# Kindergarten – Motion and Stability: Forces and Interactions
## Lesson Design

Performance Expectations: (What the students can be assessed on at the end of Kindergarten.)
K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object.

Learning Performance/Outcome: Students will need to learn how to -

1. Apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution.
2. Determine what type of force (push or pull) is best suited to start an object in motion, change the speed of an object, or change the direction of an object.
3. Gather evidence from observation and measurement of objects in motion.
4. Gather evidence from observation and measurement of changes in the motion of an object.
5. Raise questions from observation of different objects in motion and design investigations to answer their questions.
6. Compare the motion of different objects using the same force to start the object in motion, collect data and analyze the data.
7. Gather evidence from observation of changes in motion when objects collide.
8. Communicate findings from observations of different objects in motion.

Narrative/Teacher Background Information
In helping students to be successful in the performance expectations, activities are geared to build on the inherent knowledge and experience that five year olds have already acquired and use their knowledge in a wider range of tasks. Students are given the opportunity to examine, measure, reflect upon, describe, and discuss how pushes and pulls of various origins are used to produce and control motion. Students are asked to analyze what they have already observed, internalized, and made sense of through experience and observation. Students begin to form a clear sense of causation.

Within the content of motion, students are also given the opportunity to begin to recognize and apply the nature of science. The unit gives students a series of experiences that challenge their thinking about motion. By exploring motion in a variety of settings, students are better able to think about their understanding so they can analyze and interpret observations and data, synthesize ideas, build new knowledge, and clarify their understanding.

Prior Knowledge: Students entering kindergarten have considerable knowledge regarding motion of toys and how to apply a push or pull to get the toy moving. Students have observed the motion of toy cars, balls, wagons, etc. Students know that different strengths of pushes on a toy car will give them different results. The prior experience of motion of toys serves as a background to investigate strengths of pushes and pulls on a variety of objects in terms of distance, speed, and direction.

| Science and Engineering Practices: | Disciplinary Core Ideas: | Cross-Cutting Concepts: |
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| – Asking questions and defining problems<br>– Planning and carrying out investigations*<br>– Analyzing and Interpreting data*<br>– Constructing explanations and designing solutions | – PS2.A: Forces and Motion<br>▪ Pushes and pulls can have different strengths and directions.<br>▪ Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.<br>– PS2.B: Types of Interactions<br>▪ When objects touch or collide, they push on one another and can change motion.<br>– PS3.C: Relationship between Energy and Forces<br>▪ A bigger push or pull makes things go faster. | Cause and Effect<br>– Simple tests can be designed to gather evidence to support or refute students' different ideas about causes. |

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| | – ETS1.A: Defining Engineering Problems.<br>▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. | |

Possible Preconceptions/Naïve ideas regarding motion:
- All things fall down, but heavy things fall faster.
- The speed of an object is directly related to the force currently applied.
- If an object is moving, there is a force acting on it in the direction of motion.
- Constant motion requires a constant force.
- Everyday experience suggests that objects set into motion eventually come to a stop when no obvious external force acts on them.

Assessment: What will be the evidence of learning?
1. Formative Assessment - Facilitation/Questioning techniques, sharing of observations and reasoning through results, drawings and approximations of writing and labeling of investigations
2. Summative Assessment - Performance assessment: Communicate and demonstrate findings from investigation and solution to problem

Access Prior Knowledge/Current Thinking/Framing the Unit
Engage
- Make observations of motion: on playground, in nature, experiences
- What We Think Chart

| What We Think About How Things Move | How Can We Find Out? | What Do We Conclude? |
|---|---|---|

- Raise questions about motion.
- Write and draw about personal experience with motion (on play ground equipment, playing games, balls, toys, etc.). (CCSS ELA – W.K.2, W.K.3, W.K.5, W.K.8)

Lesson Descriptions

Explore:
Students:
- Engage in observations and "messing about" with motion of different objects and what happens to motion when different objects collide. (different sizes of balls, toy cars, cylinders of different sizes, ramps, and different pushes and pulls that start the objects in motion)
- Draw and label with approximation of letters observations of motion.
- Engage in conversation with teams regarding observations.

Teacher:
- Facilitation of small group exploration of materials.
- Questioning Techniques (Cause and effect)
- Additional material introduced as students begin to ask, "What would happen if questions".

Explain and define
Students:
- Create a "What would happen if…" or "I wonder" board to stimulate questions for investigations.
- Carry out investigations of motion to compare the effect of different strengths of pushes and pulls on different objects.
- Collect and analyze data from observations.
- Read about motion and relate classroom observations to text. (Example: *Move It! Motion, Forces and You* – RI.K.1, RI.K.2, RI.K.3, RI.K.7)
- Present, share, and compare findings
- Confront preconceptions or changes in thinking (What We Think chart)

Teacher:
- Record student questions for investigation.
- Facilitate planning of investigations.
- Provide framework for recording data from observations.
- Read informational text and provide opportunity for comparison of information in text with observations and data from investigations.
- Facilitate presentations and findings
- Revisit preconceptions, how has our thinking changed or grown?
- Compare findings, facilitate discussion on common ideas throughout investigations.

Elaborate
Students:
- Read (teacher read) book where push or pull solved problem (Example: *And Everyone Shouted, Pull!* RI.K.1, RI.K.2, RI.K.3, RI.K.7)
- Solve a problem of changing direction or speed using a push or pull
- Draw, label and write a plan. (W.K.2, W.K.3, W.K.7)
- Form teams to design a solution, collect data or evidence to analyze to determine if the design solution solves the problem
- Draw, label and write observations. (W.K.2, W.K.3, W.K.7)
- Make adjustments to design based on findings.

Teacher:
- Read book where push or pull solved problem
- Facilitate ideas of a problem that can be solved using a push or pull
- Facilitate teamwork as students design a solution, collect data or evidence to analyze to determine if the design solution solves the problem.
- Facilitate analysis of data and possible ideas for adjustment to design.

Evaluate
Students:
- Presentations of solutions and analysis of solution designs. (L.K.1, L.K.6)
- Opportunity to improve on designs based on analysis, new information, and feedback.

Teacher:
- Evaluate presentations and provide feedback

Elaborate further –
How do animals move? Is there a push or a pull?
Push or pull we cannot see – magnets, gravity (what goes up, must come down)