Holyoke Public Schools
Middle School Science
Curriculum Map
Grade 8

Force & Motion
Unit #3

January 2010

Overview of Curriculum Maps

Goals:

1. To ensure that students are exposed to a rigorous curriculum in every school and every grade
2. To have consistent instruction and assessment district wide
3. To prepare students for the MCAS test
4. to explain what is expected to be covered in each Science unit of study

Expectations:
The district's expectation is for students to successfully meet the Massachusetts Science and Technology/Engineering Standards, and the English Language Proficiency Benchmarks and Outcomes (ELPBO). In order to help facilitate this teachers are required to follow curriculum maps.

Accountable Talk:
To promote learning, explore solutions, and justify reasoning, conversations between students and students or students and teacher must be accountable – accountable to the learning community, to the science discipline, and to rigorous thinking.

Feedback to Students:
Feedback needs to happen daily in the classroom. There are many ways to give feedback. Conferencing, observations, questions asked during the workshop, and written responses to students' work and notebook entries.

Formative Assessments are embedded throughout the unit to provide diagnostic information, which teachers can use to inform their decisions about instruction for individual students and for the class. In general Formative Assessment should not be graded. They are intended to help teachers have greater insight into students' thinking.

Summative Assessments are used for evaluation purposes. Summative Assessments are graded. Assessments that are graded should occur at the end of an investigation.

NAEP Science Assessment sample questions
http://nces.ed.gov/nationsreportcard/science/

FIVE ESSENTIAL PRACTICES FOR TEACHING ENGLISH LANGUAGE LEARNERS

The five essential practices for teaching English language learners are practices developed by America's Choice to support the literacy needs of ELL students. These practices are a result of current second language acquisition research, literacy development, and effective classroom practices. *(America's Choice: Teaching English Language Learners: Literacy)*

Essential Practice 1	**Classroom Applications**
Develop Oral Language through Meaningful Conversation and Context. Oral language is the foundation of literacy and a main tool for learning and interacting in both academic and social settings. Natural exposure and planned experiences with oral language facilitates increases expression and understanding of the second language. Oral language also supports vocabulary development in context, paving the way for better comprehension and production. Exposure to rich oral and written language environments is vital for developing literacy and language skills.	• Develop oral language through meaningful conversation by planning language experiences and building consistent time to engage conversation. • Enunciate and rephrase difficult works allow extra time for practice and repetition. • Demonstrate and orally explain activities step-by step. Rephrase difficult instructions • Use think-alouds. Verbally share the comprehension thought process. • Provide opportunity for practice: allow extra time for practice and repetition in oral, reading, and writing activities with appropriate feedback. • Allow students to respond through Turn and Talk activities, oral, choral reading and re-reading. • Use audio recording of a text to provide extended to provide extended literacy opportunities where students listen to the reading of a text independently while developing fluency, accuracy, and language acquisition. • Plan daily read-alouds to model literacy strategies and to scaffold fluency, accuracy, and independent reading.

Essential Practice 2	Classroom Applications
Teach Targeted Skills through Contextualized and Explicit Instruction Full literacy is a fluid combination of oral, reading, and writing skills. These skills must be taught through explicit and contextualized instruction that scaffolds learning. Contextualized instruction provides students with extra linguistic clues that support understanding not only of the content but also of the language being used in the lesson. Combining contextualized practices with the knowledge of phonemic awareness, phonics skills, language structures and functions, text patterns, and literary devices such as metaphors, analogies, figurative language, and unfamiliar cultural concepts, will aid students in achieving stronger literacy skills. Explicit skills give the students the tools they need to comprehend increasingly complex literacy demands.	• Use clues of context to make instruction meaningful. Teach skills and strategies ;using materials, books or writing that students know and understand • Use Big Books or shared reading to teach phonics, vocabulary and language features. • Use student or teacher writing models to teach craft, spelling, and language use conventions. • Teach phonemic awareness within a context. ELL children must attach meaning and experience to phonemes they may never have heard before. Teach phonemic awareness while explicitly teaching vocabulary, meaning, or within-a-story context. • Understand the linguistic background native language and address these issues specifically. • Pay special attention to sounds of letters. Languages have different linguistic features. For example, while the vowel sounds in English vary, Spanish vowel sounds are consistent. Students will transfer what they know about one language and automatically, and sometimes incorrectly, apply it to English. • Use meaningful activities to teach phonemic awareness, such as language games, Word Walls, word banks, songs, poems, and rhymes that focus on particular sounds or letters.

Essential Practice 3	Classroom Applications
Build Vocabulary through Authentic and Meaningful Experiences with Words Developing and deepening a student's understanding of new words is essential for English language learners. Building vocabulary in the context of literature, experiences, and modeled writing ensures that students will own the new words they encounter. Vocabulary building is a lifelong process and students must learn ways to integrate and approach new and challenging words. Discussing, playing with, and using new words allows students to gain new vocabulary through meaningful, and therefore memorable, experiences.	• Vocabulary development must be taught intentionally. Since word knowledge correlates with reading comprehension and meaning-making strategies used in decoding, it must be a focus for instruction. • Vocabulary development must be taught in context. Connect word knowledge with background knowledge and instructional context. ELL students need both meaning and context to acquire new vocabulary. • Facilitate and plan activities that support the three main ways vocabulary is learned: 1. Through meaningful conversations with adults and other students. 2. Listening to adults read at slightly higher levels than the student's independent level. 3. Read extensively on their own at their reading level. • Pre-teach vocabulary words, prefixes/suffix, context clues, and cognates. Build students' skill box with vocabulary and give them tools to understand and connect new vocabulary. • Use content Word Walls or word webs. Support cognitive structuring for ELLs by connecting new vocabulary to themes, ideas, or generalizations. • Explicitly focus on and teach academic language. Students need to be consistently exposed to formal or content specific language and vocabulary. • Explicitly teach the building blocks of language. Students need to learn the connecting and transition words of the English language ("however," "in conclusion", etc.)Teach them in context and teach them explicitly. • Focus teaching Tier 2 words, as well as essential Tier 1 words. Although most explicit vocabulary instruction should focus on Tier 2 words (words with a high frequency in the written language, example: examine), ELLs need instruction around Tier 1, or basic spoken words as well.

Essential Practice 4	Classroom Applications
Build and Activate Background Knowledge Learning is based on establishing neural connections in the brain, drawing on previous experience, background knowledge, and prior and current environments. It is both the teacher's and the student's job to facilitate these connections in order to construct meaning and understand new ideas and concepts while expanding on their own world knowledge. Actively fostering these connections will enable students to more easily interpret their surroundings and assign meaning to new concepts while expanding their own	• Elicit student's experience and comments. Connect school, literary and personal events through talking, writing, and reading. • Consider the cultural background of students when selecting literacy materials such as books and poems. Support language development of Ell students by giving them new English words for experiences that are close to home. Using materials that represent their cultural background increases motivation and supports participation. • Discuss and build language around universal themes. Connect new language to universal experiences. • Build content-based word banks and webs. Connect new language to other known words, experiences, and ideas to support cognitive structuring. • Use native language and value home culture. View home cultures as a resource, rather then a liability. • Use hands-on experience based instruction in all academic areas. Language can be built upon common classroom experiences. • Encourage students to make connections before, during and after reading. • Find out what students know, and build on their experience.

Essential Practice 5	Classroom Applications
Teach and Use Meaning-Making Strategies Intentionally teaching meaning-making strategies provides students with a toolbox to approach future learning challenges. Meaning-making strategies vary from helping students comprehend text to various strategies students can use to understand English-dependent lessons. Modeling appropriate behaviors to students gives them the tools to be autonomous learners and supplies them with options they can use to interpret environmental input, both academically and socially.	• Explicitly teach student meaning-making strategies. Model for students how to visualize, make connections, monitor for meaning, determine importance, etc. • Provide opportunities for practice. Sustain daily work periods in reading and writing for students to practice these strategies. • Systematically assess students and adjust instruction. Monitor progress and use data to adjust the focus of mini-lessons, conferences and small-group instruction. • Model activities and thinking for certain skills. Students need to see and experience what is expected of them before they perform a task. • Beginning ELLs need more than just phonics and English Language Development instruction. EXPOSE STUDENTS RIGHT AWAY TO COMPREHENSION STRATEGIES. Waiting to address skills in chronological order hinders academic growth and English proficiency. • Teach students how to help themselves in English-dependent lessons. Model your thinking and how you approach problems. Build students cognitive toolbox by explicitly teaching the ways to help themselves during difficult language situations.

Resources:

Forces and Motion FOSS kit

Prentice Hall Science Explorer: *Motion Forces, and Energy*

- Student Text, Student Edition on Audio CD, Teacher's Edition
- All-in-One Teaching Resources, Teacher EXPRESS (4 CD-ROM Set)
- Differentiated Instruction
    - Guided Reading and Study Workbook, Adapted Reading Study Workbook, & Adapted Tests

Misconceptions about Force and Motion

1. The only "natural" motion is for an object to be at rest.
2. If an object is at rest, no forces are acting on the object.
3. A rigid solid cannot be compressed or stretched.
4. Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting upon it.
5. Force is a property of an object. An object has force and when it runs out of force it stops moving.
6. The motion of an object is always in the direction of the net force applied to the object.
7. Large objects exert a greater force than small objects.
8. A force is needed to keep an object moving with a constant speed.
9. Friction always hinders motion. Thus, you always want to eliminate friction.
10. Frictional forces are due to irregularities in surfaces moving past each other.
11. Rocket propulsion is due to exhaust gases pushing on something behind the rocket.
12. Time is defined in terms of its measurement.
13. The location of an object can be described by stating its distance from a given point (ignoring direction).
14. The terms distance and displacement are synonymous and may be used interchangeably. Thus the distance an object travels and its displacement are always the same.
15. Velocity is another word for speed. An object's speed and velocity are always the same.
16. Acceleration is confused with speed.
17. Acceleration always means that an object is speeding up.
18. Acceleration is always in a straight line.
19. Acceleration always occurs in the same direction as an object is moving.
20. If an object has a speed of zero (even instantaneously), it has no acceleration.

Big Idea: Motion is the act of changing position/ El movimiento es el acto de cambiar de posición

Massachusetts Science and Technology/Engineering Standards
PSS # 11. Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed.
MCAS item analysis (What do students need to be able to do?)

- ✓ Be able to tell the cardinal directions using a compass rose
- ✓ Know how to calculate speed
- ✓ Know how to calculate average speed
- ✓ Know how to calculate time it takes to travel a specific distance given speed

Massachusetts Science and Technology/Engineering Standards
PSS #12. Graph and interpret distance vs. time graphs for constant speed.
MCAS item analysis (What do students need to be able to do?)

- ✓ Know how to interpret a graph of distance versus time
- ✓ Recognize graphs that represent constant speed
- ✓ Interpret distance versus time graph for constant speed
- ✓ Interpret distance versus time graph for time that an object was moving the fastest or slowest
- ✓ Interpret distance versus time graph for rate of speed at different times
- ✓ Be able to extrapolate data from a graph

Guiding Question: What are variables?/ ¿Cuáles son las variables?

Engage:

- o Make a KWL chart with students. Ask students what is meant by a **controlled experiment** (*elicit prior knowledge*).
  *S.2.5. Ask and answer concrete questions about familiar content.

Explore:

- o Students observe and compare the behavior of pendulums. (See appendix and/or *FOSS Variables Teacher Guide*, Investigation 1, part 1: Exploring Swingers, page 1 to 15). Students gain experience with the concept of variables, by conducting **controlled experiments** to find out what variables affect the number of cycles a pendulum will complete in a unit of time.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  ***From the Massachusetts English Language Proficiency and Outcomes for English Language Learners (ELPBO)**

- Students test the variables of mass, release position, and length to find out how they affect the number of swings the pendulum completes in a given amount of time. (See appendix and/or *FOSS Variables Teacher Guide*, Investigation 1, part 2: Testing Variables, pages 16 to 22). Students fill out the Swingers Picture Graph, Sheet #5, using the T-table information to determine the length of each string.
  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *R.5.12.a. Identify and represent graphically main ideas.

- Students work with a partner to answer the questions on Response Sheet #6: Swingers.

- Students are introduced to **two-coordinate graphs**. They plot the swinger data on the new graph and compare it to concrete and pictorial graphs of the same information. Students use the graph to make predictions and create pendulums with new lengths to test their predictions. Students compare predictions and experimental results. (See appendix and/or *FOSS Variables Teacher Guide*, Investigation 1, part 3: Predicting Swings, pages 23 to 27).
  *R.5.12.a. Identify and represent graphically main ideas.
  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.

- Students add the following vocabulary terms to their glossaries: **pendulum/ péndulo, cycle/ ciclo, variable/ variable**
  *S.1.5. Employ vocabulary essential for grade-level content learning.
  *S.12.a. Identify **cognates** in printed, grade-level, academic content vocabulary terms.

Explain:

- Students answer the following question in their notebooks: What variables affect the number of cycles the pendulum swings in 15 seconds? Explain your answer using evidence from the experiments with swingers. Use some of the vocabulary words introduced from this lesson (these should be posted on a word wall or let students use their glossaries in their notebooks).
  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *W.5.a. Use reference list of words in English to edit spelling

Extend:

- Classroom activities to help children learn about fair testing http://www.ise5-14.org.uk/prim3/New_Guidelines/investigations/Fair_test.htm

- Doing a Fair Test: Variables for Beginners http://www.sciencebuddies.org/science-fair-projects/project_experiment_fair_test.shtml

- What is a pendulum? http://www.calacademy.org/products/pendulum/page1.htm

Evaluate: The three following questions are also available on-line: http://www.school-for-champions.com/science/pendulum.htm#Mini-quiz

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1. What happens when you double the mass of the pendulum bob?
a) The pendulum swings twice as fast
b) The pendulum swings half as fast
c) The speed stays the same

2. What happens if you decrease the length of the pendulum rod?
a) You decrease the amplitude of the swing
b) You increase the frequency or rate of the pendulum
c) You decrease the weight of the bob

3. How does a pendulum on the Moon compare with one on Earth?
a) It doesn't work, because there is no air on the Moon
b) Its frequency would be slower because gravity (**g**) on the Moon is less than on Earth
c) Its frequency would be faster because gravity (**g**) on the Moon is more than on Earth

Guiding Question: What is motion?/ ¿Qué es el movimiento?

Engage:
- How do you know something is moving? Call on a couple of students to share their conceptions of **motion/ movimiento.** See if students con express ideas of motion without using the word move. (*elicit prior knowledge)*

Explore:
- Guided Inquiry: Investigation 1: Here to There, Part 1: Fly Air Trolleys, page 47 to 56, *FOSS Force and Motion Teacher's Guide.* Students fly rubber band-powered toys along a line to think critically about motion. Have all students in the class measure the **distance/ distancia** the air trolley moves with 20 winds of the rubber band. Do not tell them how to measure the distance, let them figure it out themselves. Have them repeat the experiment 5 times.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.

Explain:

- Create a class chart of all the data collected. Discuss with students why the distance measured was not the exact same each time. What do we have to do to get better data? (Help guide students to figure out that they need to control **variables/ variables**).
  - *R.3.10.c. Locate evidence to support an argument or a conclusion.
  - *S.3.42. States a position and supports/justifies it.

Guiding Questions: What is the equation for calculating distance?/ ¿Cuál es la ecuación para el cálculo de la distancia?

Explore:

- Students redo Investigation #1 (**controlling variables/ control de las variables**) using reference points to establish the air trolley's initial and final positions in order to determine the distance the trolley moved. Students learn **distance = final position – initial position/ distancia = posición final - posición inicial.** Students calculate flight distances. Students record the equation for calculating distance in their notebooks.
  - *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  - *S.3.29. Demonstrate comprehension of oral, multiple-step directions.

- Students add the following vocabulary terms to their glossaries: **reference point/ punto de referencia, position/ posición, delta/ delta,** and **distance/ la distancia.** Students should record the equation for distance in their notebooks.
  - *S.1.5. Employ vocabulary essential for grade-level content learning.
  - *S.12.a. Identify **cognates** in printed, grade-level, academic content vocabulary terms.

- Worksheet page 7, in the *FOSS Force and Motion Lab Notebook.* Students work with a partner to calculate the distance traveled by an air trolley in each of three flights, using the **distance equation/ ecuación de distancia,** and marking their reference points with arrows. Students share their work with the class and include correct units with their answers.

- Students read and discuss "Describing Motion", page 6 to 8 in *Prentice Hall Science Explorer: Motion, Forces, and Energy* textbook. Post-reading strategy: In their journals, students should paraphrase the main points of the reading using their own words. *Writing helps students solidify their understanding and makes it easier for them to recall what they have learned.*
  - *R.2.11.a. Respond to stories and informational texts that are heard.
  - *R.3.10.c. Locate evidence to support an argument or a conclusion.

*W.2.7.c. Write a conclusion that supports the details provided in a written paragraph.

Pre-Reading ELL Strategy:

- ✓ *Before and After Vocabulary Grid* : Students attempt to define vocabulary words prior to looking up definitions.

During Reading ELL Strategy:

- ✓ *Word Sort* (see appendix): Students in mixed ELL and English-speaker groups, sort key vocabulary from the reading into categories. Groups share out.

Post Reading ELL Strategy:

- ✓ *3-2-1:* 3 facts learned in the reading, 2 connections to the reading, and 1 question.

Explain:

1) Did your air trolley move? How do you know? (Prove it).
2) What is the importance of measuring from the same place on the air trolley?
3) Give specific examples of measuring air trolley distance.
4) Give students sample data and have them make a graph. (This will allow teachers to find out if students know how to make a graph).

Guiding Question: Is there a relationship between the number of winds on the rubber band and the distance the trolley travels?/ ¿Existe una relación entre el número de los vientos en la banda de goma y la distancia que el carro de viajes?

Engage:

- o Ask students to recall the equation for calculating distance. Allow students to refer to their own science notebooks.

Explore:

- o Investigation 1: Here to There, Part 2: Air Trolley Graphs, page 57 to 62, *FOSS Force and Motion Teacher's Guide.* Students set up an experiment to find out if there is a relationship between the number of winds and the distance traveled. Students collect data about the distance traveled (dependent variable) in cm and the number of winds of the rubber band (independent variable). The conventional form and procedure for preparing two coordinate graphs are introduced, page 61 to 62, *FOSS Force and Motion Teacher Guide.* Students graph the distance versus the number of winds. Teacher introduces the concept of best fit line. Students interpret the graph and use it to make some **predictions/ predicciones**.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

*R.5.12.a. Identify the main ideas and represent them graphically.
*S.3.29. Demonstrate comprehension of oral, multiple-step directions.

- Students add vocabulary terms to their glossaries: **dependent variable/ variable dependiente,** and **independent variable/ variable independiente**. *Students should write the word and its definition. Also, they should add examples or drawings that help to explain the meaning of the word.*
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level learning, using pictures, actions, and or objects.
  *R.1.9. Apply knowledge of context clues to determine the meaning of unfamiliar words.

- Students need more examples of reading and interpreting graphs, not just making them. For example, give students a graph without numbers, and have them make up a story to explain what's happening in the graph. Make graphs with a sentence or 2 that explains the graph. Students need time and experience to learn how to interpret graphs.
  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.
  *W.2.2.e. Write brief summaries of information gathered through research.

Explain:

- Is the relationship you found between the number of winds of the rubber band and the distance the air trolley traveled easier to see in the table or in the graph? Explain. Students should work as individuals. *Use some of the vocabulary words introduced from this lesson (these should be posted on a word wall or let students use their glossaries in their notebooks).*
  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *W.5.a. Use reference list of words in English to edit spelling

Extend:

- On-line Activity: Observe the two cars. The blue car starts ahead of" the red car. (The red car actually starts *off the screen*.) Since the red car is moving faster, it eventually catches up with and passes the blue car. Observe the position-time graphs for these two cars. The position-time plot of each car's motion is depicted by a diagonal line with a constant slope. This diagonal line is an indicator of a constant velocity. At the time that the cars are side by side, the lines intersect. That is, the two cars share the same position at that instant in time. The lines would not intersect for a velocity vs. time graph; there is never an instant in time in which they share the same velocity. The two cars have the same position at seven seconds; yet they never have the same velocity at any instant in time.

http://www.physicsclassroom.com/mmedia/kinema/fs.cfm

Guiding Question: What is a reference point?/ ¿Qué es un punto de referencia? /

Engage:

- Ask students how many watch the Olympics on TV. Ask students how we know that all competitors travel the same distance? *(elicit prior knowledge)*

Explore:

- Students work with a partner to do Investigation 1: Here to There, Part 3: Road Races, page 63 to 66, *FOSS Force and Motion Teacher's Guide*. Students analyze graphic representations of races between several competitors. They determine distance traveled by many different vehicles and exercise their skills related to **reference points/ puntos de referencia, symbolic notation/ notación simbólica,** and using the equation for calculating distance. Each student completes both pages of the Road Races sheet, Page 10 and 11 in the *Force and Motion Lab Notebook*. Make sure students show their math work and include units with their answers.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.

- Students use Moving Along multimedia program (See the Multimedia User Guide in the *FOSS Force and Motion Teacher Guide*, pages 517 to 550) to determine the distance moved by an object. **The multimedia component is not optional.** So, at a minimum, you should have one computer with a CD-ROM drive and a large-screen monitor available for the entire class. But it is far better if you have access to a computer lab or 8 to 16 computers for your class. The FOSS Force and Motion multimedia is available on-line at www.fossweb.com/forceweb

Explain: (NAEP released question)

*R.5.5.a. Identify facts in a text to answer the reader's or other questions.

Q. Suppose you are riding in a car along the highway at 55 miles per hour when a truck pulls up along the side of your car. This truck seems to stand still for a moment, and then it seems to be moving backward.

a) Tell how the truck can look as if it is standing still when it is really moving forward.

b) Tell how the truck can look as if it is moving backward when it is really moving forward.

Evaluate:

- Mid-Summative Exam 1, page 485-487, in *FOSS Force and Motion Teacher Guide*. Students should work alone to complete the exam. Scoring guides on page 423 to 425.

Guiding Questions: What is speed?/ ¿Cuál es la velocidad?

Explore:

- Investigation 2: Speed, Part 1: Who Got There First, pages 78 to 82, *FOSS Force and Motion Teacher Guide*. Introduce First Arrival, transparency no. 5, page 307 in Transparency Masters section. As a class students study before and after pictures of motion events and try to determine which vehicle, the car or truck, got to the end position first. Call on students to share their ideas about first arrival. Encourage them to support their thinking with an explanation. Record ideas students offer on chart paper, blackboard, or whiteboard (whatever is available). Students will eventually realize they can't tell unless they know either how long each took or how fast each traveled. **Introduce speed as the distance an object travels in a unit time/ Introducir la velocidad como la distancia que viaja un objeto en una unidad de tiempo.**
  - *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  - *S.3.29. Demonstrate comprehension of oral, multiple-step directions.
  - *W.2.2.e. Write brief summaries of information gathered through research.

- Students add the vocabulary terms **speed/** de velocidad, **fast/** rápido, **slow/** lento, **units/** unidades, and **time interval/** el intervalo de tiempo to their glossaries.
  - *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level learning, using pictures, actions, and or objects.

- Students open the *FOSS Force and Motion Lab Notebooks*, to page 13 to 15, Who Got Their First? Point out that the three races are represented with time (clocks) associated with the initial and final position of each vehicle. The times are shown on an analog clock. Make sure students know how to use them to get the time data. Students work in groups to answer the questions under each race diagram. Emphasize that students should show their math and write clear descriptions about how they determined which vehicle arrived first at the 150 km mark.
  - *R.5.5.a. Identify facts in a text to answer the reader's or other questions.
  - *W.2.2.e. Write brief summaries of information gathered through research.

- Students read and discuss the article called "Time: The Infinite Line", page 1 to 2, *FOSS Force and Motion Resource* Book. Before reading brainstorm with students all the words they can think of that are related to **time**. The reading can be done out loud or in small groups. After reading students do a quick write. The quick-write is used as a reflective vehicle to reading/learning. Teachers could ask students to reflect on what they read/learned, key ideas from reading, problems they encountered, or questions they still may have about the text(s). Students record their quick-write statements in their journals.

  *R.2.11.a. Respond to stories and informational texts that are heard.
  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *W.7.c. Write a conclusion that supports the details provided in a written paragraph.

- Students add the vocabulary terms **universal time/ el tiempo universal** and **time interval/ el intervalo de tiempo** to their glossaries.

  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level learning, using pictures, actions, and or objects.

Explain:

- Students should work as individuals to answer the following question: How do you know that all objects in motion have a speed? Use some of the vocabulary words introduced from this lesson (these should be posted on a word wall or let students use their glossaries in their notebooks).

  *R.3.10.c. Locate evidence to support an argument or a conclusion.
  *W.5.a. Use reference list of words in English to edit spelling

Evaluate: (MCAS released questions)

*R.5.5.a. Identify facts in a text to answer the reader's or other questions.

Q. Tobias rode his bike on a road for a 2 hr period. On average, he passed a 1 km marker every 3 min during this period. (PS #11)
Which of the following was his average speed for this 2 hr period?

A. 10 km/hr

B. 15 km/hr

C. 20 km/hr

D. 25 km/hr

Q. An airplane takes off from Boston for the 980 km trip to Detroit. The plane lands two hours later. Which of the following **best** describes the average speed and direction of the airplane's flight? (PS # 11)

A. 325 km/h W

B. 490 km/h W

C. 980 km/h W

D. 1960 km/h W

Q. An escalator at a shopping mall is 10 m long and moves at a constant speed of 0.5 m/s. If José steps onto the escalator at the bottom while it is moving, how long will it take him to travel the 10 m? (PS #11)

A. 5 s

B. 10 s

C. 15 s

D. 20 s

Q. The diagram below shows the path of a jet from Washington, D.C. to Dallas, TX. (PS #11)

The trip takes approximately 2 hours and covers approximately 1900 km. Which of the following **best** describes the speed and direction of the jet's flight?

A. 475 km/h southwest

B. 950 km/h southwest

C. 1900 km/h southwest

D. 3800 km/h southwest

Guiding Questions: How is speed of an object calculated when we know the time interval and the distance traveled? How is the distance an object travels calculated when we know the time interval and speed?/ ¿Cómo es la velocidad de un objeto, cuando sabemos calcula el intervalo de tiempo y la distancia recorrida? ¿Cómo es la distancia que viaja un objeto, cuando sabemos calcula el intervalo de tiempo y la velocidad?

Explore:

- Investigation 2: Speed, Part 2: Time Travel, pages 83 to 88, *FOSS Force and Motion Teacher Guide*. Students open their *FOSS Force and Motion Lab Notebook* to page 16, Time Travel A. Students work in small groups to try and figure out how to calculate speed on their own for a short period of time. Help students discover the equation for calculating speed. Students record the equation for speed in their lab notebooks.
  - *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  - *S.3.29. Demonstrate comprehension of oral, multiple-step directions.
  - *W.2.2.e. Write brief summaries of information gathered through research.

- Students work in small groups on Time Travel B, on page 17 in the *FOSS Force and Motion Lab Notebook*. Help students discover the equation for calculating distance when speed and time interval are known. Students record the equation for distance in their lab notebooks.
  - *R.5.5.a. Identify facts in a text to answer the reader's or other questions.

- If students need more opportunities to work with speed and distance problems have students do the Speed and Distance practices problems on pages 18 and 19 of the lab notebook.

- Students read out loud and discuss "First in Flight" page 3 to 6 in *Force and Motion Resources* book. Have students work in groups to answer the three questions on page 6. Students write a brief summary of the article, using the terminology of the author.
  - *R.2.11.a. Respond to stories and informational texts that are heard.
  - *R.3.10.c. Locate evidence to support an argument or a conclusion.

*W.7.c. Write a conclusion that supports the details provided in a written paragraph.

Explain:

- Response Sheet- Speed, page 21 in the lab notebook. Students should work as individuals.

Guiding Questions: How is the average speed calculated? How does the slope of a distance versus time graph change as the speed changes?/ ¿Cómo se calcula la velocidad media? ¿Cómo funciona la pendiente de una distancia frente a cambio gráfico en tiempo como los cambios de velocidad?

Explore:

- Investigation 2: Speed, Part 3: Measuring Time, *FOSS Force and Motion Teacher Guide*. **Using stopwatches and the Dotcar, the class investigates the variable of ramp height on the speed of a car**. Students run cars down ramps, collect time and distance data, and use those data to calculate average speed and generate speed graphs. Students discover that the slope of the distance versus time graph line is related to speed, the steeper the slope, the faster the speed.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.
  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.
  *W.2.2.e. Write brief summaries of information gathered through research.

- Students read and discuss "How Fast Do Things Go?" Page 7 to 10 in the *FOSS Force and Motion Resource* Book. Students write a short summary in the notebooks.
  *R.2.11.a. Respond to stories and informational texts that are heard.
  *R.3.10.c. Locate evidence to support an argument or a conclusion.

- Students read and discuss Calculating Speed, pages 10 and 11, in *Prentice Hall Science Explorer: Motion, Forces, and Energy* textbook. Students record in their notebooks how to calculate average speed.
  *R.2.11.a. Respond to stories and informational texts that are heard.

Explain:

- Speeding Down Slopes, page 23 in the FOSS Force and Motion Lab Notebook. Students should work as individuals.

- If the students need more practice calculating average speeds, have them do Average Speed Practice, pages 24 to 25 in the Lab Notebook.

Evaluate:

- Mid-Summative Exam 2, page 488-490, in *FOSS Force and Motion Teacher's Guide*. Students should work as individuals.

Guiding Questions: How can you tell the speed of an object from a graph of distance-versus-time?/ ¿Cómo puede saber la velocidad de un objeto a partir de un gráfico de distancia-contra-tiempo?

Engage:

- Ask students if they know how fast they can run and how fast they can walk? Ask students to work together to develop a plan for determining the walker's speed and the runner's speed.

Explore:

- Investigation 3: Comparing Speed, Part 1: Walk/Run Race, page 111 to 118, *FOSS Force and Motion Teacher Guide*. Students time a walker and a runner over a known distance to determine their average speeds. (See page 26 in the lab notebooks).

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.

  *W.2.2.e. Write brief summaries of information gathered through research.

- Students make and use graphs to design a race so the walker and runner finish at the same time.

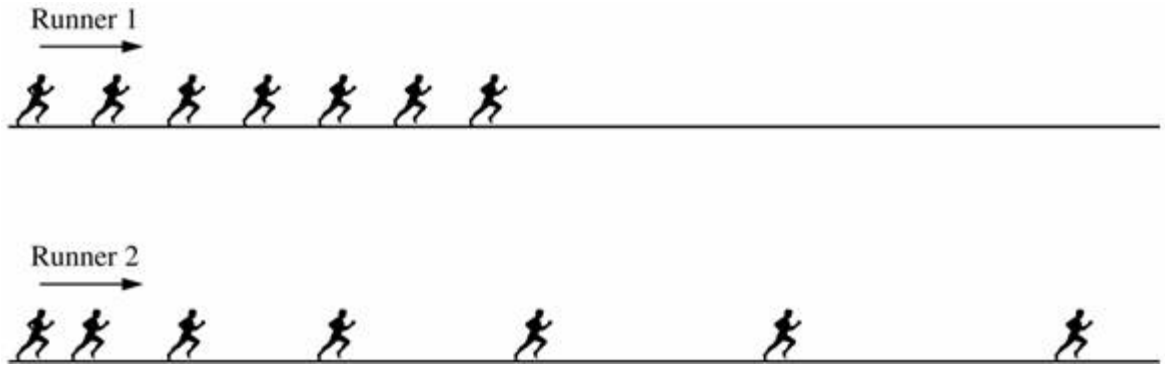
  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.

- Students move to computers **(this activity should be done in a computer lab if possible so that all students can share the photo-finish experience at the same time)** for practice using speed graphs to engineer races in which two competitors that run at different speeds finish in a tie—a photo finish.

- Students read and discuss "graphing Motion", pages 14 to 15, in *Prentice Hall Science Explorer: Motion, Forces, and Energy* textbook. Students should record that the steeper the slope the faster the speed, and that if the slope is zero then the object is not moving.

*R.2.11.a. Respond to stories and informational texts that are heard.
*W.2.2.e. Write brief summaries of information gathered through research.

Evaluate: Students should work as individuals.
*R.5.5.a. Identify facts in a text to answer the reader's or other questions.



The picture above shows the positions of two runners at one-second intervals as they move from left to right. For each runner, indicate whether the runner's speed seems to be constant, increasing, or decreasing. Explain how you can tell this from the pictures.

Guiding Questions: How can the speed of an object be determined from a graph of distance versus time?/¿Cómo puede la velocidad de un objeto determinado de una gráfica de la distancia en función del tiempo?

Explore:

- Investigation 3: Comparing Speed, Part 2: Boat Races, pages 119 to 124, *FOSS Force and Motion Teacher Guide*. Four boats travel different distances in different time intervals, see page 30 and 31 in the lab notebook. Students use calculation and graphing—four graphs on one grid—to seriate the four boats by speed. They solve other interesting problems involving moving at different speeds.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *S.3.29. Demonstrate comprehension of oral, multiple-step directions.
  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.
  *W.2.2.e. Write brief summaries of information gathered through research.

Explain:

- Response Sheet- Comparing Speeds, page 33 in the lab notebook. Students should work as individuals to respond to the conclusions reached by the two students in the scenario. See the scoring guide in the Assessment chapter, page 434 in the *FOSS Force and Motion Teacher Guide*.

  *R.3.10.c. Locate evidence to support an argument or a conclusion.

Engage:

- Ask if anyone has heard of the Iditarod and knows what it is. (See page 108 to 109 and page 126, in the *FOSS Force and Motion Teacher Guide)*. Discuss the Iditarod, an annual dog-sled race named for a small town in central Alaska.

- Students read and discuss the article "Iditarod: The Last Great Race on Earth", pages 11 to 16, in the *FOSS Force and Motion Resource* Book. Students use the **SQ3R Reading Method. SQ3R stands for Survey, Questions, Read, Recite, and Review.** (See the appendix and/or the following website for a SQ3R Chart). http://www.phs.princeton.k12.oh.us/Departments/literacy/strategies/pdf/SQ3R.pdf

  Survey: Read titles and subtitles. Notice words in special type. Skim illustrations, graphs, charts, maps. Review end of chapter questions and summaries.
  Question: Turn main topics and subtopics into 5W Questions – Who, What, When, Where, Why.
  Read: Read one section at a time looking for the answer proposed by your questions, highlighting main ideas and taking notes.
  Recite: At the end of each section, take a moment to orally answer your questions, putting the answers in your own words.
  Review: Summarize your reading. Using your answers, write a short paragraph summary.

  *R.2.11.a. Respond to stories and informational texts that are heard.
  *R.3.10.c. Locate evidence to support an argument or a conclusion.

Explore:

- Investigation 3: Comparing Speed, Part 3: Iditarod, page 124 to 127, *FOSS Force and Motion Teacher Guide*. Students study a simplified record of the 1986 Iditarod dog-sled race to determine average speeds for the winning team, see page 35 in the lab notebook.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *W.2.2.e. Write brief summaries of information gathered through research.

- Show the Video *Sled Dogs: An Alaska Epic* (in the FOSS Force and Motion kit). Have a class discussion about the video with students.

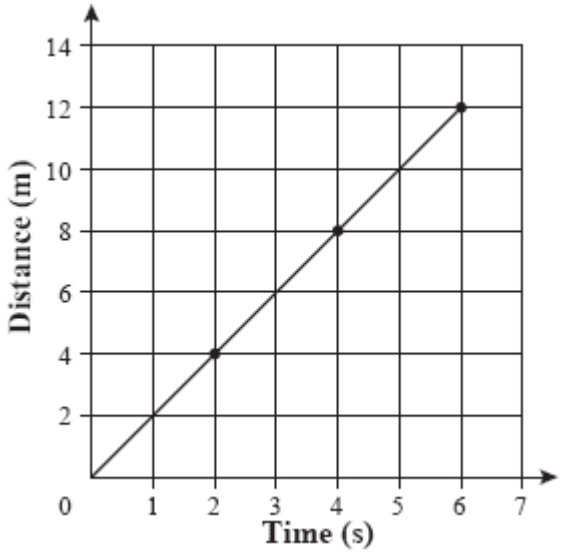
Evaluate:

- Mid-Summative Exam 3, page 491-493, in FOSS Force and Motion Teacher's Guide. Students should work as individuals.

(MCAS released questions)

*R.5.5.a. Identify facts in a text to answer the reader's or other questions.

Q. The graph below relates distance to time for a rolling ball. (PS #12)



What is the average speed of the ball?

A. 2 m/s

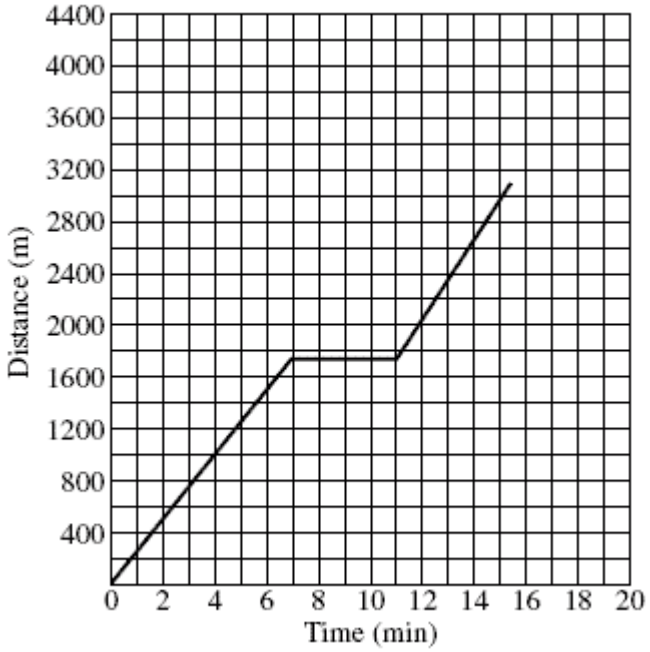
B. 6 m/s

C. 8 m/s

D. 72 m/s

Q. The graph below relates distance to time for a jogger on a morning run. (PS #12)

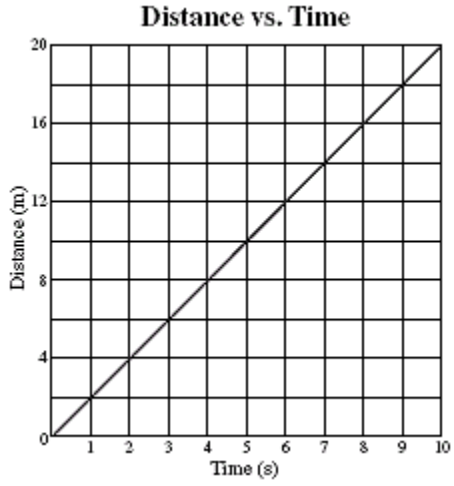
Distance vs. Time



Juan is on a morning jog. His speed is represented in the graph.

a. At what rate of speed is Juan running between 4 min and 6 min?
b. According to this graph, what can you tell about Juan's motion between 7 min and 11 min?
c. If Juan had maintained the same speed as in the first 7 min, how long would it have taken him to run 3000 m? Explain your answer.

Q. The graph below relates distance and time for a moving object.



What is the speed of the object represented by the graph above?

A. 0.5 m/s

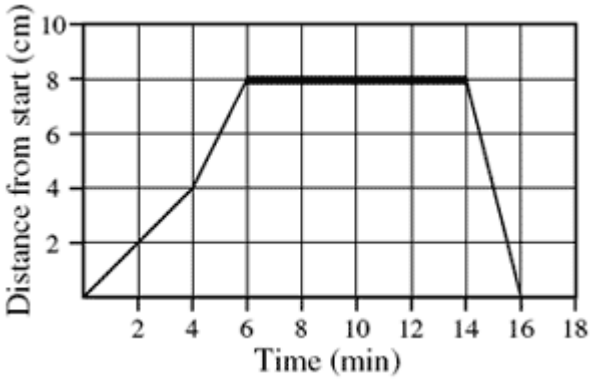
B. 2 m/s

C. 10 m/s

D. 20 m/s

Q. The graph below shows a beetle's movement along a plant stem. (PS #11 and 12)

Beetle's Movement Along A Plant Stem



During which span of time was the beetle **not** moving?

A. from 0 to 4 minutes

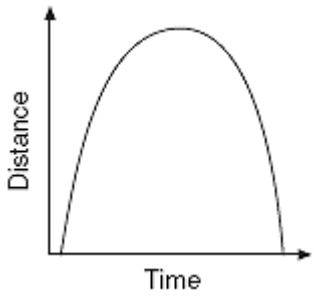
B. from 4 to 6 minutes

C. from 6 to 14 minutes

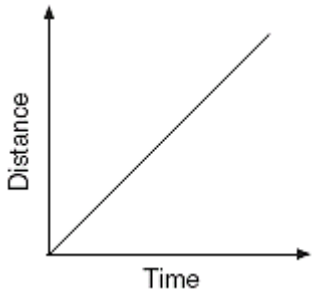
D. from 14 to 16 minutes

Q. Which of the following graphs represents a train moving at constant speed? (PS #12)

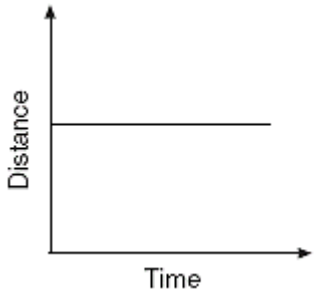
A.



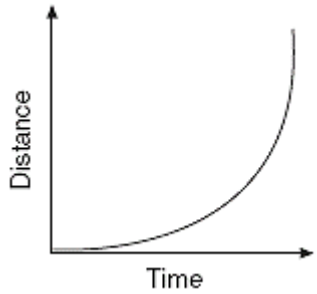
B.



C.



D.



Books about Motion:

Science Alive: Moving Things

Author: Robin Kerrod
Publisher: Silver Burdett Press, 1987
Grade Level: 3-5
Synopsis:
A book filled with illustrations and knowledge of the different aspects of motion, friction, and force. Along with these topics there are light, color, and electricity. This is a well orchestrated book for students who want to understand motion. At the end of the book there are activities for students to participate in and learn from.

The Science Book of Energy

Author: Neil Ardley
Publisher: San Diego, Gulliver Books, Harcourt Brace Jovanovich, Publishers, 1992
Grade Level: 3-5
Synopsis:
This well-illustrated text gives students the opportunity to do hands on activities about motion and energy.

Making Things Move

Author: London, Franklin Watts, 1984
Publisher: Neil Ardley
Grade Level: 3-6
Synopsis:
This well illustrated book gives students hands on experiences with motion, using simple items from home. It is a must for your science lab on movement.

Super Motion

Author: Philip Watson
Publisher: New York, Lothrop, Lee & Shepard Books, 1982
Grade Level: 3-8
Synopsis:
An easy formatted book to read and experience. The illustrations are easily interpreted and it is a fun book for hands on activities about motion.

Which Way Is Up

Author: Gail Kay Haines
Publisher: New York, Atheneum, 1987
Grade Level: 5-8
Synopsis:
Each page of this book discusses a different aspect of motion, gravity, calculus, etc. It's like every page is its own poster with an explanation of how the scientists of the past affects the work of our scientists today.

Force and Motion

Author: Peter Lafferty
Publisher: New York, Darling Kindersley, Inc., 1992
Grade Level: 6-Adult
Synopsis:
A beautiful book on motion and force, well written with fabulous photographs and illustrations. Its format is so well done that you want to turn the page to see what is next.