Course Syllabus

Title
Teaching Elementary Physical Science

Target Audience
This course is intended for pre-service and in-service physical science teachers of grades K-4.

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 K-12 classrooms.
- Have an interest in physical 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 physical science concepts effectively at the elementary level. Teaching Elementary Physical Science is an inquiry-based course designed to enhance educators' understanding and teaching of physical science. Learners explore the concepts of motion, force, and matter that are part of daily life and learn how to incorporate observation, discourse, and experimentation into their lessons to increase students' understanding of physical science. Through the readings, videos, discussions, assignments, and other interactive experiences, learners in this course will have multiple opportunities to develop content knowledge about motion and force, materials and properties, and structure of matter. Learners will experience a rich multimedia, inquiry-based learning environment as their students ideally would in their own classrooms. The course provides effective teaching methodologies, strategies and tools that can be used when teaching physical 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 elementary level.
- Understand inquiry-based learning models.
- Explore a range of effective teaching methodologies and strategies.
- Draw on a media-rich learning environment that they can use with students.
- Use classroom-practice videos to model ways of teaching beyond the textbook.
- Understand and utilize 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:

- **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 three physical science classroom activities that demonstrate learners' understanding of physical science and effective methods for teaching this content. To complete the assignment learners will:
    - Identify one or more topics that are aligned to standards and benchmarks for their grade level.
    - Identify three learning objectives that they would like your elementary-school students to master.
    - Design three activities (based on the learning objectives) using the notebook reflections from each session about which topics and resources they found interesting.
    - Write a rationale explaining why they chose each activity.
    - Write an explanation of how students will be assessed in each activity.

Required Readings

- "Galileo: His Place in Science"
- "Talking Their Way Into Science"
- "Coffee Cups, Ice Trays and Elephants (Oh, My!)"
- "Properties: An Introductory List"
- "Benchmarks for Science Learning"
- "Atlas of Science Literacy – Project 2061"
- "Dialogue on Early Childhood Science, Mathematics, and Technology Education"
- "The Structure of Matter"

SESSION 1: A WINDOW ONTO YOUR WORLD

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

- Identify some of the knowledge and experiences related to physical science content that they bring to this course.
- Identify and express ways in which familiar places and events relate to the physical science themes that this course emphasizes.
- Interpret their own and students' experiences from the perspective of physical science.
- Work with students to "surface" their prior knowledge about physical science.

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**: *Where can you find physical science in your everyday world?***

Activities in this session introduce learners to the course and the online learning environment, and highlight the value an educator's own experiences can add in engaging younger students in new areas of study. Learners will reflect on their daily experiences and recognize their own connection to physical science.

The assignment in this session requires learners to take a physical science walk and describe the examples of motion, force, matter and the built world they observed.

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: MOTION AND FORCE

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

- Assess how observation and description contribute to their learning;
- Understand how motion relates to change and time.
- Define and describe specific aspects of motion, including acceleration, in real-world examples.
- Describe ways in which motion and force relate.
- Plan, implement, and assess ways to enhance students' abilities to observe and describe motion.

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 is the relationship between motion and force?***

Activities in this session delve into the importance of making and describing observations that will sharpen students' understanding of both motion and force and the relationship between them.

Assignments in this session require learners to discuss examples of force and to summarize the relationship between motion and force.

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: INVESTIGATING ROLLING AND FALLING

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

- Make predictions about the motions of rolling and falling objects and make observations to check them.
- Develop a detailed understanding of how rolling and falling objects move.
- Relate observations of rolling and falling objects to their understanding of the concepts of constant speed, acceleration, and force.

- Seek insights into how rolling and falling might be related to each other.
- Describe methods for prediction, observation, and reflection, and use them with 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**: *What happens when an object rolls or falls?***

Activities in this session delve into examining two specific types of motion. Learners make predictions about how rolling and falling objects move and then test these predictions. Through careful observation and reflection, learners strengthen their understanding of acceleration and its relationship to rolling and falling as well as force.

Assignments in this session require learners to reflect on Galileo's inclined plane and synthesize their understanding of falling and acceleration.

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: A UNIFIED LOOK AT FORCE PHENOMENA

Objectives - After completing this session, learners will be able to:
- Seek and discover connections among a diverse set of motion situations.
- Identify, represent, and analyze major forces acting on an object.
- Articulate some ideas about the nature of rich scientific discourse, how it contributes to learning, and how they might support it in a 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 commonalities can you find in situations where objects are falling, floating, sinking, standing, or resting?***

Activities in this session delve into the some basic concepts of force and the many effects forces have on objects. Learners learn about different states of falling, balancing forces, and the forces that determine whether objects sink or float, and discuss their observations in group discussions designed to enhance each learner's thinking and understanding.

Assignments in this session require learners to refine their ideas of force and summarize how they will implement their insights on relating a variety of phenomena to each other.

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: MOVING FORWARD

Objectives - After completing this session, learners will be able to:
- Conduct experiments to find out how different parts of a system affect the motion of an object.

- Analyze examples of motion in terms of friction, gravity, the normal force and impulsive force.
- Relate their experiences to Newton's First Law of Motion.
- Identify effective processes for experimentation and apply them to their own learning and 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**: *What variables affect how a ball rolls on a horizontal surface, and what general force principles do they illustrate?***

Activities in this session delve into the role fair tests and interpretation play in helping to generate new knowledge and understanding in science. By closely examining factors that influence why objects start, stop, and move the way they do, learners deepen and extend their understanding of motion and forces.

Assignment(s) in this session require learners to demonstrate a clear understanding of how multiple forces act on an object and to compare horizontal and vertical motion.

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: FORCES, MOTION, AND PROPERTIES

Objectives - After completing this session, learners will be able to:
- Identify properties of objects and the materials that comprise them.
- Describe how the properties of objects and materials can cause different ones to respond to forces and apply forces differently.
- Use Newton's Second Law to explain how objects respond to forces and apply force.
- Provide a beginner's explanation for why different materials respond to and apply forces differently.
- Explain what it means to focus or distribute a force and how this affects the manner in which specific objects apply or respond to forces in dynamic situations.
- Identify how solving a design problem can support learning about science concepts.

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 properties of materials and objects influence the way objects exert and respond to forces?***

Activities in this session delve into the ways an object's properties and materials influence how it responds to and applies force. Through the session's central design challenge and group discussions, learners will learn firsthand that problem solving provides a direct pathway to learning.

Assignments in this session require learners to demonstrate an understanding that certain properties of objects and materials have an effect on how they respond to force and the rate at which an object slows down upon impact with them. Learners also explain their understanding of sudden and gradual impact and force distribution and concentration and provide an analysis of the different properties of objects.

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: FORCES AND MATERIALS IN STATIC STRUCTURES

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

- Explain why static structures remain stable.
- Identify key factors that static structures must withstand
- Analyze a structure to explain how its structural components and their arrangements help its stand and sustain forces.
- Identify specific material and object properties that allow static structures to withstand forces.
- Compare and contrast forces and materials in dynamic and static structures.
- Assess their own learning by examining their responses to related situations over time.

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 static structures remain static in spite of the forces acting on them?***

Activities in this session delve into the factors that enable static structures to remain stable in spite of forces acting on them. Learners learn not only to assess the forces that structures, such as buildings and bridges, must withstand to remain stable, but also to recognize the material and object properties that help them do so.

Assignments in this session require learners to assess the strength of a given structure and demonstrate understanding that all objects, whether in motion (dynamic) or standing still (static), are subject to forces.

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: STRUCTURES OF MATTER

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

- Describe how structures at both large and small scales are comprised of components and exhibit forces.
- Describe ways in which the state of a material is related to its atomic or molecular structure.
- Describe how changes in structure can affect how a material responds to external forces.
- Use metaphors and models to understand and express their understanding of the structure of matter.
- Identify some components of atoms, as well as the forces that act within an atom to keep it together.
- Identify key relationships among the four main content areas of this course.
- Assess their learning throughout this course.

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's happening in matter at the molecular and atomic levels?***

Activities in this session delve into an examination of motion, forces, and structure at the molecular and atomic levels to develop an understanding of what is happening in matter at the smallest scales. Learners

begin to recognize that how a structure behaves is determined by how its material components are arranged and connected.

Assignments in this session require learners to demonstrate an understanding of how the idea of structure applies across many levels of scale, from sub-atomic particles, to atoms, to materials, and to large-scale objects and how force and motion play important roles in structures at any scale. Learners also complete their final assignment in this session: Curriculum Design Project.

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.

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.