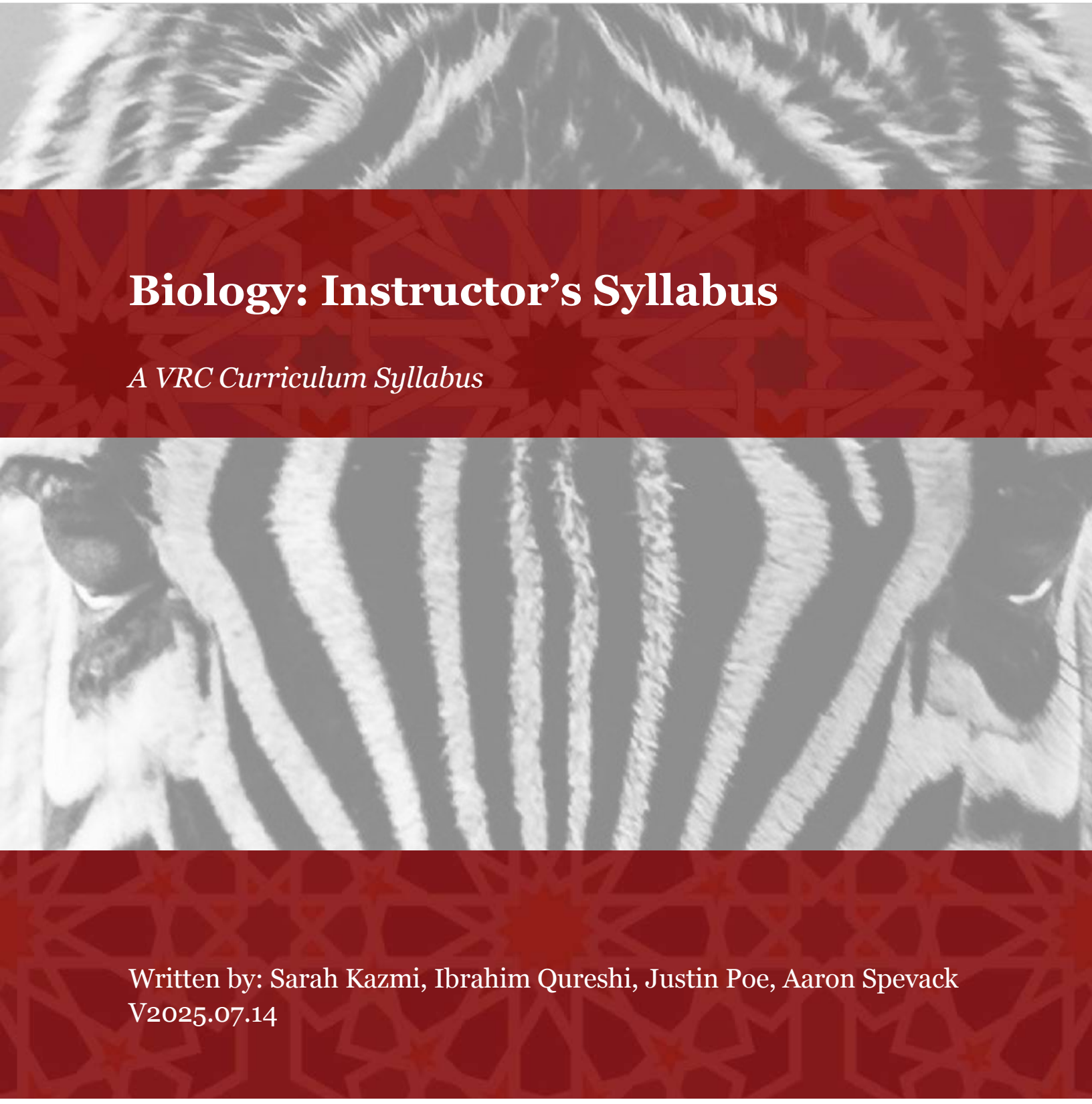
Verification and Renewal Curriculum



Biology: Instructor's Syllabus

A VRC Curriculum Syllabus

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

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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/
    b. Textbook Integration: *see end of the syllabus*
- 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)

Additional Teacher Resources:

- CK-12 Resources: https://www.ck12.org/c/biology/

- Medicine and Islam: https://www.medicineandislam.org/bioscience-and-islam/
- Ghareeb BA. Human genetics and islam: scientific and medical aspects. J IMA. 2011 Jul;43(2):83-90. doi: 10.5915/43-2-7014. PMID: 23610491; PMCID: PMC3516053.
- Safkolam, R. (2021). Effects of Islamic Scientist History on Seventh Graders' Understandings of Nature of Science in a Thai Islamic Private School. Jurnal Pendidikan IPA Indonesia.

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 & Disease *Read:* • 13.45. Innate Immune 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

Curriculum Standards for Biology:

- taken from NGSS - Next Generation Science Standards and Massachusetts State Curriculum Guidelines
- based on NGSS pages 53-58

Domain/Standards	*Topic*	*Standard*	*Main Ideas*
From Molecules to Organisms **HS-LS1-1.** **HS-LS1-2.** **HS-LS1-3.**	Structure and Function	LS1.A	
	Growth and Development of Organisms	LS1.B	
	Organization for Matter and Energy Flow in Organisms	LS1.C	
	Information Processing	LS1.D	
Ecosystems:	Interdependent		

Interactions, Energy, and Dynamics **HS-LS1-5.** **HS-LS1-6.** **HS-LS1-7.** **HS-LS2-3.** **HS-LS2-4.**	Relationships in Ecosystems		
	Cycles of Matter and Energy Transfer in Ecosystems		
	Ecosystem Dynamics, Functioning, and Resilience		
	Social Interactions and Group Behavior		
Heredity: Inheritance and Variation of Traits **HS-LS1-4.** **HS-LS3-1.** **HS-LS3-2.** **HS-LS3-3.**	Inheritance of Traits		
	Variation of Traits		
Biological Evolution: Unity and Diversity **HS-LS4-1.** **HS-LS4-2.** **HS-LS4-3.** **HS-LS4-4.** **HS-LS4-5.**	Evidence of Common Ancestry and Diversity	LS4.A	
	Natural Selection	LS4.B	
	Adaptation	LS4.C	
	Biodiversity and Humans		
Science and Engineering Practices Science Fair Process	Developing and Using Models		
	Planning and Carrying out Investigations		
	Constructing Explanations and Designing Solutions		
Crosscutting Concepts	Systems and System Models		

	Structure and Function		
	Stability and Change		

BIOLOGY VRC INTEGRATIONS

1. INTRODUCTION TO BIOLOGY

1.1. Scientific Method

Additional Learning Objectives

- The domain in which science operates and the types of premises and sources of knowledge it uses
- The conclusive and probabilistic conclusions of science
- Paradigm shifts in science

Framework

All the events that science investigates are occurrences based on a regular pattern. That regular pattern is a subject and result of Allah's knowledge, power, and will.

Connection

- Allah commands us to consider creation and the benefits we derived from it and to ponder over His creation to find wisdom and lessons.
- We consider His custom (*sunna*) in creation to learn, derive these benefits, and to recognize His actions in creation. In addition, we use the means Allah created (*asbāb*) to achieve these goals.

Did You Know?

Ibn al-Haytham (d. 1040) described the scientific method, then al-Biruni (d. 1050) further contributed to the systematic *development* and description of a scientific method. This is the same method we use today. Muslims described this method long before Francis Bacon and Galileo Galilei, who are indebted to the works and development of Muslim scientists. See 1001 Muslim Inventions and *https://muslimheritage.com/scientific-method/*. In the West, Francis Bacon and Galileo Galilei are each referred to as "The Father of Modern Science."

1.4. Characteristics of Life

Framework

- Recognize that events are regular occurrences dependent on Allah's knowledge, power, and will.
- There is complexity and design in 'Levels of Organization', the ecosystem, and the diversity of life. All of this is governed by Allah's knowledge, power, and will.

Connection

- Allah creates most things in pairs, "and from all things We created pairs" (Q 51:49).
- Allah creates most living things out of *water*, "and We made every living thing from water" (Q 21:30).
- Allah has created things of which we are not aware, "and He creates that which you do not know" (Q 16:8).
- Allah continues to create (e.g., creatures adapting and changing).

Summary

- Read a summary of Qualities of an Ideal Scientist : An Islamic Perspective | Al-Islam.org.

1.5. Principles of Biology

Connection

- Allah created everything with a balance (*mizan*).
- Allah takes out the living from the dead (i.e., connection to cell theory), "He brings the living out of the dead and the dead out of the living" (Q 6:95).

1.9. Significance of Carbon

Connection

Muslim philosophers and theologians discussed theories of matter, elements, and compounds.

1.19. Water and Life

Connection

- Allah informs of of the importance of water for life and purity, "and We made every living thing from water" (Q 21:30).
- Allah created every animal/creature from water, "Allah created every living creature from water" (Q 24:45).
- Allah sends down water and controls the water cycle, "Do you not see that Allah sends down rain from the sky and makes it flow as springs [and rivers] in the earth; then He produces thereby crops of varying colors..." (Q 39:21).
- Read about ways in which Muslims have been contributing to water conservation https://muslimheritage.com/world-water-day/.

2. CELL BIOLOGY

2.1. Parts of the Cell

Connection

Just as Allah made atoms and particles the foundation for physics and carbon and water the foundation for life, complex organisms are formed of smaller cells that all function in an orderly system that Allah regulates and maintains.

2.8. Cell Structure

Connection

Watch the following rendition of the inner life of a cell: The Inner Life of the Cell Animation - YouTube. Consider how cells move and function all by the will of Allah.

Did You Know?

- The amazing design and structure of cells is a display of Allah's knowledge and wisdom in the complex designs we find even in the smaller of living organisms.
- Cells are structured like a city. Human beings have been structuring their own cities and fortresses similar to the structure of the cell, long before they were aware of them. What other structures are designed like cities? Imam al-Ghazali speaks of the soul being the inner palace of a city with the body and limbs being the gates to the heart. We have to fortify these gates to ensure that nothing ill and vile enters the heart through them (See *The Beginning of Guidance*, p. 92-110).
- Isn't it amazing hat cells are mostly made of water (about 70-80%)? Remember how important water is to the functions of cells and to life.

2.13. Passive Transport

Connection

Creation is set in a balance and is well-proportioned, "And everything with Him is by due measure" (Q 13:8).

2.18. Glucose and ATP

Framework

We know that all living things need energy to move and function. But that's not all we need. Have you ever noticed that even after plenty of rest and sleep and a healthy and balanced diet, you may still feel lethargic and tired? Not only do we need energy, we need Allah's *baraka* (blessing and divine aid) in our daily life. We can seek to have *baraka* in our lives by saying the specific prophetic supplications for various acts, such as beginning and finishing eating, before sleeping, after waking, when starting any assignment, etc. We can also ask Allah for *baraka* in our time and efforts through supplication and making sure we have the right intention for our actions.

Did You Know?

Earlier on, Muslims scholars and scientists explored the concept of energy (*ḥarāra*) and the need for balance in all aspects of life, including one's health, to have sufficient and stable energy. They drew from prophetic medicine (*al-ṭibb al-nabawī*) and the scientific and medical knowledge and their findings available to them at that time. You can read about Ibn Sīnā's theories in *Avicenna's Medicine: A New Translation of the 11th-Century Canon with Practical Applications for Integrative Health Care* (Mones Abu-Asab, et al., Healing Arts Press, 2013).

2.21. Photosynthesis

Framework

The process through which plants absorb live and carbon dioxide and then produce glucose to sustain themselves remains somewhat a mystery to us. The sheer complexity of this process and its outward simplicity display Allah's knowledge and wisdom.

Connection

Notice that when you see the color green in a plant, it means that it is alive, it is praising Allah, and it is absorbing sun light.

Did You Know?

The Messenger ﷺ love the color green. Chlorophyll, as you will learn, is the chemical responsible for producing plants' green color. Why do you think the Messenger ﷺ loved the color green? What does the color represent and how may it affect you?

2.30. Anaerobic and Aerobic Respiration

Framework

Allah created this world in a balance such that there are organisms that rely on oxygen and other organisms that rely on carbon dioxide and others that need neither.

2.35. Reproduction

Connection

Reflect on the following verses of the Quran as you're reading this chapter.

- **General reproduction**: "Exalted is He who created all pairs, from what the earth produces, from themselves, and from that which they do not know" (Q 36:36).
- **Plant reproduction**: "[It is He] who has made for you the earth as a bed [spread out] and inserted therein for you roadways and sent down from the sky rain and produced thereby categories of various plants" (Q 20:53) and "And it He who spread

the earth and placed therein firmly set mountains and rivers; and from all of the fruits He made therein two mates; He causes the night to cover the day. Indeed in that are signs for a people who give thought" (Q 13:3).

- Allah mentions the importance of bees in (Q 16:68), which are key to plant pollination and plant reproduction: "And you Lord inspired to the bee, 'Take for yourself among the mountains, houses, and among the three and [in] that which they [humans] construct."
- **Human reproduction**: "Indeed, We created man from a sperm-drop mixture that We may try him; and We made him hearing and seeing" (Q 76:2).
- Allah created human beings from 'water': "And it is He who has created from water a human being and made him [a relative by] lineage and marriage. And ever is your Lord competent [concerning His creation]" (Q 25:54).

Connection

Muslims have been contributing to the research and discovery of human genetics for centuries. They drew inspiration from Allah's speech and from the statements of the Messenger ﷺ. See Human Genetics and Islam: Scientific and Medical Aspects - PMC.

3. GENETICS

3.11. Mendelian Inheritance

Connection

- The Prophet ﷺ mentioned phenotypes and recessive traits, showing that even the Messenger ﷺ through revelation, reasoning, or a combination of both was aware of this phenomenon. See https://sunnah.com/bukhari:5305.
- In the science of Islamic jurisprudence (*fiqh*), we use the term “inheritance” for the financial and social aspects of human life; there is a strong connection between the genetic, financial, and social aspects (marriage, lineage, *maḥram*, etc.) through family structure, all of which are based mostly on genetic relation.
- Some character traits may be “inherited” or “predisposed." The Messenger ﷺ may have indicated this through his statement, "Choose the best for your offspring, and marry compatible women and propose to them" (*takhayyarū li-nuṭafikum…*). See https://sunnah.com/ibnmajah:1968.

Did You Know?

We can also have a discussion on natural vs nurture and whether anything of one's character relates to genetics; however, we should keep in mind that Allah does not burden any soul with the sins of another. So, even if some of our character traits are "inherited," we are still responsible for our actions and seeking out Allah's love and acceptance.

3.15 Ethical, Legal, and Social Issues in Biotechnology (ELSI)

Connection

The Sharīʿa, Allah's perfect and lasting guidance for humanity, regulates and guides our moral and ethical actions. Whatever concords with the Sharīʿa is lawful and right, and whatever disagrees with the Sharīʿa is unlawful and wrong. Everything that is possible in science, like technology and experiments, may not be ethical. Just because we have the technology to do something does not necessarily mean it is moral and within what is allowed by the Sharīʿa. Can you think of any examples of science. medicine, and technology today that we have the ability to develop or have developed but its use is unlawful and unethical?

Did You Know?

Muslims scholars from the past till today have discussed the legal and moral implications and consequence of medicine, biotechnology, and scientific experimentation, more generally. Some contemporary issues that scholars are discussing and giving guidance on include cloning, genetic modification, life-altering elective surgeries, biotech enhancements, pharmaceuticals testing and use, and more.

What Do You Think?

Consider whether without an objective moral-ethical framework from an all-knowing, all-wise creator, humans would be able to determine the boundaries of 'right' and 'wrong'.

4. Molecular Biology

4.1. Central Dogma

Connection

- Throughout the sections on Molecular Biology, you will come across amazing **complexity**, **design**, and the **intelligibility** of genetics, DNA, RNA, and more. All of this reflects Allah's knowledge, power, will, and wisdom, and as Muslims, we should reflect on these wonderous creations out of awe and gratitude towards Allah.

- **Intelligibility** means that we are able to understand and investigate something. The simple fact that the world is intelligible to us, let alone something so complex as DNA and genetics, should give rise to a feeling of amazed and saying, "*subḥāna Allāh*."
- We also learn from these phenomena that all and any change is due to Allah's will of that change. None of these genetic processes and mutations arise on their own or through mere chance.
- Moreover, notice the **complexity** of amino acids, proteins and protein synthesis, and enzymes and how absurdly improbable for any of them to have come about to serve the complex functions they perform without the intervention and will of an all-powerful and wise creator.

4.8. Mutation

Connection

Genetic mutation falls under Allah's knowledge, power, and will, and He is the agent of the mutation. Every minute mutation, however seemingly insignificant, is still planned by Allah.

5. Evolution

5.1. History of Life

Additional Learning Objectives

- Understand that Muslims can accept current scientific findings about the age of the universe and theories about its early formation, and similarly about the earth. The only issue is with theories that explicitly contradict revelation, for example the universe originating without a creator, the universe not needing a creator after its creation, our father Ādam (upon him peace) having evolved from a prior species.
- Recognize that scientific 'facts' remain in the probabilistic category of knowledge and are subject to change and that science is the study of secondary causality.
- Gain familiarity with a general overview of the issue of human evolution.
- Notice that sometimes non-scientific "beliefs" are brought into science textbooks.
- Be aware of 'loose' usage of terms such as 'evolution'. The term 'evolution' may be used to mean 'adaptation' or 'detectable and observable change' or 'gradual change' while other times it may be used to mean 'random and unguided change' or be used with personification. For example, you may read, "Evolution produces," and we sometimes say statements like, "The universe evolved."

Framework

- Regardless of the details about the scientific community's theory of the origin of life and the earth, ultimately the originator, sustainer, and the one who wills and oversees all life and change is Allah. This is the only principle that cannot be negated.
- Try defining 'biology' and 'biological life' and discuss different definitions of the science and for 'life'.
- Consider whether 'biologically living things' are only those which share in carbon.
- Discuss if biology is the study of living matter/carbon-based lifeforms.
- What is the definition of life? Does biology only study what is readily observable? Why does the study of angels and jinn fall outside the scope of biology? If we do not affirm anything as living or existing that is not observable to us, what existing things would we be leaving out?
- Allah is described as 'living' while not being comprised of a substance.
- Allah wills every event and moment of the universe and remains in control of everything in it, including the epochs, evolution, extinction of living organisms, etc.

Connection

- Allah alludes to the process of creating the earth when He mentions the creation of the universe and everything else in it. He states that He created the universe in 'six days' (or epochs, etc.) in multiple places in the Quran, with the earth being created in 'four days': "And He placed on the earth firmly set mountain and over its surface, and He blessed it and determined therein sustenance in four days equitably for all that seek it" (Q 41:10).
- Allah and His Messenger ﷺ mention other lifeforms, like jinn, angels, the Burāq, etc. Why do we not study these living beings in biology? (Hint: recall the definition and subject matter of biology.)
- Appreciate that Allah left us evidence of His creative will even in the fossil record and gave us the means to discover and analyze these fossils.
- Allah tells us: "I did not make them witness the creation of the heavens and the earth nor themselves, and I have not taken those who misguide as assistants" (Q 18:51).
- Allah creates things we are not even aware of, "and He creates that of which you do not know" (Q 16:8).
- For further reading, you can read a contemporary scholar's in-depth article on evolution (Shaykh Nuh Keller): http://masud.co.uk/islam-and-evolution-a-letter-to-suleman-ali/.

5.4. First Cell

Framework

- Allah creates consistently and normatively (meaning it has a regular pattern) such that we humans can investigate, learn, and marvel over His names and attributes. From the first molecules and organisms to multicellular life, Allah demonstrates His power and wisdom, and humans are responsible for reflecting on these changes and phenomena to draw closer to Him and realize His oneness and perfection.
- Over the various eras, Allah creates and grants life and destroys and takes away life, as He wills. The fossil record is evidence of Allah's power and will. "He creates that which you do not know" (Q 16:8). Every year, scientists and archaeologists uncover more evidence of Allah's existence, but many are unaware.
- Notice how Allah created this earth and prepared it for later species in stages. Artist renditions of what they periods could have looked like should inspire a sense of awe, wonder, and gratitude towards Allah.

5.10. Classification

Connection

Allah mentions different categories of living things, from plants and animals to other living beings not of our realm.

Did You Know?

Classical scientists, philosophers, and theologians classified life and living beings in their works on philosophy and science, such as Ibn Sīnā, al-Bīrūnī, Ibn al-Bīṭār, and many others.

5.14. Theory of Evolution

Framework

- Ultimately, Muslims have no theological objection to the theory of evolution and adaptation as long as the theories and conclusions do not contradict what is unequivocally stated in revelation. Thus, Muslims may believe that Allah creates in a regular pattern that we can call 'evolution' and wills natural selection and adaptation at every moment, as long as we affirm that Allah creates every instance and moment of change.
- Furthermore, the only sticking point is the origin of the human species. Muslims affirm due to the unequivocal statements in the Quran and Sunna that Allah spontaneously created Ādam ʿalayhi al-salām, and from Ādam, Ḥawwāʾ. Details

about human beings or human-like species before and after Ādam ʿalayhi al-salām can be negotiated.

5.15. Fossils

Framework

- When discussing evolution, we should take care to consider where scientists are making strong and weak inferences, particularly when we discuss the evidence for evolution and macroevolution. We should be concerned with potential logical fallacies, which you will study in more detail in your logic courses.
- Notice the uses of the terms 'evidence' throughout the next sections.

Connection

- Allah tells us that He controls His creation, changing and modifying it as He sees fit. He says, "Praise be to Allah, Who created [out of nothing] the heavens and the earth, Who made the angels, messengers with wings, be they two, three, or four [pairs]: He adds to creation as He pleases, for Allah has power over all things" (Q 35:1).
- Allah explains that He diversified human beings so that they recognize each other and learn from each other, "Humankind! Indeed We created you from male and female and made you peoples and tribes that you may know one another. Indeed, the most noble of you in the sight of Allah is the most righteous of you. Indeed, Allah is Knowing and Acquainted" (Q 49:13).

6. Ecology

6.1. Ecosystems

Connection

- Allah made us human beings caretakers of the earth, and as such we are responsible for how we use (and abuse) the earth and its resources. Allah says, "And when your Lord said to the angels, 'Indeed, I will make upon the earth a successive authority." They said, 'Will You place upon it one who causes corruption therein and sheds blood, while we declare Your praise and sanctify You?' Allah said, 'Indeed, I know that which you do not know'" (Q 2:30) and He says, "And the camels and cattle We have appointed for you as among the signs of Allah; for you therein is good. So, mention the name of Allah upon them when lined up [for sacrifice]; and why they are [lifeless] on their sides, then eat from them and feed the needy and the beggar. Thus have We subjected them to you that you may be grateful" (Q 22:36).

- Allah created the earth (and all of creation) within a cyclical system where nothing escapes His will and wisdom nor is anything “wasted." Allah tells us, "The did you think that We created you uselessly and that to Us you would not be returned?" (Q 23:115) and, "...who remember Allah while standing or sitting or [lying] on their sides and give thought to the creation of the heavens and the earth, [saying], 'Our Lord, You did not create this aimlessly; exalted are You [above such a thing]; then protect us from the punishment of the Fire'" (Q 3:191). We are commanded to reflect on this system.
- As caretakers, we are not to be wasteful of the blessings Allah provided us, "Indeed, the wasteful are brothers of the devils, and ever has Satan been to his Lord ungrateful" (Q 17:27).
- Check out some efforts Muslims have made in the development of conservation areas: https://muslimheritage.com/ecology-muslim-heritage-history-hima-conserv-syst/
- Here's a bibliography of Muslim works on ecology and environmental awareness: https://muslimheritage.com/ecology-islamic-culture/
- Check out the following: Religions and environmental protection | UNEP - UN Environment Programme

6.5. Water Cycle

Framework

Consider the mountains, clouds, rain, and oceans in the water cycle and how organisms decompose other organisms and recycle their nutrients for other plants and animals. These are all signs of Allah's wisdom and the blessings He provides to us.

6.8. Biomes and Climate

Connection

- Scholars such as Ibn Khaldūn in his *Muqaddima* noted down the different biomes and climates on earth and how they even contribute to different human cultures and characteristics.
- Given all the diversity of life and climates, notice that Allah has placed in this earth wonders and endless areas for humans to reflect.

6.13. Predation

Connection

- Allah created **communities** of plants, animals, humans, etc., all of which interact and serve to balance the system Allah wills and oversees. He says, "And there is no creature on [or within] the earth or bird that flies with its wings except [that they are] communities like you. We have not neglected in the Register a thing. Then unto their Lord they will be gathered" (Q 6:38).
- Allah inspired all of creation its 'nature' and wills their **adaptations** to their environment. For example, Allah says, "And your Lord inspired to the bee, 'Take for yourself among the mountains, houses, and among the trees and [in] that which they construct'" (Q 16:68) and, "Exalted the name of your Lord, the Most High, who created and proportioned, and who destined and [then] guided" (Q 87:1-3).
- Have you noticed the connection between the Arabic meaning of ***umma*** and that of '**community**'? *Umma* is associated with the meaning of 'gathering' and implies the meaning of a source or acting as a single unit.
- Allah created the earth for His creation, "And the earth He laid out for creatures" (Q 55:10).
- All creatures and communities worship Allah, even if we do not understand how, "Do you not see that Allah is exalted by everything in the heaves and the earth and [by] the birds with wings spread [in flight]? Each [of them] knows its [means of] prayer and exalting [Him[, and Allah is knowing of what they do" (Q 24:41).
- Compassion is the basis of the relationship and interaction intraspecies and between humans and other animals; Allah placed one portion of His compassion in the earth, as the Messenger ﷺ told us, "Allah divided compassion into one hundred parts. He kept ninety-nine parts with Him and sent down one part to the earth, and because of that, its one single part, His creations are compassion to each other such that even the mare lifts up its hoofs away from its baby animal lest it should trample it" (al-Bukhārī #6000).
- The Messenger ﷺ was good to all animals and commanded that Muslims be good to all of creation (https://muslimheritage.com/animal-care/, https://www.ecomena.org/islam-animal/).
- Reflect on our overuse and wastefulness when it comes to water, plants, and animals; the early Muslims, like the Native Americans and other pre-modern people, held their interaction with waters, plants, animals, etc. with sanctity, even to the point of not wasting anything of animals that we slaughtered for food.

6.25. Importance of Biodiversity

Framework

- We, Muslims, should be involved in conservation efforts and be concerned with overuse and living in harmony with the environment around us, as opposed to destroying and expanding for greed and consumerism.
- Find efforts to get involved in conservation and protecting plants, animals, and the general environment.
- Look into gardening, composting, attracting native animals to your garden, providing shelter to at risk animals, etc. as an activity for you and your family.

Connection

Allah will ask the earth about what took place on it, so we humans as a group will be responsible for our own destruction of the earth. Allah says, "That day it will report its news because your Lord has commanded it" (Q 99:4).

6.27. Resources

Framework

- As caretakers of the earth, we are responsible for their use and abuse of the resources (a blessing) that Allah granted us. We will be asked about everything we used.
- We must be aware of equal sharing of natural resources and consider how we can get involved in renewables, sustainable use, and fair access to natural resources. Seek out opportunities in your local community to raise awareness of these issues and get involved.

7. PROKARYOTES AND VIRUSES

7.1. Prokaryotes

Microorganisms like prokaryotes (including bacteria) and viruses belong to the world of the 'unseen' (*ghayb*) like that which "lies beneath the earth" and outer space ("the stars on the horizons") - the unseen is physical and spiritual. Allah may reveal the spiritual dimension of the unseen; He says, "Thus do we show Abraham the [spiritual] kingdom of the heavens and the earth," (Q 6:75). Similarly, Allah may reveal the unseen regions of the physical world through the development of scientific instruments.

7.7. Bacteria and Humans

Bacteria and Honey

It may not look like it's sitting in that cute bear bottle, but honey is a bacteria-killing powerhouse. New discoveries around bees and honey reveal some of the wisdoms of this prophetic food. Allah says, "[Allah revealed to the bee to] eat from every fruit and tread

in the ways of your Lord made easy. From their bellies comes a drink [i.e., honey] of various colors in which there is a healing for men." (Q 16:68-69). To learn some of the antibacterial, healing properties of honey, watch this video: [https://www.youtube.com/watch?v=7FlzHiURdTs]

7.14. Viral Disease

Muslims and Contagion

Throughout history, infectious diseases have been an ever-present companion to human existence. Major outbreaks have claimed millions of lives and left a lasting impact on populations, politics and economies. Muslim civilizations, which flourished for several hundred years (c.7th-14th CE) and stretched from Spain to parts of China, was no stranger to infectious disease.
(Bridgeland, "Epidemics, Pandemics, and Contagion", *Muslim Heritage*)

The concept of isolation to prevent the spread of epidemics comes from the Prophetic report, "If you hear of the outbreak of plague in a land, then do not enter it. But if there is break out of plague where you are, then do not leave that place," (Bukhari 5728). Additionally, the famous Muslim physician and metaphysician Avicenna (d. 1037) recommends in his *Canon of Medicine* to isolate the sick for 'forty days' to stop microscopic organisms from spreading between individuals. This prescription of forty days is the basis of our practice of 'quarantine' which comes from the Italian word for 'forty'.
(BaHammam, "The Contributions of Islam and Muslim Scholars to Infection Control")
Preventative medicine through hygiene and a balanced diet is a core motif of Muslim tradition.

- The Prophet ﷺ emphasized the practices of washing five times a day and bathing often saying, "Cleanliness is half of faith." (Muslim 223)
- "Whoever wakes from sleep should wash his hands before putting them in the water for ablution (*wudu'*) because nobody knows where his hands were during sleep." (Bukhari 162)
- Brushing teeth before prayer is highly recommended. The Prophet ﷺ said, "Were I not afraid of burdening my community, I would order them to use the tooth brush for every prayer." (Bukhari 887)
- "When the Prophet ﷺ would sneeze, he would cover his face with his hand or with his garment and muffle the sound with it. (Tirmidhi 2745)

- "A string believer and is better and more beloved to Allah than a weak believer, but in both there is good." (Muslim 2664)
- "There is no container a human fills worse than this stomach. Enough for a human are some mouthfuls to straighten his back. But if his self overcomes him, then one third for food, one third for drink, and one third of air." (Ibn Majah 3349)

Disease and plague, however, are not just biological phenomenon: a contagion must originate from somewhere, after all. Allah often brings plague as a punishment to a land filled with corrupt morality as a symptom so that they realize the error of their ways and turn back to Truth. The Prophet ﷺ said, "Plague is a punishment Allah sends to whomever He wills. He has made it a mercy to the believers. A slave of God who stays patiently in a town when plague befalls it and knows that only what Allah decrees shall afflict him – there is none so but that Allah will grant him a reward equal to the reward of a martyr." (Bukhari 5734)

8. Protists and Fungi

8.14. Fungi Symbiosis

The Woodwide Web

When most of us think of fungus, we imagine mushrooms sprouting out of the ground. Those mushrooms are in fact the "fruit" of the fungus, while the majority of the fungal organism lives in the soil interwoven with tree roots as a vast network of mycelium. Mycelium are incredibly tiny "threads" of the greater fungal organism that wrap around or bore into tree roots. Taken together, myecelium composes what's called a "mycorrhizal network," which connects individual plants together to transfer water, nitrogen, carbon and other minerals. German forester Peter Wohlleben dubbed this network the "woodwide web," as it is through the mycelium that trees "communicate." In healthy forests, each tree is connected to others via this network, enabling trees to share water and nutrients. The mycorrhizal network plays a distribution role to keep the mycelium-connected trees alive and healthy and the fungi's supply of carbon consistent. As a sort of payment for their services, the mycorrhizal network retains about 30% of the sugar that the connected trees generate through photosynthesis. The sugar fuels the fungi, which in turn collects phosphorus and other mineral nutrients into the mycelium, which are then transferred to and used by the trees. Hence, trees and fungi too "form communities like yourselves," (Q 6:38)

(Holewinski, "Underground Networking", *National Forest Foundation*)

https://www.nationalforests.org/blog/underground-mycorrhizal-network

8.15. Use of Fungi

Truffles are an edible fungus recommended by the Prophet ﷺ for its medicinal properties. He said ﷺ, "Truffle is a *manna* (a kind of juice), and its extract is a medicine for the eyes," (Muslim 2049). Truffles represent a large group of soil fungi belonging to Ascomycota, Basidiomycota, and Zygomycota. Because of their exceptionally profitable protein, fat, polysaccharide, carbohydrate, ash, mineral, phenolic and other organic molecule contents, truffles have been appreciated as food, nutritional and therapeutic sources for many years.

9. PLANTS

9.1. Plant Characteristics

An Early Muslim Botanist

Abu Hanifa al-Dinawari (d.895 CE), a botanist, from Persia wrote the classic "The Book of Plants" (*Kitab al-Nabat*). In his exposition on soil, al-Dinawari describes a variety of soils, explaining which is good for planting, its properties and qualities. Al-Dinawari also describes plant development from its birth to its death, including the phases of growth and the production of flower and fruit. He then covers various crops including cereals, vines and date palms. Relying on his predecessors, he also explains trees, mountains, plains, deserts, aromatic plants and woods, plants used in dyes, honey and bees.

Contrary to much of the literature of plants at the time, al-Dinawari's book was less concerned with identifying herbs in the field for medicine but instead was "inspired by a delight in the manifold varieties of plant morphology." (Bruno Silberg, 1911) (Zaimeche, "Al-Dinawari", *Muslim Heritage*)

9.2. Importance of Plants

Herbs and Healing

During the latter part of the Abbasid period and the Western Caliphate, Muslims made real contributions to the knowledge of organic and inorganic medicinal remedies, as well as their compounding of these remedies. The separation of the medical from the pharmaceutical professions was started by the Abbasids, largely due to the advances that had been made in *Materia Medica* and the knowledge of compounding drugs. The large hospitals in Iraq had a pharmacist on their staff, and a well-equipped pharmacy, where

drugs were compounded and the physicians' prescriptions were filled. In these pharmacies, drugs and spices were stored.

The dominant feature, however, is that nearly all drugs were derived from plants, with a much smaller proportion of animal and mineral origin. Abul-Abbas, of Seville, was the first to apply the principles of botanical science —previously principally devoted to agriculture— to the purposes of the apothecary and the physician. Regulation of diet was an important recommendation, together with respecting the first principle of medicine, that is the preservation of health preceded the medicinal use of plants, and respect of the second principle, the restoration of health when it was lost or weakened. However, there was no very clear dividing line between food and medicine, and many plant products might well fall into both categories.

Pharmacology was discussed, for example, in the *Kamil al-Sina'a* of Ali b. Abbas al-Madjusi (d. 994). In this treatise, the pharmaceutical properties of the simple drugs are described in fifty-seven chapters. Among the latter are included those on botanical simples, animal simples, mineral simples, medicinal oils, taste and odors of simples, odor, strength, constipating and opening qualities, deterioration, pain, decreasing ability, cicatrisation effects, diuretic effectiveness, sudorific qualities, strength of seeds, leaves, and roots, extracts, gums and humors of drugs; also stones, salts, galls, dungs, diarrheic simples, and dosages are explained in separate chapters.

("Botany, Herbals and Healing", *Muslim Heritage*)

9.9. Seed Plants

The Value of Trees to Human Beings

Trees are the central pillar of ecosystems. They provide shelter and food for animals, purify the air of pollution and regulate the temperature within urban environments. They play a critical role in the quality of human life as well as the environmental well-being of our communities. Few would argue against the importance of trees, but have we really considered their full potential and the economic value of the services they provide? TD Economics conducted a study analyzing the influence and impacts of trees within Toronto and came up with several noteworthy findings:

- Urban forests do more than beautify the scenery. They represent an important investment in environmental condition, human health and the overall quality of life.
- The trees in the City of Toronto's urban forest are worth an estimated $7 billion, or about $700 per-tree.

- Toronto's urban forests provide residents with over $80 million, or about $8 per-tree, worth of environmental benefits and cost savings each year. For the average single-family household, this works out to $125 of savings per annum.
- For every dollar spent on annual maintenance, Toronto's urban forest returns anywhere from $1.35-$3.20 worth of benefits each year.

From their study, trees play an important role in managing wet-weather flow, regulating air quality, contributing towards energy savings and sequestering carbon. This has become increasingly important as climate change has altered the weather patterns across Canada, with some areas experiencing extreme drought while others face localized flooding. There are also the societal benefits of a healthy forest canopy such as the aesthetic value of trees and their importance in naturalizing parks and boulevards. ("The Value of Trees in Islam", *Khaleafa*)
https://www.khaleafa.com/khaleafacom/value-of-trees-in-islam

Tree Ethics in Islam

Trees were created by Allah as an all-encompassing blessing: they provide shade and protected from harsh weather, produce fruits and seeds of which human beings eat, and are a pleasure to the eye to behold in the gardens of this life and the next.

- The Prophet ﷺ, as a young boy aged between nine or twelve, joined his uncle's merchant caravan for a trip to Syria. The Christian monk Bahira would notice that the caravan was shaded by a cloud that hovered closely above them. The cloud moved as the caravan moved, and did not go any further when they stopped; it was as if it were providing shade for a person or people in the group. *When he also noticed that a tree lowered its branches over the caravan to provide further shade*, he immediately realized that this caravan must contain an extraordinary person or persons.
- "They will be among thornless lote trees and flower-clad acacias and extended shade and gushing water and plenty fruit never ending and unforbidden." (Q 56:28-33)
- "Whoever says, '[I say] glorifying Allah Almighty and praising Him' shall have a date palm planted for him in Paradise." (Tirmidhi 3465)

Trees hold a symbolic significance as beings that span the distance between heaven and earth: their roots extend into the "unseen" below the soil and their branches extend into the sky above.

- Allah says describing faith and the statement of tawhid, “Do you not see how Allah set the analogy of a goodly word as a good tree – its roots are fixed and its branches are in the heavens!” (Q 14:24).
- Allah speaks to Moses (peace be upon him) through a voice coming from a tree, “When he came to it [the fire], from the right side of the valley, a cry came from a tree in blessed ground: “O Moses, I, indeed, am Allah, the Lord of the Worlds!” (Q 28:29)
- Ibn ‘Umar narrates, “We were with the Prophet ﷺ and fresh dates were brought to him. He said ﷺ, ‘From [all kinds of] trees there is a tree that is an allegory for a Muslim.’ I wanted to say that it was a date palm but I kept silent because I was the youngest of the group. He ﷺ said, ‘It is a date palm.’” (Bukhari 72)

  Trees are to be treated gently as living creatures that possess a self-awareness most human beings are not privy to.
- “On Friday, the Prophet ﷺ would lean on a tree or date palm. A man or woman of the Ansar said, ‘O Messenger of Allah, shall we make a pulpit for you?’ He replied, ‘If you wish.’ So, they made him a pulpit. When Friday came, he was moved to the pulpit, and the date palm wept as children weep. The Prophet ﷺ descended from the pulpit and embraced it as it moaned as a child moans when being comforted. He ﷺ said, ‘It was crying [missing] the remembrance it would hear being given beside it.” (Bukhari 3584)
- “The Prophet ﷺ did not face any mountain or tree but it would say, ‘Peace upon you, God’s Messenger.’” (Tirmidhi 3626)
- Placing fresh, green branches or leaves on a grave reduced the punishment of its occupant so long as it does not dry out because the branch, so long as it is green and living, glorifies Allah. (Bukhari 1378, Muslim 292)
- “There is none from the Muslims who plants a tree or sows seeds from which a bird or person or animals then eats but that it is considered a charity from him.” (Bukhari 2320)

10. Animals

10.1. Animals

The Ethical Treatment of Animals

While animals are created to be sources of benefit for human beings, human beings do not have the right to use them however they please.

- The Prophet (prayers and peace upon him) said, “May God curse anyone who maims animals!” (*Musnad Ahmad,* 1:228).
- “It is a sin for a man to imprison the animals which are in his power.” (Muslim, *Zakat*, 48)
- “There is no one that without reason kills a sparrow or anything greater but that God shall ask him about it.” (Nasa’i, *Dahaya*, 42)
- “The Prophet forbade that animals should be set to fight each other.” (Tirmidhi, *Jihad*, 30)
- “The Messenger of God (prayers and peace be upon him) forbade us from hitting across the face and branding on the face [of an animal].” (Muslim, 3:1673)
- The Messenger of God (prayers and peace be upon him) said, “A woman was tormented because of a cat which she confined until it died; [for this,] she entered Hellfire. She did not provide it with food or drink as it was confined, nor did she free it so that it might eat the vermin of the earth.” (Bukhari, 2365, 3482)

The Prophet (prayers and peace upon him), along with the spiritually sensitive of his followers, could sense pain and emotions of animals. They are animate beings like ourselves.

- “We were once on a journey with God’s Messenger, who left us for a short while. We saw a sparrow with two young fledglings, and we took the fledglings. The sparrow hovered with fluttering wings, and the Prophet returned, saying, ‘Who has hurt this bird by taking its young?! Return them to her!’” (*Musnad Ahmad*, 1:404)
- The Prophet went to a farm where a camel was experiencing a fit of groaning with “her eyes streaming”. The Prophet, unafraid, walks over to the camel and rubs its ears, and she quiets down. He asks who the camel belongs to, and a man identifies himself as the camel’s owner. The Prophet ﷺ says, “Do you not fear God concerning this bear which He has let you own? It complained to me that you starve it and tire it by overworking it and using it beyond its capacity.” (Abu Dawud, *Jihad*, 44)

Accordingly, the master of Islamic Law, al-‘Izz b. ‘Abd al-Salam, includes among the rights of animals over mankind:

- Man must spend on them appropriately, even on animals which are old or sick and are no longer of benefit.
- Animals have the right not to be burdened beyond their capacity.

- Animals cannot be placed in the same enclosure as any animal (of its own species or another) which would harm it by breaking its bones, wounding it, or goring it.
- Animals have the right to access animals of the opposite gender in their own area to reproduce.
- Animals, if they are slaughtered, must be slaughtered gently and with excellence.
- Animals have the right to a good death.

(Winter, "Nations Like Yourselves", 164-165, 169-170)

10.6. Social Behavior

"Communities Like Yourselves"

Allah describes in the Qur'an, "There is not an animal in the earth nor a bird flying on two wings but that they form communities like yourselves. We have neglected nothing in the Book. Then unto their Lord they will be gathered." (Q 6:38). Islam preaches to the fellowship of believers to see the order in the animal kingdom and the unity of creation as a sign of the One Creator. In his grand exposition of the Qur'an, the theologian Fakhr al-Din al-Razi lists six ways other species are like ourselves:

1. The term communities (*umam*) indicates that nations' members resemble each other, can reproduce with each other, and find comfort in each other.
2. They are like humans in that they are also created by God and depend on His provision.
3. They are like us – and unlike the inanimate realm – in being capable of communicating with each other.
4. They are like us in that they are reached by God's grace, care, mercy, and compassion.
5. They resemble us in that they are also resurrected and receive their rights.
6. Each species forms a community (*umma*) in that each one reveals some set of human tendencies: some humans resemble dogs in their behavior, others peacocks, or lions, and so forth.

(Winter, "Nations Like Yourselves", 166)

Animals worship God in their own tongue:

- "There is nothing that does not sing His praise." (Q 17:44)
- "Do you not see that all that is in the heavens and on earth, even the birds with spread wings flying, sing His glory? Each knows its form of prayer and worship." (Q 24:41)

Animals comprehend speech:

- "One ant said, 'Ants, enter your homes so Solomon and hosts don't crush you unknowingly!'" (Q 27:18)
- "Your Lord revealed to the bee, 'Take up hives in the mountains and in the trees and in the trellises that people put up. Then eat from every fruit and tread in the ways of your Lord made easy.'" (Q 16:68-69)
- "[Solomon] inspected the birds and said, 'Why do I not see the hoopoe? Is he of those absent?'" (Q 27:20). A hoopoe is a colorful bird with a crown of feathers.

11. Invertebrates

11.9. Annelids

While having a biological reality, worms are also symbols of death – when bodies are buried in the ground, they become food for worms. Allah says, "When we decreed death for Solomon, nothing indicated to the jinn that he was dead except for a worm gnawing away at his staff." (Q 34:14). But worms as death is not simply morbid imagery: instead, it symbolizes the temporality of this life, the return of things to the earth, and the continuation of the cycle of life.

11.10 Arthropods

Spiders are mentioned once in the Qur'an. Allah says, "The example of those who take allies other than Allah is like that of the spider who takes a home. And indeed, the weakest of homes is the home of the spider, if they only knew," (Q 29:41)

12. Vertebrates

12.6. Fish

Fish (*ḥūṭ*) are mentioned once in the Qur'an. Allah says, "But when they reached the junction between them, they forgot their fish, and it took its course into the sea, slipping away." (Q 18:61)

12.10. Amphibians

Frogs are mentioned once in the Qur'an. Allah says, "So We sent upon them the flood and locusts and lice and frogs and blood as distinct signs, but they were arrogant and were a criminal people," (Q: 7.133)

12.14. Reptiles

Snakes are mentioned once in the Qur'an. Allah says, "And [Moses was told], "Throw down your staff." But when he saw it writhing as if it was a snake, he turned in flight and did not return. [Allah said], "O Moses, approach and fear not. Indeed, you are of the secure," (Q 28:31)

12.24. Mammals Overview

Several mammal species are mentioned in the Qur'an such as apes, camels, cows, dogs, goats, horses, lions, mules, pigs, sheep, and wolves.

13. HUMAN BIOLOGY

13.1. Human Body

Learning to Contemplate the Wisdom in the Human Design

Learning the anatomy of the human body trains the believer in the practice of worshipping Allah by contemplating His creation – in noticing the perfection in His design, we learn to appreciate Him. The perfect of Allah's design of the human body is in everything in the body serving a particular purpose - if the human body would have been otherwise, he could not function as completely and beautifully as he does.

The great theologian and jurist, Abu Hamid al-Ghazali, was also a notable anatomist. He describes, "Look and see if you find anything in the creation of the body that has no purpose. Was eyesight created for anything other than the purpose of perceiving things and colors? If there were colors but no eyesight to perceive them, would there be any purpose in the existence of colors? If there was no light emanating besides the inherent light of the eyes, what benefit would be gained from eyesight? Was the faculty of hearing created for anything other than the purpose of perceiving different voices? If there were sounds but hearing did not exist to perceive them, would there be any benefit in the existence of such sounds? Likewise is the case for all the senses.

Ponder on the mediums that were created between the senses and perceivable things; the senses would be incomplete except through these mediums, which include light and air. Had there not been light to make all visible things evident, then eyesight alone would not be able to carry sounds to the ears and having the ability to hear would not achieve (the complete sense of actually) hearing.

Ponder upon the one who lacks eyesight and hearing and the afflictions he suffers from: indeed, he cannot see where he places his foot, cannot know what is in front of him, cannot distinguish between various colors, cannot sense a violent attack or an enemy (and protect himself), and cannot learn most crafts and trades. As for the one who lacks

hearing, indeed, he is one who is deprived of the pleasantness found in beautiful voices and harmonious melodies. He becomes burdensome upon the one who attempts to speak to him, such that he (the speaker) leaves him, and he is not able to hear anything of the news of people and their conversations. He becomes treated like the one who is absent (from a conversation) even though he is present and treated like a dead person even though he is alive. As for one who lacks intelligence, look how he becomes worse than beasts. [Allah says, “They are but like cattle; no, they are further astray!” (Q 25:44)]” (Ghazali, *Concerning Divine Wisdom*, 78-80)

13.3. Skeletal System

Why So Many Bones?

Imam al-Ghazali describes the allocation of bones throughout the body, “God made the head comprised of fifty-five bones of different forms and shapes. He joined some of them to others such that the skull is perfectly balanced (atop the spine), as is apparent. Six bones from these (fifty-five) are exclusively for the skull, twenty-four are for the upper jaw, and two bones are for the lower jaw. The rest are from the teeth; some are broad and flat and suitable for grinding (food), and some are sharp and suitable for cutting (food). Then He made the neck as a seat for the head. He assembled from it seven hollow circular vertebrae…Then He constructed the neck upon the book (i.e., the spine), from the bottom of the neck until the end of the sacral bone, consisting of twenty-four vertebrae and the sacral bone joined with three other bones. He joined the coccyx bone, which itself is composed of three other bones, to the bottom (of these vertebrae). Then He joined the spine with the pelvic bones, the shoulder bones (i.e., the clavicle and scapula), the bones of the two arms, the bones of the sacrum, and the bones of the thighs (femurs), shins, and bones of the feet. He made the total number of bones in the human body as 248, not including the small bones that complete the intervening joint spaces. If only one extra bone was added, it would cause an ailment in the human being, and he would need to remove it. If he were missing a bone or had a defect in any bone, he would need something to compensate for it. And so, God most Exalted created a lesson in this form for the people of insight." (Ghazali, *Concerning Divine Wisdom*, 66)

The Miracle of the Structure of the Hand

Imam Ghazali, says,

“Look at the creation of the two hands and how they both guide man towards grasping what he aims for and deflecting harms. Look at how He made the palm wide (through

the arrangement of the fingers). He apportioned the five fingers and apportioned the fingers with finger bones. He made four fingers on one side (of the hand) and the thumb on the other so that it may hover and rotate over the other four fingers (i.e., an opposable thumb). If the ancients and moderns (i.e., humanity through all of time) had assembled and attempted with meticulous planning to place (the fingers in an arrangement) other than how the fingers are placed, they would not manage anything other than this arrangement with this distance between the thumb and the four fingers, this variation in the length of the four fingers, and their alignment in a single row." (58-60). Reflect on how robotics, despite the vast resources of humanity being poured into their development, can only manage to engineer a hand in poor imitation of natural human hands.

"By virtue of this arrangement, grasping and releasing become possible. If a person spreads his fingers out, they become like a plate upon which he can place whatever he wishes. If he clenches his fingers together (in a fist), they become a tool he may use to hit. If he brings them together, curved but not completely back (i.e., not touching the palm), the hand becomes like a ladle for him. If he stretches them out and keeps them joined together, it becomes like a scoop for him." (Ghazali, *Concerning Divine Wisdom*, 60)

13.6. Joints

The Divine Wisdom in Joints

"Because the human being is need of all of his body, but he needs some of his limbs more frequently, God did not make his bones as one bone but rather as many (i.e., as a skeletal system). There are joints between bones such that movement becomes easy with them. He ordered the shape of each of them to be in accordance with the type of movement sought with each limb. Then He brought together the joint spaces and tied together some of them with others by using pegs (i.e., ligaments). He strengthened them from one end of the bone and attached the other side like a bandage. Then He created a protruding appendage on one end of the bone, and a recessed cavity in the other end of an adjacent bone that matches the shape of the protruding appendage. This is so that each bone fits suitably with the other bone. When man wishes to move one part of his body without moving another, he is not (anatomically) prevented from doing so. (Ghazali, *Concerning Divine Wisdom*, 62-64)

13.8. Muscles

Muscles: Not Too Many, Not Too Few, Just Right

Imam al-Ghazali marvels, “Look at how God created muscles as instruments for mobbing the bones. He created five hundred and twenty-nine muscles in the human body. Muscles are constructed from flesh; then nerves and membranes are joined and covered over them. They are of different capacities and shapes according to their placement and need. So twenty-four muscles are for the movement of the eyes and eyelids alone, such that if even one were missing or damaged, the movement of the eye would be unbalanced and dysfunctional. Likewise, there are muscles appropriately numbered for each limb and organ, being exclusively for them and measured in perfect accordance and agreement (matching their functions). (Ghazali, *Concerning Divine Wisdom*, 66)

13.17. Senses

The Structure and Design of Sense Organs

Each of the sense organs is well-designed to allow the sense receptors to receive what is being sensed.

The Eye

If it were not the particular structure of the eye, it would not be able to sense light: “Allah constructed the eye having seven layers, and each layer has a quality and a specific shape. If the eye was missing any layer or possessed any more [layers or thicker layers], it would be rendered incapable of sight.” (Ghazali, *Concerning Divine Wisdom*, 50)

“So observe the shape of the eyelids that protect the eye, and what magnificence He created in their ability for swift movement [i.e., blinking] for the purpose of protecting the eye from whatever may reach it and cause harm to it, like dust. The eyelids were created equivalent to a door, opening when needed (for vision) and closing at other times (for sleep and protection from damage).” (Ghazali, *Concerning Divine Wisdom*, 50-52)

“He created saltiness in the conjunctiva of the eye in order to destroy whatever may fall into it. He made the two sides of the eye (i.e., each canthus) as two small depressions from the center of eye so that anything that fell into the eye would be directed towards these outer edges.” (Ghazali, *Concerning Divine Wisdom*, 52)

The Ear

“God pieced into the human being the organ of hearing [i.e., the ear canal]. He placed a bitter wetness in the ears to protect them from the harm of insects, such that it kills most of the vermin that enter into the ear. He protected the ear with the auricle, which also

gathers all sound (waves) and directed them to the auditory meatus. He gave it a heightened sensitivity to be able to perceive any pests and other such things that may try to reach it. He also shaped many internal curvatures within it to amplify the sound (in it). In order to lengthen the distance of movement of things (like an insect or other harmful thing) which may crawl (invading) into it, He made this path long such that it may awaken the person from sleep and affect him." (Ghazali, *Concerning Divine Wisdom*, 56)

The Nose

"Then look at the human being's (ability) to perceive odors by air entering (through the nostrils)…Then look at how He raised the nose in the middle of the face and made man's appearance beautiful thereby (by placing it in this location as opposed to elsewhere on the face). He opened the two nostrils, and He placed in it a sense capable of smelling so that man may have proof through his faculty of olfaction as to the smell of his food and drink, and that he may find pleasure in the smells of perfume, guard himself against foul odors, and be able to inhale the essence of life (i.e., oxygen) as nourishment for his heart. He made the two nostrils to allow for the nourishment of his heart and ventilation of heat from the insides." (Ghazali, *Concerning Divine Wisdom*, 56-58)

13.28. Blood

Blood Cupping

A core Muslim tradition for healing is blood cupping (*hijama*). Cupping treatment is an alternative medicine in which a therapist puts special cups on one's skin for a few minutes to generate a pull and suction. It is used for different purposes, including blood flow, relaxation, and well-being, to help with pain, inflammation, and as a type of deep-tissue massage. The Prophet ﷺ said, "Healing is in three things: drinking honey, the incision in blood cupping, and branding with fire (i.e., cauterization), but I forbid my community from cauterizing," (Bukhari 5680). Cupping also has a range of immunological benefits.

[Source]

13.34. Digestive System Organs

The Structure and Design of Mechanical Digestion

The organs in the mouth are well-designed to facilitate digestion while remaining aesthetically beautiful.

The Lips

"Look at the mouth and tongue and see what Divine wisdom is contained in them. He made the two lips as a curtain for the mouth as if they were a door that is closed but that opens when the time for such a need arises. The lips are also a covering over the gums and teeth with the added purpose of giving the face beauty. Had it not been for these two lips, the entire form (of the face) would be misshapen and ugly. The lips also aid in the purpose of speech. (Ghazali, *Concerning Divine Wisdom*, 52)

The Tongue

The tongue is created for rational speech and to articulate what is in man's inner self. It turns over food and delivers it under the teeth, mollifying it until it is fit for chewing and easy for swallowing. (Ghazali, *Concerning Divine Wisdom*, 52-54)

Teeth

Then He made the teeth into different numbers, such that they are not like a single bone. If one of them were afflicted with an ailment, there would still be benefit from (being able to use) the others. He combined utility and beauty into teeth. He made each tooth have a tooth opposite to it and extended each one so that it met with the one below it (and thus allowed human beings to chew food properly and with ease). He made them sturdy, yet not as sturdy as the bones of the body, due to man's need for continually using teeth. There is both size and prodigality in the molars, due to the need of chewing food since chewing is the beginning of digestion. The incisors and canines were made specifically for the cutting of food, yet also as a (source of) beautification for the mouth, so he strengthened their roots and sharpened their ends. He whitened the color of teeth, which are surrounded by the redness of gums (appearing beautiful through this contrast of color), and made them possess symmetrical tops and proportionate arrangement, like a row of pearls.

Then look at how He created a stored moisture (with saliva) in the mouth that is isolated and does not appear until there is a need for it. If saliva was present and flowed before there was a need for it, it would be a disfigurement. It was therefore made to provide wetness to whatever food was to be chewed, until it became easy to swallow without any hardship or pain. This extra wetness, which was created specifically for the moistening of food, is also not present when one is not eating. Yet there remains enough wetness to moisten the uvula and throat for the purpose of forming words, such that these organs do not become dry – for if they became dry, it would lead to the human being's death. (Ghazali, *Concerning Divine Wisdom*, 54)

The Stomach and Liver

"God made the stomach as durable, strong sinew to (facilitate its function) digesting nourishment with its requirement (of such a sturdy construction) for this digestion. Thus it was possible for the stomach to cut and grind food. He made the initial chewing of food by the teeth as an aid for the stomach, in order to achieve efficiency in both grinding and digesting. He made the liver for the purpose of diverting (digested) nourishment to the blood, such that blood may draw from it (and transport) to every single organ the (specific) nourishment suitable for it." (Ghazali, *Concerning Divine Wisdom*, 70)

13.40. Balanced Eating

Prophetic Foods

"People, eat of the lawful and wholesome [foods] in the earth and follow not the footsteps of Satan!" (Q 2:168)

The prophetic diet exemplified the virtue of moderation. When served meat and pumpkin, he would eat of both: the Companion Anas b. Malik relates that once when a tailor invited the Messenger of God ﷺ for a meal that he had prepared with barley bread, dried sliced meat, and pumpkin. "I saw the Messenger of God ﷺ going after the pumpkin around the dish, so I have liked pumpkin since that day," (Abu Dawud 3782). The Prophet ﷺ would encourage eating only a little: "Enough for a human are some mouthfuls to straighten his back. But if his self overcomes him, then one third for food, one third for drink, and one third of air," (Ibn Majah 3349). Overeating is discouraged: Allah says, "Eat and drink without going to excess! Indeed, Allah does not love the wasteful." (Q 7:31).

Prophetic foods include:

- Dates – "Whoever eats seven 'ajwa dates every morning will not be affected by poison or magic on the day he eats them." (Bukhari 5445)
- Figs – "By the fig and the olive." (Q 95:1)
- Milk – "There is a lesson for you in cattle. We provide you drink from what is in their udders between the feces and blood – pure milk – palatable to those who drink it." (Q 16:66)
- Meat
- Grapes
- Honey – "From the bellies of bees comes a drink [i.e., honey] of various colors in which there is a healing for men." (Q 16:68-69).
- Olives & Olive Oil – The Prophet ﷺ said, "Consume olives and use its oil, because it comes from a blessed tree." (Tirmidhi 1852)

- Barley – Once when the Prophet ﷺ was eating wet dates and ‘Ali reaches out for some. The Prophet ﷺ said, “Wait, ‘Ali. You have just recovered from being sick.” When some greens and barley was made for the Prophet ﷺ, he said to ‘Ali about the barley, “’Ali, eat some of this. It is better for you.” (Ibn Maja 3442)
- Pumpkin

13.66. Embryo Growth

Embryology of Human Beings

The formation of the human being is described in detail in the Qur’an. Imam al-Ghazali explains, “Then Allah created both male and female from the zygote after its journey from sperm to clot to a lump of flesh, until it had bones; then He covered it with flesh, strengthened it with nerves and sinews, and weaved blood vessels (into the midst of these). He created the limbs, assembled them, and made the head round in shape (upon them). (In the head), he opened forth (organs of) hearing, sight, smell, taste, and other orifices. (Ghazali, *Concerning Divine Wisdom*, 50).

- “Let man reflect on what he was created from. He was created from **sperm** gushing. Emitting from between the backbone and ribs.” (Q 86:5-7)
- “Read in the name of your Lord who created. Created man from a **clot**.” (Q 96:1-2)
- “Indeed we did form man from a portion of clay. Then we made him into a **drop** in a safe dwelling. Then we formed a **clot** from the drop, and we formed a lump of **flesh** from the clot, and we formed **bones** from the lump, then we covered the bones with flesh. Then we created him into another form. Blessed is Allah, the best of creators!” (Q 23:12-14)
- “Allah brought you out from the wombs of your mothers knowing nothing. He made for you hearing, sight, and hearts that you show gratitude. (Q 16:78).

The fetus is surrounded by three walls: the anterior abdominal wall of the mother, the uterine wall, and the amnio-chorionic membrane.

- “He forms you in the womb of your mother stage after stage in **three darkening [walls]**.” (Q 39:6)

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