d, 3d

Students reflect on the pros and cons of creating a DNA fingerprint registry of all Canadians.

Students reflect on and respond to the following questions:

- What kinds of biotechnology were available to your grandparents?
- What kinds of biotechnology are available to you?
- What kinds of biotechnology do you think will be available to your children?

Journal Writing S1-0-2c, 6d, 7b, 7c, 7d

Students complete a fact- or issue-based article analysis of a current newspaper, Internet, or magazine article related to biotechnology. (See *SYSTH*, pages 11.30, 11.40)

Students compose fictitious but scientifically accurate stories about genetic engineering accidents that have produced dangerous organisms and how these "monsters" were eventually stopped. A RAFTS format could be used. (See *SYSTH*, pages 13.23–13.28)

(continued)

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

Rubrics or checklists can be used for peer-, self-, or teacher-assessment.

Written Quiz/Test

Students

- complete a Word Cycle of terms related to biotechnology. (See *SYSTH*, page 10.21)
- write an essay defending their opinion of a biotechnology-related issue.
- complete a fact- or issue-based article analysis of a current newspaper or magazine article related to the biotechnology topic. (See *SYSTH*, pages 11.30, 11.40)
- write a newspaper article outlining current research and findings related to the biotechnology topic.

Research Report S1-0-2a, 2b, 2c, 8d

Students or student groups investigate a particular application/issue and prepare

- written reports
- oral presentations
- posters
- pamphlets
- information technology presentations
- debates
- newspaper articles
- dramatic presentations
- multimedia presentations

(See Appendix 5.2)

Journals

Assess journal entries using a Journal Evaluation form. (See *SYSTH*, page 13.21)

(continued)

SUGGESTED LEARNING RESOURCES

Science 9

5.13 Explore an Issue: Slowing Down Aging, p. 170

6.6 Explore an Issue: Transplant Farms, p. 188

7.10 Explore an Issue: Genetic Screening, p. 224

BLM 6.1c Who Committed the Crime?

BLM 7.10 Amniocentesis — A Genetic Screening Method

TSM-3 Cooperative Learning

TSM-9 Debating

Sciencepower 9

Investigation 4-C:
The Cloning Controversy, pp. 120–21

Investigation 4-D:
Genetic Screening, p. 123

Investigation 4-E:
Problems with Pesticides, p. 134

Investigation 4-F:
Assessing Breeding Potential, pp. 139–140

Issue Analysis
Genetically Altered Food, p. 146

BLM 3-1 In Vitro Fertilization Project

BLM 4-1 The Steps in Making DNA Fingerprints

BLM 4-2 Identify the Murderer

BLM 4- 8 Designer Genes: Pros and Cons

BLM 4-9 Panel Discussion about Cloning

BLM 4-11 The Proof Is in the Blood

BLM 4-12 Create a Karyotype

(continued)

PRESCRIBED LEARNING OUTCOMES

Students will...

(continued)

S1-1-17 Discuss current and potential applications and implications of biotechnologies including their effects upon personal and public decision making.

Include: genetic engineering, cloning, Human Genome Project, DNA fingerprinting.

GLO: B1, B2, C4, C8

S1-1-18 Use the decision-making process to address a current biotechnology issue.

GLO: C4, C6, C7, C8

Skills and Attitudes Outcomes

S1-0-3e. Determine criteria for the evaluation of an STSE decision.
Examples: scientific merit; technological feasibility; social, cultural, economic, and political factors; safety; cost; sustainability...
GLO: B5, C1, C3, C4

S1-0-3f. Formulate and develop options which could lead to an STSE decision.
GLO: C4

S1-0-4d. Use various methods for anticipating the impacts of different options.
Examples: test run, partial implementation, simulation, debate...
GLO: C4, C5, C6, C7

S1-0-5d. Evaluate, using pre-determined criteria, different STSE options leading to a possible decision.
Include: scientific merit; technological feasibility; social, cultural, economic, and political factors; safety; cost; sustainability.
(ELA: S1: 3.3.3) GLO: B5, C1, C3, C4;
TFS: 1.3.2, 3.2.3

S1-0-6d. Adjust STSE options as required once their potential effects become evident.
GLO: C3, C4, C5, C8

S1-0-7b. Select the best option and determine a course of action to implement an STSE decision.
GLO: B5, C4

S1-0-7c. Implement an STSE decision and evaluate its effects.
GLO: B5, C4, C5, C8

S1-0-7d. Reflect on the process used to arrive at or to implement an STSE decision, and suggest improvements.
(ELA: S1: 5.2.4) GLO: C4, C5

SUGGESTIONS FOR INSTRUCTION
(2-1/2 HOURS)

➢ **Student Learning Activities (continued)**

Collaborative Teamwork S1-0-1c, 1d, 2d, 3d, 5d, 7b

Students prepare and present mock interviews of people who have been affected by biotechnologies. For example, a television talk show host interviews David Milgaard and O.J. Simpson about DNA fingerprinting.

Students hold a mock Royal Commission on a biotechnology issue. They identify the issue and the stakeholders, break into groups representing the stakeholders, research the issue from the stakeholders' perspectives, and present their briefs at public hearings. Class discussions are held after all of the briefs have been presented, and recommendations for a course of action are developed. The Decision-Making Process could be used in this learning activity.

Class Discussion S1-0-3e, 3f, 4d, 5d

Students debate the pros and cons of biotechnology applications, such as the ethics of organ transplant farming, genetic screening, etc.

Field Trip/Guest Speaker: Students visit a lab where biotechnology methods are used OR invite a biotechnologist to the classroom. Students prepare questions in advance of the tour or visit. Questions may include:

- What biotechnology methods are used?
- Who are you clients (if appropriate)?
- What background/education/experience is required to work in the field of biotechnology?
- What proportion of your work generates revenue? What proportion is purely research? Does it provide a service to the public?

SUGGESTIONS FOR ASSESSMENT

Rubrics/Checklists

(See Appendix 5.4: Rubric for the Assessment of a Decision-Making Process Activity)

SUGGESTED LEARNING RESOURCES

BLM 4-14	How Credible are Movies?
BLM 4-17	Role-Play a Press Conference
BLM 4-18	Organic Foods
BLM 4-19	Create a Biotech Glossary
BLM 4-23	Boom or Bust of Bt?
BLM 4-24	Terminator Technology and Patents
BLM 4-25	Why Is Biodiversity Important?
BLMG-41	Procedure for a Public Hearing
BLMG-42	Debating Procedures
BLMG-28B	Debate Organizer
BLMG-44	Worksheet for Investigating Issues
BLMG-45	Decision-Making Organizer

Appendices

1.13	Student Learning Activity Biotechnology Organizer
5.2	Rubric for the Assessment of Class Presentations
5.4	Rubric for the Assessment of a Decision-Making Process Activity

SYSTH

10.21	Building a Scientific Vocabulary
11.30, 11.40	Developing Scientific Concepts Using Graphic Displays
13.21, 13.23–13.28	Writing to Learn Science

NOTES