PATTERNS OF CHANGE - FRICTION

Science

Grades: 9-12

Acceleration Approach

Standard has been accelerated by using the CIM and PASS standards.

1	2	3	4	5	6	7	8	9	CIM	CRLS/ CAM	PASS
								→			

Organizing Overarching Concept (e.g., systems, patterns of change, models, scales)

Patterns of change

Organizing Higher Order Skills (e.g., Bloom's, Paul's Model of Reasoning)

Bloom's evaluation and Paul's consequences and implications

Differentiation Features – Students

- Have additional variables to study
- Study a concept in multiple applications
- Make reasoning explicit

COMMON CURRICULUM GOAL

Science - Scientific Inquiry
Use interrelated processes to pose questions and investigate the physical and living world.

Forming the Question/Hypothesis
Formulate and express scientific questions or hypotheses to be investigated.

Designing the Investigation
Design safe and ethical scientific investigations to address questions or hypotheses.

Collecting and Presenting Data
Conduct procedures to collect, organize, and display scientific data.

Analyzing and Interpreting Results
Analyze scientific information to develop and present conclusions.

Science - Unifying Concepts and Processes
Understand that patterns of change and stability are important in the natural world.

CONTENT STANDARDS

Science - Scientific Inquiry
Make observations. Formulate and express scientific questions or hypotheses to be investigated based on the observations.

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Archetypal Model

This activity is focusing on change. Students will understand "cause and effect," dependent and independent variables and how changing one affects the other. How does one design an experiment that can isolate and determine such a relationship between variables?

Given a set of hypotheses and associated experimental designs, evaluate them to determine

- Quality of the hypothesis
- Ability of the experiment to actually prove/disprove the hypotheses.

Ideas for the Teacher who Develops Three Hypotheses

- **Version 1:** Have hypothesis (it may be right or wrong) the same for all three. Change the sophistication of the language. Make the experimental designs different, but make at least one incorrect" (i.e., variables not isolated).
- **Version 2:** Have three different hypotheses, at least one actually stating that only the normal force and nature of the surfaces determine frictional force.
- **Version 3:** Have the three experimental designs all "correct" but greatly varying the amount of detail and supporting/background information. Make one "overkill" to see if they criticize it.

TASK DEMAND

Sample Task Activity

- Pull object across surface.
- Ask students to suggest factors that influence/cause friction. Do not edit these. Typical responses include:
    - The mass of the object
    - The weight of the object
    - The speed at which object pulled
    - The roughness of the surfaces
    - The surface area of the bottom face of the object
- Give students three sets of hypotheses and associated designs experiments. (See above)
- Ask them to evaluate the hypotheses.
- To check for understanding, the student must access two or three theses/dissertations and read them.
- Once read, the students pullout the hypotheses and critique them and finally, relate how the experiment proved/disapproved the hypotheses.

Design scientific investigations to address and explain questions or hypotheses.

Collect, organize and display scientific data.

Analyze scientific information to develop and present conclusions.

PASS – Standard B
Design and conduct scientific investigations.

BENCHMARKS

CIM- Scientific Inquiry

Based on observations and scientific concepts, ask questions or form hypotheses that can be answered or tested through scientific investigation.

Design a scientific investigation that provides sufficient data to answer a question or test a hypothesis.

PASS – Standard B
Student must:
Formulate questions and hypotheses.

Design an investigation.

Collect and present data.

Analyze and interpret.

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Questions

- Which hypothesis do you most agree with and why?
- Which experimental design is most likely to prove/disprove its hypothesis and why?
- Which experiments will not prove/disprove the accompanying hypothesis?
- Each hypothesis has an accompanying dialogue. Which dialogue best justifies the accompanying hypothesis?
- How would you change/improve hypotheses #1 (or #2 or #3)?
- Discuss complications that may arise in the design of experiment #1 (or #2 or #3).

Implementation Time

Because of potential complexity, the implementation time needs to be determined by the teacher, but two or more 45 – 50 minute periods in addition to homework are suggested.

Assessment Recommendation

Use as part of the PASS portfolio: B Standards.

Resources

The three hypotheses/designs that the teacher has carefully crafted to include:

- Common pitfall
- Some excellent designs
- Misconceptions

DIFFERENTIATED CURRICULUM CHALLENGING HIGH END LEARNERS ADDRESSING OREGON STANDARDS & BENCHMARKS

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TAG NEEDS ADDRESSED

INTELLECTUALLY GIFTED

- ☒Advanced Critical Reasoning
- ❒Scholarly Interaction
- ❒Continuous Progress for Level and Rate*
- ☒Challenging Resources
- ❒Effecting Change
- ❒Decision Making; Ethical Use of Influence
- ❒Leadership Training/Career
- ❒Realistic Goal Setting
- ❒Regular Interaction with Intellectual Peers
- ❒Social-Emotional Issues; Support; Coping Strategies
- ❒Advanced Academic Planning
- ❒Opportunity for Competition/Failures/ Successes
- ❒Creative Problem Solving with Real Problems/Audiences
- ❒Pursuit of Advanced Level Research
- ☒Advanced Vocabulary Development

ADVANCED SCIENCE KNOWLEDGE/SKILLS

- ❒Advanced Critical Thinking in Science
- ❒Continuous Progress/Level and Rate* in Science
- ☒Challenging Science Resources
- ❒Creative Problem Solving Strategies in Science
- ❒Science Advanced Vocabulary Development
- ❒Leadership Training/Career
- ❒Decision Making; Ethical Use of Influence
- ❒Regular Interaction with Talented Science Peer
- ❒Realistic Goal Setting
- ❒Opportunity for Competition/Failures/ Successes
- ❒Advanced Academic Planning in Science

CAREER RELATED LEARNING STANDARDS FOR CAM - Certificate of Advanced Mastery

- ☒ Personal Management
- ☒ Problem Solving
- ☒ Communication
- ❒ Teamwork
- ❒ Employment Foundations
- ❒ Career Development

TEACHER CHECKS THE BENCHMARK LEVEL STUDENT IS PURSUING

Science:

- ❒1
- ❒2
- ❒3
- ❒CIM
- ❒CAM
- ❒PASS

* Rate requires monitoring to ensure that the student was allowed to move ahead upon acquiring concepts.

Student _____ **Grade** _____

Teacher _____ **School** _____

Date Initiated _____ **Date Completed** _____

Check TAG Identification category:

❒ **Intellectual** ❒ **Academic Math** ❒ **Academic LA**