Third Grade Companion Document

3-Unit 1: Changes in Motion

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Introduction to the K-7 Companion Document
An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. . The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing “hands-on” activities.
e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
f. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

3rd Grade Unit 1:
Changes in Motion

Content Statements and Expectations

3 Unit 1: Changes in Motion

Big Ideas (Key Concepts)

- The position of the observer and object affect the description of motion.
- Forces are pushes and pulls.
- Gravity is the force that pulls objects to the Earth.
- Motion is affected by the strength of the force and the mass of the object.

Clarification of Content Expectations

Standard: Force and Motion

Content Statement - P.FM.E.2
Gravity – Earth pulls down on all objects with a force called gravity. With very few exceptions, objects fall to the ground no matter where the object is on the Earth.

Content Expectation

P.FM.03.22 Identify the force that pulls objects towards the Earth.

Instructional Clarifications

1. Identify means to recognize that gravity is the force that pulls objects to Earth.
2. Gravity is the force that pulls objects towards the Earth.
3. The term gravity is very abstract. Third grade students do not need to define the term gravity. They need only to observe that dropped or thrown objects eventually fall to the ground. Some exceptions are helium and hot air balloons, or objects rising in water. Third graders may be aware of the exceptions but do not need to understand the science behind it.
4. Gravity is the attraction between all matter; it is the force that pulls objects toward each other. The larger the object, the greater the force. Because of the Earth's size, the pull of gravity is very apparent.
5. The downward force of gravity is called weight. Weight is the measure of the pull, or force, of gravity on an object.
6. Weight is measured using a scale, whereas mass is measured using a balance.
7. The emphasis of this expectation is that gravity is the force that pulls objects to the Earth. Weight is the measure of the pull of gravity.

Students describe objects as having more or less pull by the Earth and more or less weight.
8. A common misconception is that only large objects have gravitational force.
9. A common misconception is that energy and force are interchangeable.

Assessment Clarification

1. Gravity is the force that pulls objects towards the Earth.

Content Statement - P.FM.E.3

Force – A force is either a push or a pull. The motion of objects can be changed by forces. The size of the change is related to the size of the force. The change is also related to the mass of the object on which the force is being exerted. When an object does not move in response to a force, it is because the environment is applying another force.

Content Expectations

P.FM.03.35 Describe how a push or a pull is a force.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words that a force is a push or pull.
2. Force is a push or a pull on an object or substance by another object or substance.
3. A push is to move an object away.
4. A pull is to move an object toward.
5. Forces can change the shape of an object or speed up, slow down, change the direction, start or stop the motion of an object.
6. Examples of forces are limited to gravity and pushes and pulls caused by people, machines, magnets or nature (wind and water).
7. Note: The third grade unit focuses on the motion of objects on Earth and refers only to weight. Mass is introduced at a later grade level.

Assessment Clarifications

1. Force is a push or a pull on an object or substance.
2. Examples of forces are gravity and pushes and pulls caused by people, machines, magnets or nature (wind and water).
3. A push moves an object away from another object and a pull moves an object toward another object.

P.FM.03.36 Relate a change in motion of an object to the force that caused the change in motion.

Instructional Clarifications

1. Relate means to establish an association or connection between a force and how it causes a change in motion of an object.

2. Forces cause objects to slow down, speed up, change direction, stop and start.
3. A change in motion is to slow down, speed up, stop, or change direction.
4. The emphasis of the expectation is for students to identify the force that causes the change in motion. These forces include gravity, sliding or rubbing (friction) to stop, start or slow things down; pulling, as with a rope; and pushing.
5. Force descriptions are limited to people, machines, wind, and water.

Assessment Clarifications

1. Forces cause changes in motion.
2. Forces cause objects to slow down, speed up, change direction, stop or start.
3. A change in motion is to slow down, speed up, stop, start, or change direction.
4. The emphasis of the expectation is for students to identify the force that causes the change in motion. These forces include gravity, sliding or rubbing to stop, start or slow things down; pulling, as with a rope; and pushing.
5. Force descriptions are limited to people, machines, wind, and water.

P.FM.03.37 Demonstrate how the change in motion of an object is related to the strength of the force acting upon the object and to the weight of the object.

Instructional Clarifications

1. Demonstrate means to show through manipulation of materials, drawings and written and verbal explanations how a change in the motion of an object is related to the strength of the force and the weight of the object.
2. The terms weight and mass are often used interchangeably. However, they are not the same. Mass is the amount of matter in an object, which is a constant amount. Weight is a measure of the gravitational pull of an object. The weight of an object changes if the gravitational pull changes, for example, the weight of an object differs on Earth when compared to the weight of the same object on the moon, yet the mass of the object stays the same. The use of the word mass is more accurate than the word weight in most cases. The use of the word mass is highly recommended.
3. Changes in motion are related to the strength of the force acting on an object. The larger the force the greater the change in motion.
4. Changes in motion are related to the mass of an object. Heavier objects require a stronger force to cause a change in motion. Lighter objects require less force to cause a change in motion.
5. The term mass has not been introduced to students at the third grade level. Third grade students should use the term weight.
6. A common misconception is that large objects always exert a greater force than small objects.
7. Students at the third grade level are not expected to measure force; they make observations of changes in motion due to stronger and weaker forces.

Assessment Clarifications
1. The larger the force the greater the change in motion.
2. Heavier objects need a stronger force to cause a change in motion. Lighter objects need less force to cause a change in motion.

P.FM.03.38 Demonstrate when an object does not move in response to a force, it is because another force is acting on it.

Instructional Clarifications
1. Demonstrate means to show through manipulation of materials, drawings, and written and verbal explanations when an object does not move in response to a force, it is because another force is acting on it.
2. There may be many forces acting on an object at one time. The combination of all the forces result in changes in motion or no motion.
3. A common misconception is that when an object is at rest, there are no forces acting on the object.
4. If forces are equal and opposite, an object will remain at rest.
5. Third grade students do not need to understand these concepts; they simply observe the results of opposing and equal forces and recognize that more than one force acts on an object.
6. At this level, demonstrations include such examples as pushing on a large object such as a boulder (friction is another force) tug-of-war games (equal pulling on opposite ends of the rope) and lifting a heavy object (gravity is the other force).

Assessment Clarifications
1. There may be many forces acting on an object at one time. The combination of all these forces results in changes in motion or no motion.
2. When a heavy object, such as a boulder, is pushed and does not move another force is acting on it.

Content Statement – P.FM.E.4
Speed – An object is in motion when its position is changing. The speed of an object is defined by how far it travels in a standard amount of time.-

Content Expectations

P.FM.03.41 Describe the motion of objects in terms of the path and direction.

Instructional Clarifications
1. Describe means to tell or depict in spoken or written words the motion of objects in terms of path and direction.
2. Motion is described relative to a frame of reference (relative to something else).
3. Motion is a change in position.

4. Motion is the movement of an object from one place to another or physical motion such as twirling and waving.
5. The path of motion can be described as moving away from, toward, around, above, below, behind, between and through an object that is not moving.
6. The terms north, south, east and west describe motion with reference to the Earth.

Assessment Clarifications

1. Motion is movement from one place to another.
2. Motion can be physical movement (twirling, waving, blinking, bending).
3. The path of motion is moving away from, toward, around, above, below, behind, between and through an object that is not moving.
4. Describe the direction of an object as it relates to an object that is not moving. (A girl is walking toward the desk but a boy is walking away from the desk.)

P.FM.03.42 Identify changes in motion (change direction, speeding up, slowing down).

Instructional Clarifications

1. Identify means to recognize changes in motion as changing direction, speeding up or slowing down.
2. Students identify changes in motion as a change in direction, speeding up, or slowing down.
3. A common misconception is that acceleration is speeding up. The term "acceleration" should not be used in the third grade.
4. Changes in direction include north, south, east, west, right, left, up, and down.

Assessment Clarification

1. A change in motion can be identified as a change in direction, speeding up, or slowing down.

P.FM.03.43 Relate the speed of an object to the distance it travels in a standard amount of time.

Instructional Clarifications

1. Relate means to establish an association or connection between distance, time and speed.
2. Third grade students are not expected to calculate speed. Students often confuse speed and distance. Students describe speed as the distance an object travels in a standard amount of time or the amount of time it takes an object to travel a standard distance. For example, if it takes car A 5 seconds longer to travel the same distance as car B, car B is traveling at a faster speed. If car A travels a further distance than car B, in the same amount of time, then car A is traveling at a faster speed.
3. Students' measurement abilities include measuring the distance something travels (kilometers, meters, centimeters) and the amount of time it takes to travel a certain distance (hours, minutes, seconds).

4. Measurement tools include meter sticks, rulers, measuring tapes, stop watches, clocks with a second hand.
5. Speed descriptions include faster and slower.

Assessment Clarifications

1. Speed is the distance an object travels in a certain amount of time.
2. Speed descriptions include faster and slower.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implication

Inquiry Processes
S.IP.03.11 Make purposeful observations of motion of objects in terms of direction.
S.IP.03.12 Generate questions based on observations of objects in motion.
S.IP.03.13 Plan and conduct simple and fair investigations to compare and contrast the motion of objects in terms of path and direction.
S.IP.03.14 Manipulate simple tools (for example ruler, meter stick, stop watch/timer) to determine the speed of an object by measuring the time it took to travel a measured distance.
S.IP.03.15 Make accurate measurements with appropriate units (centimeters, meters, seconds, minutes) of the distance an object traveled in a measured time.
S.IP.03.16 Construct simple charts and graphs from data and observations of time and distance of an object's travel.
Inquiry Analysis and Communication
S.IA.03.11 Summarize information from charts and graphs to answer questions about the speed of a moving object.
S.IA.03.12 Share ideas about changes in motion through purposeful conversation in collaborative groups.
S.IA.03.13 Communicate and present findings of investigations that describe the motion of objects in terms of direction.
S.IA.03.14 Develop research strategies and skills for information gathering and problem solving about determining the speed of a moving object.
S.IA.03.15 Compare and contrast sets of data from multiple trials of an investigation on the motion of objects to explain reasons for differences.
Reflection and Social Implications
S.RS.03.11 Demonstrate similarities and differences in the motion of objects in terms of direction through various illustrations, performances or activities.
S.RS.03. 14 Use data/samples as evidence to separate fact from opinion about the speed of an object.
S.RS.03.15 Use evidence when communicating, comparing and contrasting the motion of objects in terms of path and direction.
S.RS.03.16 Identify technology used in everyday life to measure speed.
S.RS.03.17 Identify current problems about changes in the motion of objects that may be solved through the use of technology.
S.RS.03.19 Describe how people such as al Jazari, Isaac Newton, the Wright Brothers, Sakichi Toyoda, and Henry Ford have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
force	change of speed
force strength	measurement of motion
push	relative position
pull	north
gravity	south
weight	east
mass	west
motion	right
position	left
speed	up
speeding up	down
slowing down	
faster	
slower	
stop	
start	
change of motion	
change of direction	
moving away from	
toward	
around	
above	
below	
behind	
between	
through	
centimeters	
meters	
kilometers	
seconds	
minutes	
hours	
compare and contrast	
cause	
stop watches	
timers	
clocks with a second hand	
meter sticks	
rulers	
measuring tapes	

Instruments, Measurement, and Representations

Measurement	Instruments	Representations
weight	scale	heavier, lighter, same
mass*	balance	heavier, lighter, same
distance	ruler, meter stick, measuring tape	centimeter, meter, kilometer
time	stop watch, timer, clock with a second hand	seconds, minutes, hours
speed**	ruler, meter stick, measuring tape Stop watch, timer, clock with a second hand	faster, slower

Representations in Charts, Tables and Graphs

With teacher assistance, third grade students label and enter information into a data table that represents multiple trials. Third grade students use the median number for graphing.

With teacher direction, modeling and examples, students construct a simple bar graph with information from a data table that includes appropriate labels (clear title, axes labels, unit labels, scales or standard interval counting beginning at zero).

Third grade students are expected to read and interpret both horizontal and vertical bar graphs.

* To be instructed in the 4th grade.

** Third grade students will not calculate speed.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting, findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Gravity: P.FM.03.22
Force: P.FM.03.35, P.PM.03.36, P.FM.03.37, P.FM.03.38
Speed: P.FM.03.41, P.FM.03.42, P.FM.03.43

Objectives

- Demonstrate that objects fall to Earth due to a force called gravity.
- Make observations of the motion of objects and describe the forces acting on them.
- Demonstrate how a force can change the motion of an object and describe the changes that are taking place.
- Using the measurements of distance and time, explain how speed is the relationship between the distances an object travels in a certain amount of time.

Engage and Explore

- Engage students in a variety of activities that require them to move objects, such as moving the desks, rearranging books, cleaning their desks and discarding unwanted items into a waste container, and playing kickball. Students describe how they were able to move the objects (pushing, pulling, lifting, throwing).
- After students have had an opportunity to discuss the ways in which the objects moved, discuss the cause of the motion. Through collaborative conversations, they conclude that the motions were the result of pushes, pulls, or gravity (forces). Introduce the term *force* to describe pushes and pulls exerted on one object by another object. Reinforce gravity as the force that pulls objects to Earth. (P.FM.03.22, P.FM.03.35, P.FM.03.36)

- Take the students on a *motion walk* to make observations of different forces and the resulting motions in and around the school. (P.FM.03.36)
- In collaborative groups, students participate in a variety of games or sports (floor hockey, paper football, kickball, marbles, basketball, soccer, and baseball) to discover and describe how objects move due to the forces acting on them.
- After students discuss the motion of the objects in their activity, challenge them to evaluate the motion of the objects in terms of path and direction. Organize their observations into a chart with the heading, *Motion*, and subheadings: *Path* and *Direction*.
- Create a list of observations and words that describe the path(s) and direction(s) the objects in their activity were moving. Draw a diagram of the motion of the objects in the games and label the forces and the changes in motion (change in direction, speeding up, slowing down, starting and stopping). Add *Changes in Motion* to the chart and list observations and descriptions of how the objects changed their motion. (P.FM.03.36, P.FM.03.37, S.IP.03.11, S.IA.03.11, S.IA.03.12)

Motion		
	Observations	Descriptions
Direction		away from, toward, etc.
Path		straight, curvy, zigzag
Changes in Motion		changes in direction, speeding up, slowing down, starting, stopping

- As students discuss and share ideas through purposeful conversation, each group records ideas and questions regarding motion, forces, path, direction, and changes in motion (changes in direction or speed) on word strips or chart paper (for example: How does a lighter ball move differently than a heavier ball? How does the material that the ball is made from make a difference? How does the surface that the ball travels on make a difference?) (P.FM.03.36, P.FM.03.37, P.FM.03.38, S.IP.03.12, S.IA.03.12)

Explain and Define

- Explain and create classroom definitions for the terms *gravity, motion, force, direction* and *speed*. (P.FM.03.35, P.FM.03.36, P.FM.03.43)
- During the discussion, add to the descriptive terms on the chart used to describe direction and changes in motion. (P.FM.03.41, P.FM.03.42, P.FM.03.43)

Elaborate and Apply

- Elaborate on the questions generated during the explore activities by dividing them into questions on path and direction and questions on changes in motion. (P.FM.03.41, P.FM.03.42)
- As a class, choose one question regarding the direction of objects that can be investigated and not answered by yes or no or simple research. For example: How do different observers describe the direction of a moving object? (S.IP.03.12)
- Working in collaborative groups, students plan and conduct a simple investigation, based on the class question, to describe the motion of objects in terms of path and direction. For example: Students predict whether classmates standing in different locations around the room will describe direction of a rolling ball in the same way. Four students stand in different locations. As a ball is rolled across the floor, the students individually record their descriptions of the path and direction the ball is moving. The trial is conducted multiple times using different students for each trial. Groups summarize their data in charts. (P.FM.03, 41, S.IP.03.13, S.IP.03.16)
- To evaluate understanding, each collaborative group communicates and presents findings using evidence from trials to compare and contrast the motion of objects in terms of direction. Based on evidence, students analyze and summarize the differences in the results. Finally, students create a drawing or performance to further explain the similarities and differences in the motion of objects in terms of direction. (P.FM.03.42, S.IP.03.13, S.IA.03.13, S.IA.03.15, S.RS.03.15)
- To further elaborate and extend understanding of motion, students review their original questions regarding changes in motion focusing on speeding up and slowing down. For example: How can we measure the speed of a toy car?
- After conducting research and gathering information, students discuss the concept of the speed of a moving object and how to describe speed in terms of distance and time. The purpose of this activity is to discover the relationship of distance and time. (P.FM.03.42, P.FM.03.43, S.IA.03.12, S.RS.03.15)
- Elaborate on the term *distance* by giving students the tools, units, and skills to collect quantitative measurements (meter sticks, rulers, measuring tapes, centimeters, meters, kilometers). (P.FM.03.43, S.IP.03.15)
- Elaborate on the term *time* by giving students the tools, units, and skills to collect quantitative measurements (stop watch, clock with second hand, timer, second, minute, hour). (P.FM.03.43, S.IP.03.14)
- Expand on the measurement of speed by measuring the amount of time it takes (using a stopwatch and seconds) a toy car to travel a specified distance down a ramp. Conduct at least three trials and find the median for a more accurate measurement. Further expand on the measurement of speed by measuring the distance (using a meter stick or ruler) a car travels in a specified amount of time. Conduct at least three trials.

Students construct simple charts and graphs from the data and from observations of time and distances of the toy cars' travel. (P.FM.03.42, P.FM.03.43, S.IP.03.14, S.IP.03.15, S.IP.03.16, S.IA.03.11, S.IA.03.14, S.RS.03.14)

Evaluate Student Understanding

Formative Assessment Examples

- Create operational definitions in student language for the terms: gravity, force, motion, direction, and speed. For example: A ball will fall to Earth because of a force called gravity. Speed is how fast or slow an object moves in a certain amount of time. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.43)
- Organize observations of motion into charts. (P.FM.03.36)
- Draw a diagram of the motion of objects in games; label the forces and changes in motion. (P.FM.03.36, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- Summarize data from investigations on motion and direction into charts. (P.FM.03.36, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- Engage in purposeful conversation about motion as it relates to distance and time. (P.FM.03.43)
- Construct simple charts and bar graphs from data on speed investigations. (P.FM.03.43)

Summative Assessment Examples

- Explain and illustrate the forces that are causing the motion in a dropped ball, a rolling ball, a stationary object such as a large boulder, a ball changing direction and a ball slowing down to a stop. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.38)
- Create a drawing or performance to identify and explain the similarities and differences in the motion of objects in terms of path and direction. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.37, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- After analyzing the data, students summarize the information on their charts and graphs to answer the question, "How can we measure the speed of a toy car?" Through purposeful conversation, collaborative groups of students develop a shared understanding of speed utilizing the data gathered as evidence to support their ideas, rather than expressing an opinion. Students use the writing process to summarize their findings in an organized format. (P.FM.03.43)

Enrichment

- Investigate changes in motion due to different forces such as pushing, pulling, and falling. Create models to illustrate forces.
- Plan and conduct simple investigations comparing the speed of toy cars moving down ramps of differing heights and surfaces. Include the mathematical calculations of speed for students with the ability.
- Explore the forces, motion, changes in motion and speed of different objects including hot air balloons, airplanes, rockets, sailboats, surfboards, etc.

Intervention

- Explore direction (forward, backward, toward, away, left, right) by participating in games such as *Mother May I, Red Light, Green Light,* or *Simon Says*.
- Watch video clips of various sporting events. Describe the motion of the players, objects, etc. and the forces that caused the motion.
- Qualitatively observe, compare and describe the speed of two or more objects using terms such as faster, slower, same speed, slowing down, speeding up, stopping or starting.
- Provide opportunities for students to observe, record and discuss forces and resulting motion in and around the school
- Read informational texts such as *Forces Make Things Move* by Kimberly Brubaker Bradley, 2005. Conduct suggested activities included in the text.

Examples, Observations, and Phenomena (Real World Context)

Observation, measurement, and communicating ideas are everyday skills. Students use their senses to continually learn about their environment. They use measurement of distance and time in everyday activities. They understand that some things move slowly and others move quickly without having an understanding of the algorithm of speed. Students begin to extend the concept of speed as a function of time and distance. They recognize that if the dog runs the same distance in less time than the cat, then the dog is running faster. Similarly, if the cat runs a farther distance than the mouse in the same amount of time, then the cat is running faster.

Throwing balls, running, rolling balls, swinging, and sliding are all common activities for children. Everyday experiences naturally include a description of the direction of motion and the speed at which motion occurs.

Students are familiar with everyday technology used to measure distance, time, and speed. Firsthand experiences include using stopwatches, egg timers, clocks or watches with a second hand. They are also becoming proficient in measuring with rulers and meter sticks. Students understand that the speedometer in the car measures speed. They are aware that speed is described as miles per hour when discussing the speed limit or the speed at which the car is traveling. To further their understanding, attention to miles (distance) per hour (time) can reinforce their experiences in classroom activities involving toy cars. Additionally, students recognize that using technology (timers, speedometers, etc.) to make accurate measurements can avoid or solve problems in such activities as car racing, horse racing, excessive speed, space travel, and scuba diving.

Contributions of scientists throughout history and across cultures have contributed significantly to current scientific thought. Students research and recognize that the contributions of scientists such as al-Jazari, Isaac Newton, Albert Einstein, the Wright Brothers, and Sakichi Toyoda have contributed to the science of forces and motion.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.02 retell in sequence the story elements of a grade level narrative text and major idea(s) and relevant details of grade-level informational text.

Examples of trade books available for learning about changes in motion:

Forces Make Things Move by Kimberly Brubaker Bradley, 2005
Why Doesn't the Earth Fall Up? By Vicki Cobb, 1989
Mr. Gumpy's Motor Car by John Burningham, 1983

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e. compare/contrast, cause/effect, problems/solutions) with a title, heading, subheading, and a table of contents.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

- Write an informational description of changing motion (changing direction, speeding up, slowing down, starting, or stopping) using cause and effect. Include the measurement tools and units that are used to provide evidence and support for ideas.
- Use the writing process to produce and present research on determining the speed of a moving object. Beginning with a question to investigate, summarize findings about speed from a variety of resources in an organized format.

Speaking

S.DS.03.04 plan and deliver presentations using an effective informational organizational pattern (e.g. descriptive, problem/solution, cause/effect) supportive facts and details, reflecting a variety of resources; and varying the pace for effect.

- Plan and deliver presentations comparing and contrasting the motion of objects in terms of direction using an informational organization pattern (descriptive); supportive facts and details reflecting data collected from a simple investigation.

Mathematics Integration

Number and Operations

N.ME.03.01 Read and write numbers to 10,000 in both numerals and words, and relate them to the quantities they represent.

N.FL.03.07 Estimate the sum of and difference of two numbers with three digits (sums up to 1,000), and judge reasonableness of estimates.

N.FL.03.08 Use mental strategies to fluently add and subtract two-digit numbers.

Measurement

M.UN.03.01 Know and use common units of measurement in length, weight and time.

M.UN.03.02 Measure in mixed units within the same measurement system for length, weight, and time: feet and inches, meters and centimeters, kilograms and grams, pounds and ounces, liters and milliliters, hours and minutes, minutes and seconds, years and months.

M.PS.03.12 Solve applied problems involving money, length and time.

Data and Probability

D.RE.03.01 Read and interpret bar graphs in both horizontal and vertical forms.