

Course Syllabus

Title

Teaching Middle School Life Science

Target Audience

This course is intended for pre-service and in-service life science teachers of grades 6-8.

Prerequisites

To successfully participate and complete the assignments in this course, the learner must:

- Be familiar with taking an online course or have completed the PBS “Practice Learning Online with TeacherLine” course.
- Have some experience in grades 6-8 classrooms.
- Have an interest in life science.

Course Description

This course focuses on three elements: content knowledge, inquiry and other teaching strategies, and use of multimedia and visualization tools in teaching and learning about how to teach middle school life science topics. Teaching Middle School Life Science is designed to help educators gain an understanding of science concepts needed to teach standards-based curricula at the middle school level. This course incorporates inquiry, methodology, and metacognitive strategies for learning and teaching, including scientific reasoning, prediction, and abstract and critical thinking, and helps educators optimize their science teaching experiences. Through the readings, videos, discussions, assignments, and other interactive experiences, learners in this course will have multiple opportunities to develop their content knowledge about the structure and function of organisms, behavior, regulation, the structure and function of cells, reproduction and development, DNA and heredity, applied genetics, and natural selection. Learners will experience a rich multimedia, inquiry-based learning environment as their students ideally would in their own classroom. The course provides effective teaching methodologies, strategies, and tools that can be used when teaching life science concepts.

Instructor/Facilitator

See instructor/facilitator sheet.

Credits

To be determined by college or university.

Course Goals/Objectives

As a result of participating in this course learners will:

- Develop content knowledge about topics taught at the middle school level.
- Understand inquiry-based learning models.
- Explore a range of effective teaching methodologies and strategies.
- Draw on a media-rich learning environment that you can use with your students.
- Use classroom-practice videos to model ways of teaching beyond the textbook.
- Understand and utilizing the scientific process.

Outline of Content and Assignments

Learners in this course are expected to participate in discussions and complete assignments. Learners are also expected to keep a personal notebook (which is not assessed) to keep notes, complete exercises, and record reflections about their learning experiences in this course.



Discussion Activities

- **Essential Question** – Each session includes a discussion about an essential question and to teaching and learning issues related to this question. Learners post responses to questions posed in the course and respond to posts submitted by their colleagues.
- **Final Project Discussion** - There is also an ongoing discussion concerning final assignment preparation.

Assignments and Final Course Project - Learners are expected to submit assignments and a final assignment. Rubrics are provided for assessment of all assignments, and the course content includes assignment samples.

Assignments in this course include:

- **Questions: Compare Your Answer**
Learner's written responses to a question are compared to answers written by experts in the field.
- **Writing Assignments** – Short writing assignments (essays) that answer the essential questions for the session are submitted to the facilitator for assessment.
- **Final Course Assignment: Curriculum Design Project**
This assignment consists of developing three activities based on local standards and learners' experiences with the content and methodology in the course. To complete the assignment learners will provide for each activity:
 - A thorough description of the activity.
 - The learning objective the activity serves.
 - A demonstration of their understanding of the content covered in the activity.
 - A list of materials and resources and a description of how they fit into the activity.
 - A description of how they would organize students in the classroom to ensure an optimal learning environment, and an explanation of why they chose this method.
 - A description of where the activity would fall in the course of a day's lesson and an explanation of why this is the best place for it.
 - A detailed rationale explaining why they chose to create each activity.
 - A description of how students' mastery of each objective will be assessed.

Required Readings

- Session 1:
 - "The Remarkable Cocklebur: Worldwide Hitchhiker & Nature's Velcro®"
 - "On Scientific Method"
 - "Nature of Science (from ENSI)"
 - "The Nature of Science (from Project 2061)"
 - "Convergence: Marsupials and Placentals"
- Session 2:
 - "View Science Learning From a Constructivist Perspective"
- Session 3:
 - "How The Body Uses O₂"
 - "Climbing without O's"
 - "Beyond the Textbook"
- Session 4:
 - "Children's Understanding of Scale"
 - "Microscopic Explorations"
 - "Mitochondria"
 - "Mitochondria Functions and Training"
 - "Celling the Drama"
 - "Larger Than Life"

- “Simply Cells”
 - “Rethinking Models”
- Session 5:
 - “Stem Cell Debate”
 - “The Freedom to Teach and the Freedom to Learn”
 - “Strategies for Preventing Potential Conflict”
- Session 6:
 - “Molecular Level of Genetics”
 - “How Genetic Disorders Are Inherited”
 - “Flying Through Genetics”
 - “Genetics of Sesame Street Characters”
 - “The Alien Lab: A Study in Genetics”
- Session 7:
 - “How to Conquer a Genetic Disease”
 - “Viewpoints: Harvest of Fear”
 - “Capitalizing on Literacy Connections”
 - “Human Genetics Ethical Case Studies”
- Session 8
 - “Life’s Grand Design”
 - “Natural Selection in Real Time”
 - “NSTA Position Statement on Evolution”

SESSION 1: STRUCTURE AND FUNCTION OF ORGANISMS

Objectives - After completing this session, learners will be able to:

- Give examples of the structures animals possess that allow them to survive and reproduce in their environments.
- Identify the relationships between the traits of organisms and the functions those traits serve.
- Describe how an organism’s traits may relate to its ability to survive and reproduce in a particular environment.
- Identify key elements of the scientific process and describe how they provide answers to questions about structure/function relationships.
- Use elements of the scientific process in their teaching.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How can animals and plants survive in every biome on Earth -- from blazing hot to freezing cold, from sopping wet to bone dry?***

Activities in this session introduce learners to the course and the online learning environment, and the process of thinking like a student again. Learners explore scientific processes, structures, and functions that allow animals to survive in their environments, and how to incorporate these ideas into their teaching practice.

The assignments in this session require learners to identify two organisms from a video, and explain how their traits enable them to live successfully in a particular environment. Learners also describe a hypothesis, the process that might have lead to this hypothesis, and the evidence that might have been found to support this hypothesis.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 2: BEHAVIOR

Objectives - After completing this session, learners will be able to:

- Explain how an animal's behavior may affect its ability to survive and reproduce in its environment.
- Recognize that variations in behavior exist among different animal species and among individuals of the same species.
- Recognize that an animal's behavior may vary depending on the stimuli it receives.
- Describe how behaviors can be integrated with physical traits in a way that provides a survival advantage.
- Distinguish between learned behaviors and inherited behaviors.
- Describe ways in which a student's learning environment may affect his or her ability to learn.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How do animals respond to other organisms and various environmental conditions to ensure that they get what they need to survive and thrive?***

Activities in this session build on what learners learned about the physical characteristics of animals and take a closer look at how behavior influences an animal's survival in its environment. Learners explore how learning environments affect students' learning behaviors.

Assignments in this session require learners to identify one animal from a video, and describe its structures and behaviors that allow it to survive and reproduce in its environment. Learners form and support a hypothesis on the impact of relocation or different traits of the animal's behavior. Learners will also identify a science lesson they teach and describe what they might do to the lesson to make it an effective learning experience for their students thus demonstrating an understanding of the constructivist learning model.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 3: REGULATION

Objectives - After completing this session, learners will be able to:

- Describe the importance of homeostasis to the survival of organisms.
- Describe how organisms' cells, tissues, organs, and systems maintain homeostasis given changing internal and environmental conditions.
- Explain how extreme environments can limit the body's ability to maintain homeostasis.
- Describe the role of the immune system in protecting cells against pathogens.
- Describe ways to use prediction effectively as a teaching tool.
- Identify uses for a range of non-textual materials with their students.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How do organisms keep their cells alive and functioning properly when their internal conditions and external environments change?***

Activities in this session delve into how organisms protect their cells from bacteria and viruses and maintain homeostasis (a relatively stable internal condition), particularly amid changing internal and

environmental conditions. The content in this session provides the groundwork for using prediction, measurement, and observation as teaching tools.

Assignments in this session require learners to identify two of the body's needs to maintain homeostasis and describe the physiological responses of the body's systems that ensure these needs are met. Learners also choose a regulatory response and describe an experience when this regulatory response was important to their comfort or well-being.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 4: STRUCTURE AND FUNCTION OF CELLS

Objectives - After completing this session, learners will be able to:

- Describe the relationship between a cell's structure and its function.
- Explain how some organisms can survive as single cells, while others are made up of many types of specialized cells.
- Compare the structure and function of different types of cells.
- Describe the benefits and limitations of using models.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How does the structure of cells make life possible?***

Activities in this session transition from organisms to the structure and function of cells as the basic building blocks of life. Learners define a cell and explore how models help students understand things that are difficult to observe.

Assignments in this session require learners to explain how the structure of cells makes life possible by comparing and contrasting plant and animal cells or one specialized cell versus another. Learners also explain how new ideas about cell structure and function could be incorporated into future lesson cells.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 5: REPRODUCTION AND DEVELOPMENT

Objectives - After completing this session, learners will be able to:

- Explain why there is a limit to cell size and why cells must divide for an organism to grow.
- Describe the similarities and differences between the processes of mitosis and meiosis and between the results of asexual and sexual reproduction.
- Name several factors that influence cell growth, division, and differentiation.
- Describe the roles that differentiation plays in development and that stem cells play in cell specialization.
- Use techniques for surfacing prior knowledge of students.
- Employ strategies for handling controversial topics in the classroom.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this

session is: ***What mechanisms allow organisms to develop and reproduce, and what constraints require them to do so?***

Activities in this session take a closer look at cells, how they reproduce and grow, and the factors that influence cell growth, division, and differentiation. Learners also consider the role that stem cells play in cell specialization and learn approaches to teaching controversial topics.

Assignments in this session require learners to explain the process of cell size and cell division and demonstrate an understanding that cell size is limited by the ratio of surface area to volume. Learners are also expected to identify four different types of specialized cells, relating the cell specialization to the structures and/or behaviors of organisms and their environments.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 6: DNA AND HEREDITY

Objectives - After completing this session, learners will be able to:

- Describe the relationship between an organism's DNA, genes, and chromosomes, and the traits that result from this genetic information.
- List and explain the molecules and processes involved in DNA replication and protein synthesis.
- Describe how genetic information is passed from parent to offspring and how it results in various traits.
- Explain how a gene mutation can affect the structure and function of one or more traits, and how such genetic alterations can be passed on to offspring.
- Employ classroom techniques that make abstract concepts more accessible to students.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How does DNA provide instructions for an organism's development and functioning?***

Activities in this session delve into the role DNA plays in determining an organism's traits and how genetic differences create variability within a species. Learners also explore teaching strategies that help students better understand abstract concepts.

Assignments in this session require learners to describe the most important roles of DNA in the cells of organisms and how they may change their approach to teaching about DNA and heredity after completing this session while still incorporating their local standards.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 7: APPLIED GENETICS

Objectives - After completing this session, learners will be able to:

- Explain how scientists can alter the genetic codes of plants and animals to change the traits of those organisms.
- Describe the potential benefits and risks of genetic modification.

- Explain the results of the Human Genome Project and other genome research and some of the effects these findings might have on the health of future generations.
- Describe opposing arguments regarding the use of technology to explore various ways of applying genetics.
- Identify methods that will enable students to use scientific evidence to defend a position.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How is our understanding of DNA changing the world in which we live?***

Activities in this session explore genetic modification and the potential promises and risks of advances in genetic technologies. Learners also explore arguments for and against using applied genetics technologies and learn teaching strategies that help students understand both sides of an issue.

Assignments in this session require learners to create an argument and counter argument with specific evidence supporting issues regarding DNA and human transgenics.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

SESSION 8: HEREDITY AND NATURAL SELECTION

Objectives - After completing this session, learners will be able to:

- Explain how variations among individuals in a population may -- depending on environmental conditions -- provide some individuals with greater survival and reproductive advantages than others.
- Explain how environmental pressure can select for some individual organisms in a population and against others, depending on the traits those individuals possess.
- Describe how the process of natural selection can cause the traits of populations to change over time, which may result in entirely new species.
- Describe how concept mapping can surface and deepen understanding of a topic.
- Outline strategies for dealing with topics that might create controversy in the classroom.

Using an inquiry-based approach, the session is divided into the following sections: Invitation, Exploration, Explanation, Application, and Putting It into Practice. The **Essential Question** for this session is: ***How can the environment in which a species lives influence which traits are passed on to future generations?***

Activities in this session delve into the process of natural selection and how the environment in which a species lives influences which traits are passed on to future generations. Learners learn how concept mapping can enhance understanding of natural selection and how to further develop strategies for teaching controversial topics, and they complete their final assignment for the course.

Assignments in this session require learners to write detailed examples in which environmental conditions have played a role in determining which traits are passed from one generation to another and describe a plausible mechanism that makes it possible for these traits to be passed on to future generations. Learners also examine their local curriculum standards for teaching adaption and apply the standards and concepts to lessons they teach. Learners also complete their final assignment.

Discussions in this session focus on finding solutions for the essential question for this session.

Learners will record notes and reflections in their personal notebook about different concepts, methods, activities, and ideas presented throughout the session.

Schedule

This course is scheduled to take approximately 45 hours to complete. The number of hours identified for each course reflects time spent online, but does not reflect the total time spent completing offline coursework and assignments. All learners are different and learners will likely spend double the indicated number of hours completing all coursework depending on learning styles and work habits.

Requirements

Learners are expected to:

- Complete all assignments.
- Participate and actively engage in discussions with fellow learners while contributing to the social construction of knowledge.
- Be self-directed and self-motivated.
- Ask for assistance when they need it.

Facilitators are expected to:

- Provide feedback to all learners.
- Participate in discussions to keep them moving forward.
- Provide assistance to learners who need it.

Technical Requirements

- Word Processor
- Internet service provider
- E-mail
- Shockwave and Flash: <http://www.macromedia.com/downloads/>
- Acrobat Reader: <http://www.adobe.com/products/acrobat/readstep.html>
- QuickTime: <http://www.apple.com/quicktime/download/>

Standards of Academic Integrity

As posted on PBS TeacherLine Web site at
http://teacherline.pbs.org/teacherline/help/help_template3.cfm?subID=197

Evaluation

This course is evaluated on a letter grade basis, and graduate credit may be available. See the PBS TeacherLine Web site for details pertaining to specific graduate credit instructions.