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Grade 10-12, Physics 1, Unit 0

Lesson Planning Resource

These lessons are aimed to introduce students to the concept of Modeling and physics thinking strategies. No prior knowledge is necessary beyond basic measuring and mathematical skills.

Expected time: 40 minutes

STAGE ONE: DESIRED RESULTS

Essential Questions:

1. How are Models used to describe ideas in science?
2. How can problems be simplified in order to make better predictions?

Student Learning Objectives:

1. The student will plan and conduct investigations using experimental design processes. (PH.1b, c, d, f)
    a. Instruments are selected and used to extend observations and make measurements.
    b. Information is recorded and presented in an organized format.
    c. The limitations of the experimental apparatus and design are recognized.
    d. Models and simulations are used to visualize and explain phenomena, to make predictions from hypotheses, and to interpret data.
2. Students will construct a Particle Model.

STAGE TWO: ASSESSMENT EVIDENCE

Diagnostic Assessment:

1. Socratic Method used to setup the DIY lab
2. Observation and questioning of specific lab groups and individual students as they work.

Formative Assessment:

1. Observation and questioning of individual students as they work. [Student Learning Objective (SLO) 1]
2. Students record work in lab notebook, teacher reviews notes while circulating among groups. (SLO 1b)
3. Whiteboarding: Students record information on a large whiteboard to share . Students present to the class and teacher in a large group setting. Students ask questions of other groups. Teacher facilitates discussions as needed with targeted questions. (SLO1, 2)

Summative Assessment:

1. Students record notes about Particle model and summarize in their own words. (SLO 1d, 2)

2. Quick quiz given the next class period. (SLO 1d,2)

STAGE THREE: LEARNING PLAN

Materials/ Setup

Long strings of various materials are hung from the ceiling. (One per group)
A collection of objects with different masses and shapes: shoe, apple, steel sphere, washer etc. Need elongated objects that will rotate in addition to particle-shaped objects.
Triple beam balances or scales.
2ft x 3ft white boards- one per group.
Balancing toys, center of mass toys.

Activator/Framing the Learning:

1. Ask students to make observations in their lab notebook. Attach a stuffed fish to the end of a long string. Pull back the fish so that it swings. Allow it to swing back and forth several times.
2. Ask students for their observations. Record on the board, without judgment, but keeping the focus on the salient parts of the pendulum. The working Problem is "What factors change the swing of the pendulum?" (<5 minutes)
3. Write the Problem on the board: What factors change the swing of the pendulum? Lead a discussion on what can be measured. Focus so that students are varying the mass/weight of the object and measuring the time of the swing. Make the height of the drop, length of string, and type of string constants for each individual group. (5 minutes)

Active Instruction:

1. Students design a DIY pendulum lab, based on the information on the board. They may request any materials that they need, but give minimal support. Students are learning that they are expected to work independently, depend on classmates, and may make mistakes. Look for major misconceptions or problems, and intervene only where necessary. (10 minutes)

Practice (Guided, Collaborative, and Independent):

1. Student groups create whiteboards showing: IV, DV, collected data, conclusions (5 minutes)
2. Students circle up so that all of the whiteboards can be seen. Students are asked to record observations about the whiteboards in their notebook (gallery walk if needed to see the boards). Lead a discussion on the lab:
    - What similarities do you notice?
    - Are there any boards which are different?
    - What challenges did people run into in making measurements? How did you compensate or overcome them? (possibly) What would you do differently if you did this lab over again?
    - What conclusions were made from the data? (If a board gets interesting conclusions, spend time on how they conducted the lab, and brainstorm where the errors came from)
3. Record key elements of the lab (these are student statements, in students' words): mass does not affect the time of the swing; how students measured height and swing for objects of different size and shape→ use this to build the Particle Model; other assumptions- massless string, negligible air resistance.

Summarize and Anchor the Learning:

1. Students define the Particle Model in writing: Most objects can be considered as a single dot or particle to simplify the problem. The dot or particle represents the balance point, or center of mass of the object.
2. Pass around balancing bird and similar toys that show that the balance point/center of mass to reinforce the idea, and make the concept more memorable.

Differentiation:

1. All key academic vocabulary will be written on the board in a specific location to reinforce new or unfamiliar vocabulary. The terms should be written *before* they are needed by students. eg: pendulum, swing, negligible, center of mass, air resistance, particle, mass-less.
2. Targeted individual assistance is provided while groups are working. This includes both support and enrichment.

Strategies for Promoting Executive Function:

- Pacing for this activity should be quick, but with plenty of time for students to record observations in their notebooks before interacting. Use clear time limits and visible timer, such as TimeToaster. Do not allow excessive time for drawing whiteboards, completing the lab- the majority of time should be spent on planning and analysis. Remember that this lab is setting up expectations for the year, not quite enough time for execution will help ensure that they ask questions ahead of time and stay focused during activities all year.
- Encourage students to analyze others work during white boarding, and in creating notes on the board. This is a lesson in critical thinking; specifically, how to construct knowledge in science. The lesson continues all year.

Quick Quiz:

1. What were the results from the DIY Pendulum lab? How did this lead to the Particle Model?

2. Memory depends on having a rich context (build a detailed picture in your head). Describe a memory of the lab; explain how this image reminds you of the Particle Model.

Grade x, Science, Unit x

Lesson Planning Resource

These lessons are aim to bridge an area of high need. A clear understanding of x.

STAGE ONE: DESIRED RESULTS

Essential Questions:

3. x
4. x

Mastery Objectives:

3. x (SCI.x.x).
4. x (SCI.x.x).

STAGE TWO: ASSESSMENT EVIDENCE

Diagnostic Assessment:

4. (Accessing prior knowledge)

5. x

Formative Assessment:

6. (Classroom assessment used throughout the lesson)

7. x

Summative Assessment:

3. (Assessment that is used at the end of this lesson)

4. x

STAGE THREE: LEARNING PLAN

Activator/Framing the Learning:

4. (Spark interest and set clear goals for the lesson)

Active Instruction:

2. (Students are engaged in a hands-on investigation)
3.

Practice (Guided, Collaborative, and Independent):

4. (Students further explore the concepts/skills)

5.

Summarize and Anchor the Learning:

3. (Connections to literacy and other multimedia resources)
4.

Differentiation:

3. (Strategies to target ELL students, re-teaching, and acceleration)
4.

Strategies for Promoting Executive Function:

1. Executive Function is a term that emphasizes the reinforcement of students' work with the frontal cortex of their brain, i.e., the structural elements that enhance the use of working memory, self-regulation and self-management, and goal setting and achievement. In this lesson, the focus on comparative text analysis requires careful attention to several recurrent elements:
   - Clear articulation of lesson essential questions and mastery objectives.
   - Use of an advance organizer (especially some type of visual representation) at the beginning of each day to ensure that students have a "road map" for where they are going—and the learning experiences they will have along the way.
   - "Chunk" the lesson, ensuring that regular opportunities occur for students to reflect upon what they are learning—and how well they are able to articulate the purpose(s) of learning activities.
   - Encourage periodic self-reflection (e.g., in the form of reflective journal entries or exit slips).
   - Provide opportunities throughout the lesson for recaps, summaries, and debriefings.

2. Since this lesson focuses upon hands-on investigations, it will be useful for a great deal of teacher modeling and "think-alouds" to occur throughout the lesson. In particular, reinforce students' self-regulation and self-assessment through the creation and ongoing modification of visual representations (synthesizing the big ideas and themes common across the investigations).