DISCOVERING SCIENCE 9
TEACHER'S RESOURCE

UNIT 2: REPRODUCTION

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McGraw-Hill Ryerson

UNIT 2: OVERVIEW

Unit 2 provides students with the opportunity to explore and connect the fields of cell biology, molecular genetics, developmental biology, and biotechnology. Students also learn how a fertilized egg reproduces, develops, and differentiates in response to gene messages. Current research in molecular genetics, biotechnology, and reproductive technology is presented throughout the unit.

Chapter 4: The nucleus controls the functions of life. Understanding the structure of DNA and how the nucleus controls the cell's activities is an important basis for understanding reproduction. Chapter 4 begins by reviewing the parts of a cell and provides a framework to understand how the nucleus controls the functions of life. As the chapter unfolds, students are introduced to scientists' current understanding of how the nucleus functions to control the activities of a cell. Students learn about the function of genes and the function of proteins. Integrating their previous knowledge of cell functions, students understand how proteins are made within the cell. The last part of chapter 4 introduces the concept of mutation—how an error in DNA creates an error in the gene message and an error in the protein. Examples of the consequences of mutation are given.

Chapter 5: Mitosis is the basis of asexual reproduction. The concept of the nucleus controlling cell activities through the production of proteins is carried into chapter 5. Students are introduced to the concept that the cell cycle, or life of a cell, is controlled by checkpoint proteins. Details of each stage of the cell cycle are provided, including copying the gene message in DNA replication and ensuring that the same message is passed on to cloned cells through the events of mitosis. The second part of chapter 5 relates the cell cycle and mitosis to asexual reproduction, the production of identical cells. Students study a variety of methods of asexual reproduction. The chapter ends with a consideration of human-assisted cloning.

Chapter 6: Meiosis is the basis of sexual reproduction. The last chapter of Unit 2 focusses on sexual reproduction. Students learn that new characteristics beneficial to the survival of the species may emerge through the introduction of new gene combinations, and therefore new proteins, in meiosis. They also learn that the union of gametes in fertilization necessitates the reduction of chromosome number through meiosis. By studying meiosis, students comprehend how genetic variation occurs. Students learn about the three stages of reproduction, which include mating, fertilization, and development, and how these stages differ in different organisms. Some organisms, for example many insects, undergo complete or incomplete metamorphosis as part of their development. Humans develop in many ways in each trimester before birth. In Chapter 6 students are introduced to the current understanding of genes, explore the use of karyotyping, learn about some types of assisted reproductive technologies, and consider the societal impact of human intervention in the reproductive processes of nature.

MULTIPLE INTELLIGENCES CORRELATION FOR UNIT 2 ACTIVITIES AND INVESTIGATIONS

The table below identifies possible multiple intelligences that could be incorporated into activities and investigations in this unit. For more information about differentiated instruction and multiple intelligences, see the Introduction and Implementation section in this Teacher's Resource.

Multiple Intelligences:	VL	VS	BK	MR	LM	N	E	IA	IE
UNIT 2: REPRODUCTION									
Find Out Activity: Designing Your Supper		■			■		■		■
Chapter 4: The nucleus controls the functions of life.									
Find Out Activity 4-1A, The Nucleus as a Black Box		■	■		■			■	■
Find Out Activity 4-2A, Identify the Mutation	■	■			■			■	■
Think About It Activity 4-2B, Considering Gene Therapy	■			■			■		■
Chapter 5: Mitosis is the basis of asexual reproduction.									
Find Out Activity 5-1A, From One Cell to Many Cells	■				■			■	
Find Out Activity 5-1B, The Cell Cycle: A Play in Six Scenes	■	■	■	■			■	■	■
Conduct an Investigation 5-1C, Observing the Cell Cycle in Plant Cells	■	■	■		■				
Find Out Activity 5-2A, Asexual Reproduction in Duckweed	■		■		■	■			
Core Lab Conduct an Investigation 5-2B, Determining the Best Conditions for Yeast Reproduction	■	■	■		■	■		■	■
Chapter 6: Meiosis is the basis of sexual reproduction									
Find Out Activity 6-1A, Eating Like a Bird	■		■			■		■	■
Core Lab Conduct an Investigation 6-1B, Comparing Mitosis and Meiosis	■	■			■			■	■
Find Out Activity 6-2A, Predict a Pollinator	■	■				■		■	■
Think About It Activity 6-2B, Comparing Sexual and Asexual Reproduction	■	■	■		■			■	■
Find Out Activity 6-3A, Comparing Differentiation in Embryos	■	■			■			■	■
Find Out Activity 6-4A, Analyzing a Karyotype	■	■			■				

Multiple Intelligence codes:
VL = Verbal-Linguistic Intelligence; VS = Visual-Spatial Intelligence; BK = Body-Kinesthetic Intelligence; MR = Musical-Rhythmic Intelligence; LM = Logical-Mathematical Intelligence; N = Naturalist Intelligence; E = Existential Intelligence; IA = Intrapersonal Intelligence; IE = Interpersonal Intelligence

Planning Chart for Activities and Investigations for Unit 2: Reproduction

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Unit 2: Reproduction			
Find Out Activity: Designing Your Supper	• No advance preparation necessary	None	• 20 min
Chapter 4: The nucleus controls the functions of life.			
Find Out Activity 4-1A, The Nucleus as a Black Box	• 2 weeks before for initial preparation – Gather materials and boxes. – Student volunteers could create the black boxes. – Number the boxes and prepare a list of the contents before they are sealed. • Same day of instruction in subsequent years	For each group: – 1 assembled black box – 1 cotton ball – 1 drinking straw – clear adhesive tape – 1 wooden skewer	• 20 min
Find Out Activity 4-2A, Identify the Mutation	• No advance preparation necessary	None	• 15 min
Think About It Activity 4-2B, Considering Gene Therapy	• No advance preparation necessary	None	• 20 min
Chapter 5: Mitosis is the basis of asexual reproduction.			
Find Out Activity 5-1A, From One Cell to Many Cells	• Day of instruction – Optional: Photocopy BLM 2-5, Find Out Activity 5-1A, From One Cell to Many Cells. – Optional: Photocopy BLM 2-6, Showing Cell Growth with Pennies.	For each group: – Optional: calculator	• 20 min
Find Out Activity 5-1B, The Cell Cycle: A Play in Six Scenes Day of instruction	• No advance preparation necessary	For each group: – Students obtain or design their own props.	• 60 min
Conduct an Investigation 5-1C, Observing the Cell Cycle in Plant Cells	• 1 day before – Gather materials and apparatus. – Photocopy BLM 2-12, Conduct an Investigation 5-1C, Observing the Cell Cycle in Plant Cells.	For each group: – ruler – pencil – microscope – prepared slide of an onion root tip – optional: calculators	• 45 min
Find Out Activity 5-2A, Asexual Reproduction in Duckweed	• 2 weeks before the activity – Order duckweed. • 1 day before the activity – Prepare Knop's solution (see activity instructions). • Day of activity – Assemble the other materials.	For each group: – 2 small jars or culture dishes – 100 mL distilled water – 100 mL Knop's solution – 8 duckweed plants – wax pencil	• 20 min to set up the experiment • 5 min per day for 2 weeks to observe • 20 min after 2 weeks to graph and answer questions

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Core Lab Conduct an Investigation 5-2B, Determining the Best Conditions for Yeast Reproduction	• 3 days before – Purchase yeast and balloons. – Assemble materials for the lab. – Photocopy BLM 2-18, Conduct an Investigation 5-2B, Determining the Best Conditions for Yeast Reproduction.	For each group: • Part 1 – petri dish – 0.5 g yeast – 1 g sucrose (table sugar) – 5 mL warm tap water (24°C – 27°C) – thermometer – medicine dropper or toothpick – microscope slide – cover slip – microscope • Part 2 – 4 Erlenmeyer flasks or small glass soft-drink bottles – wax pencil or marker – 320 mL hot tap water (40°C) – thermometer – 85 g sucrose (table sugar) – stirring rods – 16 g yeast – four 7.8 cm balloons – masking tape – string or thread • Part 3 – 4 Erlenmeyer flasks or small glass soft-drink bottles – wax pencil or marker – 320 mL hot tap water (40°C) – hermometer – 20 g sucrose (table sugar) – stirring rods – medicine dropper – 10 mL vinegar – 10 mL ammonia – pH paper – 16 g yeast – four 7.8 cm balloons – masking tape – thread or string	• 60 min
Chapter 6: Meiosis is the basis of sexual reproduction.			
Find Out Activity 6-1A, Eating Like a Bird	• 3 days before – Gather the materials. • Once assembled, many of the items can be reused from year to year.	For each group: – 1 spoon – chopsticks (1 set) – forceps or tweezers (1 pair) – handful of marbles – small pile of toothpicks – small pile of cereal – handful of pennies – 1 timer	• 30 min
Core Lab Conduct an Investigation 6-1B, Comparing Mitosis and Meiosis	• Day of instruction – Photocopy BLM 2-25, Conduct an Investigation 6-1B, Compare the Events of Meiosis and Mitosis. – Photocopy BLM 2-26, Mitosis (optional)	None	• 40 min
Find Out Activity 6-2A, Predict a Pollinator	• No advance preparation necessary	None	• 15 min

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Think About It Activity 6-2B, comparing Sexual and Asexual Reproduction	• No advance preparation necessary	None	• 30 min
Find Out Activity 6-3A, Comparing Differentiation in Embryos	• No advance preparation necessary	None	• 20 min
Find Out Activity 6-4A, Analyzing a Karyotype	• No advance preparation necessary	None	• 15 min
Unit 2 Project: Making a Decision for Genetown	• 1 day before instruction – Photocopy BLM 2-30, Making a Decision for Genetown Stakeholder List. – Prepare cards numbered 1–30 that students can randomly pick from an envelope. – Photocopy BLM 2-31, Presentation Organizer, for students.	For each group: – Students acquire their own props (optional).	• 100 min
Integrated Research Investigation: Just Because We Can, Does It Mean We Should?	• 1 week before: – Book library or computer lab, if desired. – Decide what sort of format(s) will be accepted for this investigation. – Consider whether assessment rubrics will be used.	For each group: – access to the Internet	• 60 min

TALKS AND TOURS

Speaker and field trip recommendations for Unit 2:

- Some colleges and universities offer hands-on lab activities in genetic and/or biotechnological techniques at their campuses.
- You may be able to arrange guest speakers, such as:
  - representatives from university or college departments of cell biology, genetics, biotechnology, forensics, and embryology to talk about recent research and occupations in their fields
  - a horticulturist to talk about and demonstrate different methods of vegetative reproduction in plants
  - a representative from the Cancer Society to talk about the causes and treatments for cancer in relation to the cell cycle
  - a genetic counsellor to talk about the career and the techniques used for genetic analysis

UNIT 2 Blackline Masters

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
UNIT BLM 2-1, Unit 2 Summary BLM 2-2, Unit 2 Key Terms BLM 2-33, Unit 2 Test BLM 2-34, Unit 2 Review Concept Map BLM 2-35, Unit 2 Review BLM 2-36, Unit 2 BLM Answers	• Assessment Checklist 5, Investigating an Issue • Assessment Checklist 9, Oral Presentation • Assessment Checklist 10, Computer Slide Show Presentation • Assessment Checklist 16, Science Portfolio • Assessment Checklist 20, Assessment Record Form • Assessment Checklist 21, Project Self-Assessment • Assessment Checklist 22, Project Group Assessment • Assessment Checklist 23, Learning Skills • Process Skills Rubric 9, Questioning • Assessment Rubric 3, Co-operative Group Work Rubric • Assessment Rubric 7, Scientific Research Planner Rubric • Assessment Rubric 8, Research Project Rubric • Assessment Rubric 9, Collecting Information Rubric • Assessment Rubric 10, Presentation Rubric • Assessment Rubric 11, Communication Rubric
CHAPTER 4 BLM 2-3, Making Predictions about Mutations BLM 2-4, Chapter 4 Quiz	• Assessment Checklist 1, Making Observations and Inferences • Assessment Checklist 2, Asking Questions • Assessment Checklist 3, Designing an Experiment • Assessment Checklist 5, Investigating an Issue • Assessment Checklist 6, Developing Models • Assessment Checklist 7, Scientific Drawing • Assessment Checklist 11, Poster • Assessment Checklist 13, Concept Map • Assessment Checklist 14, Events Chain or Flowchart • Assessment Checklist 15, Venn Diagram • Assessment Checklist 20, Assessment Record Form • Assessment Checklist 23, Learning Skills • Assessment Checklist 24, K-W-L Assessment Checklist • Process Skills Rubric 1, Developing Models • Process Skills Rubric 2, Hypothesizing • Process Skills Rubric 3, Controlling Variables • Process Skills Rubric 4, Problem Solving • Process Skills Rubric 7, Predicting • Process Skills Rubric 8, Interpreting Data • Process Skills Rubric 9, Questioning • Assessment Rubric 1, Concept Rubric • Assessment Rubric 2, Science Notebook Rubric • Assessment Rubric 3, Co-operative Group Work Rubric • Assessment Rubric 6, Design Your Own Investigation Rubric

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
CHAPTER 5 BLM 2-5, Find Out Activity 5-1A, From One Cell to Many Cells BLM 2-6, Showing Cell Growth with Pennies BLM 2-7, Parts of the Cell BLM 2-8, Stages of the Cell Cycle BLM 2-9, The Cell Cycle BLM 2-10, Steps of Mitosis BLM 2-11, Cell Growth and Division BLM 2-12, Conduct an Investigation 5-1C, Observing the Cell Cycle in Plant Cells BLM 2-13, Find Out Activity 5-2A, Asexual Reproduction in Duckweed BLM 2-14, New Plants from Cuttings BLM 2-15, New Plants from Roots BLM 2-16, New Plants from Stems BLM 2-17, New Plants from Grafting BLM 2-18, Conduct an Investigation 5-2B, Determining the Best Conditions for Yeast Reproduction BLM 2-19, Chapter 5 Quiz	• Assessment Checklist 1, Making Observations and Inferences • Assessment Checklist 2, Asking Questions • Assessment Checklist 3, Designing an Experiment • Assessment Checklist 4, Laboratory Report • Assessment Checklist 5, Investigating an Issue • Assessment Checklist 7, Scientific Drawing • Assessment Checklist 13, Concept Map • Assessment Checklist 15, Venn Diagram • Assessment Checklist 16, Science Portfolio • Assessment Checklist 18, Data Table • Assessment Checklist 19, Graph from Data • Assessment Checklist 20, Assessment Record Form • Assessment Checklist 23, Learning Skills • Assessment Checklist 24, K-W-L Assessment Checklist • Assessment Checklist 25, Safety Checklist • Process Skills Rubric 2, Hypothesizing • Process Skills Rubric 3, Controlling Variables • Process Skills Rubric 4, Problem Solving • Process Skills Rubric 5, Fair Testing • Process Skills Rubric 6, Designing Experiments • Process Skills Rubric 7, Predicting • Process Skills Rubric 8, Interpreting Data • Process Skills Rubric 9, Questioning • Process Skills Rubric 10, Measuring and Reporting • Assessment Rubric 1, Concept Rubric • Assessment Rubric 2, Science Notebook Rubric • Assessment Rubric 3, Co-operative Group Work Rubric • Assessment Rubric 4, Scientific Drawing Rubric • Assessment Rubric 5, Conduct an Investigation Rubric • Assessment Rubric 6, Design Your Own Investigation Rubric • Assessment Rubric 11, Communication Rubric • Assessment Rubric 12, Using Tools, Equipment, and Materials Rubric
CHAPTER 6 BLM 2-20, How Variation Occurs in Meiosis BLM 2-21, Gametes BLM 2-22, Mitosis and Meiosis BLM 2-23, Cell Reproduction BLM 2-24, Gamete Summary BLM 2-25, Conduct an Investigation 6-1B, Compare the Results of Mitosis and Meiosis BLM 2-26, Midosis BLM 2-27, The Male Reproductive System BLM 2-28, The Female Reproductive System BLM 2-29, Chapter 6 Quiz BLM 2-30, Making a Decision for Genetown Stakeholder List BLM 2-31, Presentation Organizer BLM 2-32, Debate Procedures	• Assessment Checklist 1, Making Observations and Inferences • Assessment Checklist 2, Asking Questions • Assessment Checklist 6, Developing Models • Assessment Checklist 7, Scientific Drawing • Assessment Checklist 8, Science Fair Display • Assessment Checklist 13, Concept Map • Assessment Checklist 15, Venn Diagram • Assessment Checklist 16, Science Portfolio • Assessment Checklist 18, Data Table • Assessment Checklist 19, Graph from Data • Assessment Checklist 20, Assessment Record Form • Assessment Checklist 23, Learning Skills • Assessment Checklist 24, K-W-L Assessment Checklist • Process Skills Rubric 1, Developing Models • Process Skills Rubric 2, Hypothesizing • Process Skills Rubric 4, Problem Solving • Process Skills Rubric 7, Predicting • Process Skills Rubric 8, Interpreting Data • Process Skills Rubric 9, Questioning • Assessment Rubric 1, Concept Rubric • Assessment Rubric 2, Science Notebook Rubric • Assessment Rubric 3, Co-operative Group Work Rubric • Assessment Rubric 4, Scientific Drawing Rubric • Assessment Rubric 5, Conduct an Investigation Rubric • Assessment Rubric 6, Design Your Own Investigation Rubric • Assessment Rubric 7, Scientific Research Planner Rubric • Assessment Rubric 8, Research Project Rubric • Assessment Rubric 9, Collecting Information Rubric • Assessment Rubric 10, Presentation Rubric • Assessment Rubric 11, Communication Rubric • Assessment Rubric 12, Using Tools, Equipment, and Materials Rubric

Teaching Notes
for
Pages 106 to 221 of the Student Textbook