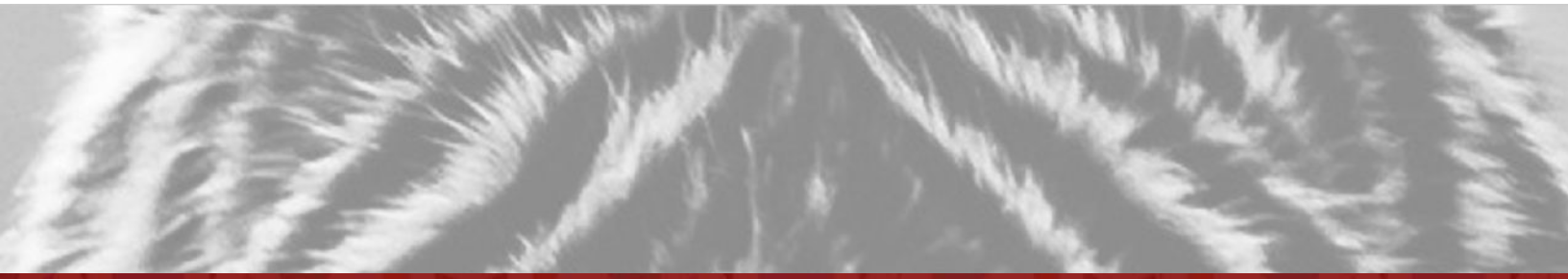
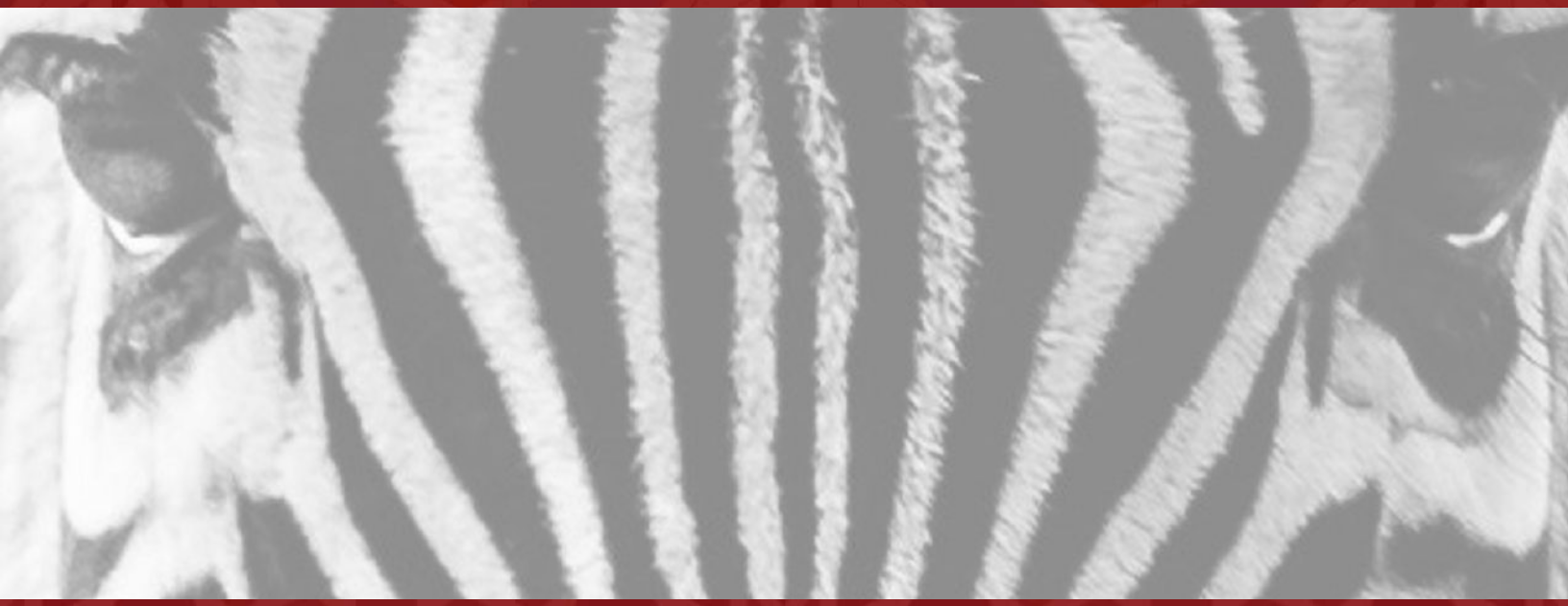
Verification and Renewal Curriculum



Biology: Student's Syllabus

A VRC Curriculum Syllabus



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The American Society of Islamic Philosophy and Theology

Biology Syllabus

A Verification and Renewal Curriculum (VRC) Syllabus

Written by Sarah Kazmi, Ibrahim Qureshi, Justin Poe, Aaron Spevack

Produced with a generous grant from the Templeton Foundation

Course Description:

Dear students,

Welcome to Biology! Biology is the science that studies life. Its name comes from the Greek words *bios*, which means 'life', and *-logia*, which means 'study of'. In biology, you will discover many patterns about living things from the smallest cells to plants, humans, insects, birds, and other organisms and how they interact with each other and their environment.

Course Overview:

Term	*Content*	*Science Fair*	*Interdisciplinary Integration*
Term 1	-Scientific Thinking -Science of Biology -Chemistry of Life -Biosphere -Ecosystem & Population	<u>Developing Your Topic</u> - Class discussions about various science fair topics - Brainstorming possible **research** or **engineering** design questions - Conducting literature search - Finalizing a research or engineering design topic and question - Writing a project proposal	• Epistemology & Theory of Knowledge • Nature as God's patterns in creation • Systems and Cycles as signs
Term 2	-Cell Structure and Function -Photosynthesis -Respiration -Cell Division -Introduction to Genetics -Theory of Evolution	<u>Science Fair</u> - Conducting experiments or building and testing prototypes - Finalizing results - Writing research paper & presenting science fair project	• Cells as Microcosms • Balanced Eating and Energy • Religion and Evolution
Term 3	-DNA -RNA and Protein Synthesis		• The Design in Plant/Animal Kingdoms

	-Human Genome - Biodiversity/Classification - Viruses/Prokaryotes/protists/fungi -Plants -Animal Systems		• Contributions of Muslim Scientists • Plants and Animals in Qur'an • Miracle of Human Embryology

Course Outcomes:

Transferable knowledge that students will gain:

1. Students will become familiar with basic biological terminology of atomic and molecular structure, cellular systems, genetics, evolution and ecosystems
2. Students will begin to understand crosscutting concepts such as patterns, energy and matter, structure and function, cause and effect, and systems and system models.
3. Students will begin to reflect deeply about the wisdom, complexity, patterns and interconnectedness of Allah's creation.
4. Students will begin to gain some familiarity with basic laboratory skills of safety, following instructions, making observation, measurement and conversions, instrumentation and data interpretation.
5. Students will begin their familiarity with some primary literature researches, following the scientific method to conduct their own research and writing scientific reports using APA format

Course Materials:

- CK-12 Online
    a. Textbook: https://flexbooks.ck12.org/user:78aa16ce4b61/cbook/vrc-biology-9th-grade-23588336/
- 2 Composition Notebooks
    a. Class Notes
    b. Lab Notebook/Science Fair Log Book
- Lab Safety Contract
- Shared folder/Google Drive (for keeping corrected assignments and tests)

Class Breakdown and Expectations:

This course engages students holistically using all of their faculties to facilitate understanding. This course follows three stages: deep reading (*mutala'a*), class sessions (*dars*), and review (*mudhakara*).

- Deep Reading (*mutala'a*): Students should closely prepare all required sections prior to class sessions and identify key topics and terms. Optionally, students may benefit from preparing an outline of the topics covered and a list of key terms and definitions.

  The method of deep reading trains students to begin to "self-teach" themselves from a textbook and to engage it critically: jotting down questions to be asked, noting places of inconsistency, and challenging evidence. Traditionally, deep reading only involved books and commentaries; however, in biology, deep engagement may also involve watching assigned videos and participating in hands-on activities where appropriate.

  The purpose of preparation is for students to familiarize themselves with the material and to grasp the structure of the upcoming lesson. When preparation is done well, a student is able to intelligently engage with the teacher in class sessions so that everything a teacher discusses is familiar to the ear and easily able to be placed within the larger study of biology.
- Class Sessions (*dars*): Students should keep a class notebook in addition to their textbook where they add notes (*mulahaza*) based on the class lecture and discussion. Students are encouraged to ask questions.
- Review (*mudhakara*): Students should gather in person or virtually for group review outside of class hours before the next class session. They should read through the material together and take turns reteaching the material from their notes to their peers. This is a place for students to work with each other to seek clarity and engage in deeper conversation and independent research around the material.

In this course, students are expected to:

1. Actively & constructively participate in class discussions
2. Work collaboratively during laboratory investigations
3. Accurately and effectively report the results of laboratory investigations
4. Complete all the assigned homework in a timely and presentable manner
5. Utilize class notes, homework assignments, and reading notes in preparation for quizzes and tests.

Evaluation:

Homework (every day)	*20%*

Quizzes (once a week)	*20%*
Tests (midterm and final)	*20%*
Labs	*15%*
Class Participation	*10%*
Science Fair (Term 1 & Term 2)	*15%*

Homework

The purpose of daily homework assignments is to reinforce classroom learning and to encourage application of the concepts learned. This also serves as feedback for the instructor to assess students' level of comprehension of the material.

Quizzes

Quizzes will be short assessments about recent homework or class work.

In-Class Activities & Projects

These may include model building activities, short experiments, or problem-solving sessions.

Tests

Tests will emphasize understanding of concepts, not memorization.

Lab

Lab is an integral part of this class as it affords students the opportunity to apply the scientific method for themselves as biologists have done in the past. All students must complete any pre-lab assignments before they may participate in the lab. Students will take lab notes and present a completed lab report in their notebook one week after the lab is performed.

Science Fair

- MA Science and Engineering Fair: https://scifair.com/
- Standards: https://www.doe.mass.edu/frameworks/scitech/2016-04/STE-Standards.pdf (pages 69-72)
- Timeline for Experiment-Based Project:Science Fair Timeline - Experiment based Project 202324.docx
- Timeline for Engineering Design Project:Science Fair Timeline - Engineering Design Project 202324.docx

Honors/AP Level:

Students in the honors/AP level will have additional assignments. Choices of research or experiment based science articles are provided for students to get used to reading primary literature and use APA citation to respond according to a rubric.

Resources

- https://nhsjs.com/?mainpage
- https://www.sciencejournalforkids.org/articles/reading_level/high-school-upper/
- https://www.snexplores.org/

Student should reflect on:

- Islamic components
- bias in research
- qualitative/quantitative research method

This is the rubric for grading:

Science Article Summary Rubric Name: _____ Date: _____ Class: _____

Category	5 – Exemplary	4 – Accomplished	3 – Developing	2 – Beginning	0 – Incomplete	Score
Article Summary Summarize what you read into **5 paragraphs** sentences.	Article summary is accurate, well organized, coherent and well written. No spelling mistakes. Capitalization and punctuation used.	Summary is accurate, but organization could be improved. No more 2 capitalization or spelling errors.	Summary is reasonably accurate (some minor errors) or organization is poor. No more than 4 capitalization or spelling errors.	Summary is inaccurate (contains important errors) 5 or more capitalization or spelling errors.	No summary provided.	
Reading Strategies & Impact of Science and Technology (Answer questions on paper with summary)	Reaction clearly shows critical analysis of article; All nine questions addressed.	Reaction to article shows thought and provides an idea of writer's position on the issue; 8 of the 9 questions are addressed.	Reaction to article provides some evidence of thought; 7 of the 9 questions are addressed.	Reaction to article very vague and lacks obvious critical thought; 5 of the 9 questions are addressed	Reaction to article not included or 5 or more questions are not addressed	
Article Verification/Citation	Article has a correct citation.	No more than one citation error.	No more than 2 citation errors.	More than 2 citation errors.	No citation is given.	
List of 10 new vocabulary words with definitions	List is complete and has full definitions		Only half the number of vocab words are given		No vocab words Total Score: _____/20	

1. **Predict**: What can you predict from the title/headline? Or what do you predict will happen next in the passage?
2. **Clarify**: Ask yourself questions when you are confused about the information the author is trying to tell you. What did you have to reread in order for it to make sense? OR what did you read that didn't make sense at first, but by the end of the passage you understood what the author meant?
3. **Visualize**: What did you visualize when you read the passage?
4. **Evaluate**: What is your opinion of what you read? Be sure to include reasons as to why or why not you feel the author was successful in persuading, informing, or entertaining the reader.
5. **Connect**: How did the passage connect to your life? OR what did you already know about this topic before you read this passage?
6. **Question**: What is a question you still have after reading the passage?
7. How does this affect society -what are the drawbacks/benefits?
8. Why was there a need for this research?
9. Why did you choose this particular article?

Weekly Schedule

TERM 1			
Week	*Topics (to read & watch)*	*Activities (to do)*	*Additional Resources*
Unit 1: Introduction to Biology			
1	1.1-1.3: What is Science? *Read*: • 1.1. Scientific Method • 1.2. Experiment • 1.3. Scientific Theories	*Exercise:* • Lab Notebook	*Read:* • Qualities of a Muslim Scientist • Great Muslim Scientists
	1.4-1.8: What is Biology? *Read:* • 1.4. Characteristics of Life • 1.5. Principles of Biology • 1.6. Interdependence of Living Things • 1.7. Organization of Living Things • 1.8. Evolution of Life	*Exercise:* • Language of Biology	
2	1.14-1.20: The Chemistry of Life *Read:* • 1.14. Biochemical Reactions • 1.15. Energy and Biochemical Reactions • 1.16. Types of Biochemical Reactions • 1.17. Enzymes • 1.18. Enzyme Function • 1.19. Water and Life • 1.20. Acids and Bases	*Exercise:* • Lab Safety Interactive • Design an Experiment Interactive • Microscope Parts	*Watch:* • Lab Safety
	1.9-1.13: Carbon & Biomolecules *Read:* • 1.9. Significance of Carbon • 1.10. Carbohydrates • 1.11. Proteins • 1.12. Lipids • 1.13. Nucleic Acids	*Lab:* • Food Tests for Biomolecules Experiment	*Watch:* • Biomolecules • Mindful Eating
Unit 2: Ecology			
3	6.1-6.7: Biosphere	*Lab:*	*Read:*

	Read: • 6.1. Ecosystems • 6.2. Energy Flow • 6.3. Food Chain • 6.4. Trophic Level • 6.5. Water Cycle • 6.6. Carbon Cycle • 6.7. Nitrogen Cycle	• Seed Germination	• Religions and Environment Protection
4	6.8-6.12: Biomes *Read:* • 6.8. Biomes and Climate • 6.9. Terrestrial Biomes • 6.10. Aquatic Biomes • 6.11. Freshwater and Wetland Biomes • 6.12. Aquatic Organisms	*Trip:* • Visit wetlands/aquarium/meteorology center	*Watch:* • Ecosystems • Save the Rainforest! • Deep Ocean Mysteries (TED Ed)
5	6.13-6.16: Communities *Read:* • 6.13. Predation • 6.14. Competition • 6.15. Symbiosis • 6.16. Succession	*Exercise:* • 6.15. Mutualism, Commensalism, & Parasitism Interactive	*Watch:* • Ecological Relationships • Do Bugs Get Along with Each Other?
6	6.17-6.23: Populations *Read:* • 6.17. Population • 6.18. Population Structure • 6.19. Population Growth • 6.20. Population Growth Patterns • 6.21. Human Population • 6.22. Demographic Transition • 6.23. Recent/Future Population Growth	*Exercise:* • UN Population Simulator • Population Density Interactive • 6.22. Demographics Simulator	*Watch:* • Food Webs and Energy Pyramids
7	6.24-6.30: Global Change *Read:* • 6.24. Biodiversity • 6.25. Importance of Biodiversity • 6.26. Mass Extinction • 6.27. Resources • 6.28. Soil and Water • 6.29. Air Pollution • 6.30. Global Warming		*Read:* • The Destruction of Nature and the Islamic Solution *Watch:* • Stressing Streams • Conservation and Theodore Roosevelt • Indoor Air Quality
Unit 3: Cell Biology			

8	2.1-2.10: Cell Structure & Function *Read:* • 2.1. Parts of the Cell • 2.2. Prokaryotic & Eukaryotic Cells • 2.3. Phospholipid Bilayer • 2.4. Membrane Proteins • 2.5. Cytoplasm & Cytoskeleton • 2.6. Nucleus • 2.7. Ribosomes & Mitochondria • 2.8. Cell Structure • 2.9. Plant Cell Structure • 2.10. Cell Organization	*Lab:* • 2.1. Cheek Cell/Onion Cell • 2.4. Cell Membrane Bubble *Exercise:* • Membranes Interactive • Cell Structure Interactive	*Watch:* • Cell Structure and Function (playlist)
9	2.11-2.16: Cellular Transport *Read:* • 2.11. Diffusion • 2.12. Osmosis • 2.13. Passive Transport • 2.14. Active Transport • 2.15. Sodium-Potassium Pump • 2.16. Exocytosis & Endocytosis	*Lab:* • 2.12. Osmosis (Gummy Bear) Exercise: • 2.11. Diffusion Interactive • 2.12.Osmosis Interactive	Watch: • The Plasma Membrane
10	2.17-2.24: Photosynthesis • 2.17. Autotrophs & Heterotrophs • 2.18. Glucose & ATP • 2.19. Chloroplast • 2.20. Leaves & Photosynthesis • 2.21. Photosynthesis • 2.22. Calvin Cycle	*Lab:* • 2.20. Leaf Stomata	Watch: • Photosynthesis
11	2.25-2.30: Cellular Respiration *Read:* • 2.25. Cellular Respiration • 2.26. Glycolysis • 2.27. Krebs Cycle • 2.28. Electron Transport • 2.29. Fermentation • 2.30. Anaerobic & Aerobic Respiration	*Lab:* • 2.25. Respiration • 2.29. Yeast Fermentation Protocol	*Watch:* • Cellular Respiration • Fermentation
12	2.31-2.39: Cell Growth & Division *Read:* • 2.31. Cell Division	*Lab:* • 2.34. Mitosis (Onion Root Tip)	*Watch:* • The Cell Cycle • Meiosis • Mitosis

	• 2.32. Cell Cycle • 2.33. Chromosomes • 2.34. Mitosis • 2.35. Reproduction • 2.36. Meiosis • 2.37. Gametogenesis • 2.38. Genetic Variation • 2.39. Life Cycle		

TERM 2			
Week	*Topics*	*Lab*	*Resources*
		Unit 4: Genetics	

13	3.1-3.7: Introduction to Genetics
	Read:
	• 3.1. Pea Plants
	• 3.2. Mendel's First Experiment
	• 3.3. Mendel's Second Experiment
	• 3.4. Mendel's Laws
	• 3.5. Probability
	• 3.6. Punnett Squares
	• 3.7. Non-Mendelian Inheritance
		Exercise:
		• 3.6. Punnett Squares
		• Spongebob Genetics
		  ○ Monohybrid Cross
		  ○ Dihybrid Cross
			Read:
			• Human Genetics and Islam
			
			Watch:
			• Intro to Heredity

14	3.8-3.12: The Human Genome *Read:* • 3.8. Human Genome • 3.9. Human Chromosomes • 3.10. Genetic Linkage • 3.11. Mendelian Inheritance • 3.12. Genetic Disorders	*Exercise:* • Sex-Linked Inheritance	*Read:* • Human Genome Project *Watch:* • Genetic Engineering
15	3.13-3.15: Biotechnology *Read:* • 3.13. Biotechnology • 3.14. Biotechnology Applications • 3.15. Ethical, Legal, & Social Issues in Biotechnology	*Lab:* • Extracting Onion DNA *Exercise:* • DNA Fingerprinting	*Read:* • Articles Library *Watch:* • Biotechnology (playlist)
16	4.1.-4.4: DNA & RNA *Read:* • 4.1. Central Dogma • 4.2. DNA • 4.3. DNA Structure & Replication • 4.4. RNA	*Exercise:* • Life's Instructional Manual • Making a DNA Model *Lab:* • Extracting Strawberry DNA	*Watch:* • DNA vs RNA • DNA Replication
17	4.5-4.7: Protein Synthesis	*Lab:*	*Watch:*

	Read: • 4.5. Transcription • 4.6. Genetic Code • 4.7. Translation	• Gel Electrophoresis Lab ○ Run your own Gel	• Protein Synthesis
18	4.8-4.10: Mutation *Read:* • 4.8. Mutation • 4.9. Mutation Causes • 4.10. Mutation Effects		
Unit 5: Evolution			
19	5.12-5.14: Darwin & The Theory of Evolution *Read:* • 5.12. Darwin • 5.13. Influences on Darwin • 5.14. Theory of Evolution 5.15-5.17: Evidence of Evolution *Read:* • 5.15. Fossils • 5.16. Comparative Anatomy • 5.17. Biogeography	*Exercise:* • 5.16. Comparative Embryology	*Read:* • *Ghazali and Modern Evolutionary Paradigm* (pg. 362)[1] *Watch:* • Evolution • Fossil Rock Anthem *Recommended:* • *Islam and Evolution: Classical Sources and Methodologies*[2] • *New Frontiers in Islam and Evolution*[3]
20	5.18-5.21: Microevolution *Read:* • 5.18. Population Genetics • 5.19. Hardy-Weinberg • 5.20. Forces of Evolution • 5.21. Natural Selection	*Exercise:* • Population Genetics Interactive • Hardy-Weinberg Interactive	*Watch:* • Evolution (playlist)
21	5.22-5.25: Macroevolution *Read:* • 5.22. Origin of Species • 5.23. Coevolution • 5.24. Macroevolution • 5.25. Animal Evolution	*Exercise:* • 5.22. Allopatric Speciation • Speciation Activity	
22	5.1-5.9: History of Life *Read:* • 5.1. History of Life • 5.2. Formation of Earth • 5.3. First Organic Molecules	*Trip:* • Visit museum of prehistoric history	*Watch:* • History of Life • Taxonomy

	• 5.4. First Cell • 5.5. Eukaryote Evolution • 5.6. Late Precambrian • 5.7. Paleozoic Era • 5.8. Mesozoic Era • 5.9. Cenozoic Era		

[1] Malik, S. A. (2021). *Islam and Evolution: Al-Ghazālī and the Modern Evolutionary Paradigm*. Taylor & Francis.
[2] Jalajel, D. S. (2009). *Islam and Biological Evolution: Exploring Classical Sources and Methodologies*. Western Cape: University of the Western Cape.
[3] Malik, S. A., Jalajel, D. S. *New Frontiers in Islam and Evolution: Scriptures, Scholars, and Societies* (Routledge Science and Religion Series) 1st Edition.

TERM 3			
Week	*Topics*	*Lab*	*Resources*
Unit 6: Microorganisms & Fungi			
23	7.1-7.3. Prokaryotes *Read:* • 7.1. Prokaryotes • 7.2. Bacteria Classification • 7.3. Bacteria Structure 7.8-7.12. Viruses *Read:* • 7.8. Viruses • 7.9. Virus Characteristics • 7.10. Virus Structure • 7.11. Virus Classification • 7.12. Virus Origin	*Exercise:* • Types of Archaebacteria	*Watch:* • Viruses
	8.1-8.7. Protists *Read:* • 8.1. Protists • 8.2. Protist Evolution • 8.3. Protist Characteristics • 8.4. Protozoa • 8.5. Algae • 8.7. Protists & Disease 8.8-8.12. Fungi *Read:* • 8.8. Fungi • 8.9. Fungi Structure • 8.10. Fungi Reproduction • 8.12. Fungi Classification	*Lab:* • Mushroom Dissection *Exercise:* • Fungi Structure Activity	*Watch:* • Protists and Fungi
Unit 7: Plants			
24	9.1.-9.5: Plants Overview *Read:* • 9.1. Plant Characteristics • 9.2. Importance of Plants • 9.3. Plant Life Cycle 9.6-9.10: Plants Classification *Read:* • 9.6. Plant Classification • 9.7. Nonvascular Plants • 9.8. Vascular Plants	*Lab:* • Flower Dissection	*Read:* • Medicinal Fruits in the Qur'an • Plant Psychology *Watch:* • Plants

	• 9.9. Seed Plants • 9.10. Angiosperm		
25	9.11-9.16: Plant Structure & Function *Read:* • 9.11. Plant Cell • 9.12. Plant Tissue • 9.13. Plant Growth • 9.14. Roots • 9.15. Stems • 9.16. Leaves	*Lab:* • Transpiration	
Unit 8: Animals			
26	10.1-10.3. Animals Overview *Read:* • 10.1. Animals • 10.2. Animal Classification • 10.3. Animal Behavior Evolution		*Watch:* • Animal Behavior
27	10.4-10.8. Animal Behavior *Read:* • 10.4. Innate Behavior • 10.5. Learned Behavior • 10.6. Social Behavior • 10.7. Cyclic Behavior • 10.8. Reproductive Behavior		*Watch:* • Untamed Nature • Self-Recognition in Apes • The Great Migration
28	11.1-11.13. Invertebrates *Read:* • 11.1. Invertebrate Diversity • 11.3. Invertebrate Classification • 11.4. Sponges • 11.7. Roundworms • 11.8. Mollusks • 11.10. Arthropods • 11.11. Insects • 11.12. Echinoderms • 11.13. Invertebrate Chordates	*Lab:* • Dissecting a Worm • (Virtual Dissection Resources)	*Read:* • The Ruling on Human Dissections *Watch:* • Bioluminescence
29	12.1-12.23. Vertebrates *Read:* • 12.1. Chordates	*Lab:* • Dissecting a Frog	*Watch:* • Classification Interviews with Vertebrates!

	• 12.2. Vertebrate Diversity • 12.3. Vertebrate Reproduction • 12.4. Vertebrate Classification • 12.6. Fish • 12.10 Amphibian Structure & Function • 12.14. Reptile Structure & Function • 12.19. Bird Structure & Function	• (Virtual Dissection Resources)	• Major Phyla: Fish • Life Cycle of Salmon • Major Phyla: Reptiles • Major Phyla: Birds
30	12.24-12.27. Mammals *Read:* • 12.24. Mammal Overview • 12.25. Mammal Structure & Function • 12.26. Endothermy • 12.27. Locomotion		*Watch:* • Reproduction • Homeostasis • Greenland Sled Dogs
Unit 9: The Human Body			
31	13.24-13.28: Circulatory System *Read:* • 13.24. Heart • 13.25. Blood Vessels • 13.26. Circulatory System • 13.28. Blood *Optional:* • 13.27. Cardiovascular Diseases 13.34-13.40: Digestive System *Read:* • 13.34. Digestive System Organs • 13.35. Digestive System • 13.39. Food and Nutrients • 13.40. Balanced Eating *Optional:* • 13.38. Digestive System Diseases 13.41-13.44: Excretory System *Read:* • 13.41. Excretory System • 13.42. Urinary System	*Lab:* • Virtual Heart Dissection *Activity:* • Sample Prophetic Foods *Exercise:* • Homeostasis Interactive • 13.28. Blood Types Interactive	*Read:* • Mindful Eating *Watch:* • Human Body Systems (Overview) • Circulatory System • Digestive System • Excretory System *Recommended:* • Digital Anatomy Interactive (purchase required)

	• 13.43. Kidneys *Optional:* • 13.44. Excretory System Diseases		
32	13.29-13.33: Respiratory System *Read:* • 13.29. Respiratory System • 13.30. Respiratory System Organs • 13.31. Breathing • 13.32. Regulation of Breathing *Optional:* • 13.33. Respiratory System Disorders 13.8-13.12: Muscular & Integumentary System *Read:* • 13.8. Muscles • 13.9. Skeletal Muscles • 13.10. Muscle Contraction • 13.11. Skin • 13.12. Nails & Hair 13.13-13.19: Nervous System *Read:* • 13.13. Neuron • 13.14. Nerve Impulse • 13.15. Central Nervous System • 13.16. Peripheral Nervous System • 13.17. Senses *Optional:* • 13.18. Drugs and the Nervous System • 13.19. Nervous System Diseases 13.20-13.23: Endocrine System *Read:* • 13.20. Endocrine Glands • 13.21. Hormone • 13.22. Hormone Regulation	*Lab:* • Breathing and Homeostasis Lab *Exercise:* • 13.9. Jointed Appendages Interactive • 13.15. Brainy Puzzle Interactive	*Watch:* • Respiratory System • Integumentary System • Nervous System • Endocrine System

	Optional: • 13.23. Endocrine System Diseases		
33	13.45-13.54: The Immune System *Read:* • 13.45. Innate System • 13.46. Inflammatory Response • 13.47. Lymphatic System • 13.48. Humoral Response • 13.49. Cell-Mediated Response • 13.50. Immunity • 13.51. Allergies • 13.52. Autoimmune Disease • 13.53. Immunodeficiency	*Trip:* • Visit Immunology Lab/Public Gallery *Exercise:* • 13.48. Humoral Immune Response Interactive	*Watch:* • Immune System Read: • Prophetic Foods and Disease Management

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