

Motion (K-2) Program of Study Plan

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Inquiry-based Science Curriculum from
The *Guided Inquiry supporting Multiple Literacies* Project
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Program of Study regarding MOTION

GOALS – CYCLE 1

Substantive: The distance an object travels in a particular period of time is its speed.

All objects, regardless of weight, *fall* at the same speed; i.e., they *fall* through equal distances in equal time.
(due to gravity, a constant force is applied).

Syntactic: Scientists conduct tests to answer a question (e.g., determine how the world works).

Tests that scientists conduct must be fair; i.e., all variables are controlled but the one that is the focus of the question.

Tests that scientists conduct must be reliable; i.e., results should be consistent.

Cycle	GISML Phase	Investigative Focus	Conceptual Focus
1	Engage	Motion of Objects	Focusing on a specific question, knowing that scientists conduct investigations to answer questions.
	Investigate / Report	2 nd hand: Balls of different masses rolling down an inclined plane.	Question - what influences the motion of a ball down a ramp? Characteristic of a fair test – control all variables but one. Characteristics of good measurement – multiple trials. The result from varying the mass is that there is no difference in speed.

Program of Study regarding MOTION

GOALS – CYCLE 2

Substantive: The height of a ramp determines its incline, its slope.

The steeper the incline or slope, faster the ball falls.

The steeper the slope the higher the ball is at the starting point on the ramp, and the higher the starting point the greater the amount of energy the ball has to spend in rolling down a ramp.

Syntactic: Scientists conduct tests to answer a question.

Tests that scientists conduct must be fair and reliable.

Scientists measure variables they are investigating in order to determine specific relationships.

Scientists record systematically by organizing data in charts.

The relationships that scientists identify are presented as knowledge claims to the scientific community.

Cycle	GI _s ML Phase	Investigative Focus	Conceptual Focus
2	Engage	What else might influence the motion of a ball rolling down a ramp?	<p>Identification of other variables in the system that might impact the motion – selectively reinforce or seed the variable of ramp height.</p> <p>How to investigate to determine whether the ramp height influences speed? – characteristics of a fair test, issues of reliability and repeatability.</p>
	Investigate / Report	1 st hand – <i>demonstration</i> : A ball rolling down the same inclined plane set at different heights.	<p>Question is whether ramp height influences the motion of a ball down a ramp.</p> <p>Characteristic of a fair test – control all variables but one.</p> <p>How to measure speed?</p> <p>Characteristics of good measurement – multiple trials.</p> <p>How to set up a chart to record data?</p> <p>How to combine data from multiple trials?</p> <p>How to organize data to determine relationships?</p> <p>Tell Ss that a way to think about the situation is that the higher the ball starts the more energy the ball has and can spend in rolling.</p> <p>The result from varying the ramp height is that the greater the height the greater the speed of the rolling ball.</p>

Program of Study regarding MOTION

GOALS – CYCLE 3

Substantive: When an object in motion hits an object at rest, it can cause the object at rest to move.

The momentum of an object is related to its velocity.

The momentum of an object determines how it influences an object that it hits, and the greater the momentum, the greater the influence on the other object.

Syntactic: Scientists conduct fair and reliable tests to answer a question.

Scientists systematically measure variables they are investigating and record them in chart form.

Scientists record systematically by organizing data in charts. Scientists determine relationships by representing their data graphically.

The relationships that scientists identify are presented as knowledge claims to the scientific community.

The adequacy of knowledge claims is a function of the strength of the evidence supporting them.

Cycle	GIsML Phase	Investigative Focus	Conceptual Focus
3	Engage	<p>What do you think will happen to a ball at rest that is hit by a moving ball?</p> <p>How do you think we could make a difference in what happens to the ball that is hit?</p>	<p>Posing the question of how a moving object impacts an object at rest.</p> <p>Having Ss identify variables that can influence how the moving object affects the object at rest (i.e., speed – as a function of ramp height, mass).</p> <p>Show Ss what happens when the ball from the ramp hits the can; tell them that the concept scientists use to talk about what influences how far the can goes is momentum.</p> <p>Ask how to set up test so that the result of the momentum of the moving object on the object at rest can be recorded; issue of what to measure and how to measure.</p> <p>How to set up a chart to record data?</p> <p>Characteristic of a fair test – control all variables but one.</p> <p>Characteristics of good measurement – multiple trials.</p> <p>Demonstrate what happens in multiple trials (measurements can differ).</p> <p>How to combine data from multiple trials?</p>

Program of Study regarding MOTION

Investigate	1 st hand: the influence of the <u>speed</u> of a rolling ball on the motion of a ball at rest.	Question is whether speed (as controlled by ramp height) influences what happens to an object at rest that is hit by an object in motion. How to organize data to determine relationships? In thinking about their claims, suggest Ss think about the situation as they had previously regarding the amount of energy to spend in rolling.
Report		Check for claim statements; description of a relationship. Check for evidence to support the claim. Ways to state the relationship: a) the greater the height the greater the speed of the rolling ball and the farther the can moves when hit; b) the greater the height the more energy the ball has to spend and transfer to the can to make it move further (more desirable claim); c) the greater the momentum of the moving ball the farther it moves the ball at rest.

Program of Study regarding MOTION

GOALS – CYCLE 4

Substantive: When an object in motion hits an object at rest, it can cause the object at rest to move.

The momentum of an object determines how it influences an object that it hits, and the greater the momentum, the greater the influence on the other object.

The momentum of an object is related to its mass.

Syntactic: Scientists conduct fair and reliable tests to answer a question.

Scientists systematically measure variables they are investigating and record them in chart form.

Scientists determine relationships by representing their data graphically.

The relationships that scientists identify are presented as knowledge claims to the scientific community.

The adequacy of knowledge claims is a function of the strength of the evidence supporting them.

Cycle	GIsML Phase	Investigative Focus	Conceptual Focus
4	Engage	Thinking about what will happen to a ball at rest that is hit by a moving ball, how else do you think we could make a difference in what happens to the ball that is hit? What other variables might we investigate	Having Ss identify mass as another variable that can influence how the moving object affects the object at rest. Tell Ss that mass is also part of the concept of momentum. Ask how to set up test so that the result of the momentum of the moving object on the object at rest can be recorded; issue again of what and how to measure. How to set up a chart to record data? Characteristic of a fair test – control all variables but one. Characteristics of good measurement – multiple trials. How to combine data from multiple trials?

Program of Study regarding MOTION

Investigate / Report	2 nd hand: the influence of the <u>mass</u> of a rolling ball on the motion of a ball at rest.	Question is whether mass of the ball influences what happens to an object at rest that is hit by the ball. How was this question investigated? What claims were made? [The greater the momentum of the moving ball the farther it moves the ball at rest.] Did the data support the claim? What variables determine momentum? What influence does momentum have on the interaction of objects if at least one is moving? How can we explain this result in terms of the transfer of energy?
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