SPEED 5th Grade

Kristin Herderich

Kallen Molnar

Lesley Righetti

OAKLAND UNIVERSITY

MATEE 11

TD 513: Teaching Elementary & Middle School Science

Speed

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Speed

Unit Overview

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Unit Cover Page

Unit Title: Speed **Grade Level**: 5

Subject Content and Topic Area(s): Physical Science

Key Words:
Critically Important: Change of Direction, Change of Motion, Change of Speed, Graph, Relative Position, Constant Speed, Direction of Motion, Speed
Instructionally Useful: Acceleration, Deceleration, Velocity

Designed By: Lesley Righetti, Kallen Molnar and Kristin Herderich **Time Frame:** 11 Weeks

School District: ROCHESTER **School**: NORTH HILL ELEMENTARY

Brief Summary of Unit:

Scientific Inquiry

K-7 Standard S.IP: *Develop an understanding that scientific inquiry and reasoning involves observing, questioning, investigating, recording, and developing solutions to problems.*

S.IP.M.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

S.IP.05.11 Generate scientific questions based on observations, investigations, and research.

S.IP.05.12 Design and conduct scientific investigations.

S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.

S.IP.05.14 Use metric measurement devices in an investigation.

S.IP.05.15 Construct charts and graphs from data and observations.

Inquiry Analysis and Communication

K-7 Standard S.IA: *Develop an understanding that scientific inquiry and investigations require analysis and communication of findings, using appropriate technology.*

S.IA.M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.

S.IA.05.12 Evaluate data, claims, and personal knowledge through collaborative science discourse.
S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

Reflection and Social Implications

K-7 Standard S.RS: *Develop an understanding that claims and evidence for their scientific merit should be analyzed. Understand how scientists decide what constitutes scientific knowledge. Develop an understanding of the importance of reflection on scientific knowledge and its application to new situations to better understand the role of science in society and technology.*

S.RS.M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations. Reflecting on knowledge requires careful analysis of evidence that guides decision-making and the application of science throughout history and within society.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments, and data.
S.RS.05.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

Physical Science Content Standards

K-7 Standard P.FM: Develop an understanding that the position and/or motion of an object is relative to a point of reference. Understand forces affect the motion and speed of an object and that the net force on an object is the total of all of the forces acting on it. Understand the Earth pulls down on objects with a force called gravity. Develop an understanding that some forces are in direct contact with objects, while other forces are not in direct contact with objects.

P.FM.M.4 Speed – Motion can be described by a change in position relative to a point of reference. The motion of an object can be described by its speed and the direction it is moving. The position and speed of an object can be measured and graphed as a function of time.

P.FM.05.41 Explain the motion of an object relative to a point of reference.
P.FM.05.42 Describe the motion of an object in terms of distance, time and direction, as the object moves, and in relationship to other objects.
P.FM.05.43 Demonstrate how motion can be measured and represented on a graph.

Math Connection:

D.RE.05.01 Read and interpret line graphs, and solve problems based on line graphs, e.g. distance - time graphs, and problems with two or three line graphs on same axes, comparing different data.
D.RE.05.02 Construct line graphs from tables of data; include axis labels and

scale.
D.AN.05.03 Given a set of data, find and interpret the mean (using the concept of fair share) and mode.
M.UN.05.04 Convert measurements of length, weight, area, volume, and time within a given system using easily manipulated numbers.

Physical Education Connection:
M.MS.05.02 demonstrate mature form of locomotor skills of walk, run, leap, slide, gallop, hop, skip, flee, and dodge using movement concepts in controlled settings.
A.AN.05.04 utilize physiological indicators associated with moderate to vigorous physical activity (e.g., sweating, increased heart rate, increased respiration, palpating pulse) to adjust participation/effort in controlled settings.

Writing Connection:
W.PR.05.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.
W.PR.05.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., role and relationships of characters, settings, ideas, relationship of theory/evidence, or compare/contrast).
W.PR.05.05 proofread and edit writing using grade-level checklists and other appropriate resources both individually and in groups.
W.GN.05.04 use the writing process to produce and present a research project; use a variety of resources to gather and organize relevant information into central ideas and supporting details for a teacher-approved narrowed focus question and hypothesis.

Big Ideas:

- ✓ Motion is described relative to something else (point of reference).
- ✓ A change in motion is due to unbalanced forces.
- ✓ No change in motion and an object at rest are due to balanced forces.
- ✓ Construct and analyze graphs of motion.
- ✓ Given a point of reference describe motion in terms of speed, distance, time and direction.

Michigan Department of Education. (2010). 5-7 Science grade level content expectations companion document. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/5-7_Science_GLCE_Companion_Document_v.1.09_2_264472_7.pdf
Michigan Department of Education. (2010). Fifth grade science grade level content expectations. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/Complete_Science_GLCE_12-12-07_218314_7.pdf

Background Information

Students will participate in an in-depth study of motion as related to a point of reference, distance, time, and direction. Their exploration into motion also presents high interest content for students to hone skills in metric measurement and the use of tools and equipment appropriate to scientific investigations. The elementary school experience of investigating balanced and unbalanced forces, and their relationship to the size of change in motion, provide concrete experiences on which a more comprehensive understanding of force can be based at the middle school level. Students can move from qualitative descriptions of moving objects in the early elementary grades to quantitative descriptions of moving objects and the identification of the forces acting on the objects.

The completion of the study in motion involves the exploration and identification of contact and non-contact forces and how they change the motion of objects. Students' everyday experiences in motion lead them to believe that friction causes all moving objects to slow down and stop. In-depth explorations into reducing the force of friction can help the students understand and demonstrate that a moving object requires friction to keep it moving. The understanding of objects at rest requires the students recognize that there are balanced forces in equilibrium, such as a book on a table or chair on the floor. (MDE, Fifth pg. 51)

- ✓ Motion is relative to something else (point of reference). (MDE, 5-7 pg. 7)
- ✓ A point of reference offers all observers a common frame through which to judge motion and its changes. A point of reference is the point from which movement is determined. (MDE, 5-7 pg. 7)
- ✓ Speed is the ratio of distance covered per unit of time, S=D/T. (MDE, 5-7 pg. 7)
- ✓ An object's motion can be described in terms of speed and direction. (MDE, 5-7 pg. 7)
- ✓ The term distance describes amount of space between two things or points. Distance is measured in millimeters, centimeters, meters, and kilometers. (MDE, 5-7 pg. 8)

Michigan Department of Education. (2010). Fifth grade science grade level content expectations. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/Complete_Science_GLCE_12-12-07_218314_7.pdf

Michigan Department of Education. (2010). 5-7 Science grade level content expectations companion document. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/5-7_Science_GLCE_Companion_Document_v.1.09_2_264472_7.pdf

Misconceptions

Misconception #1: Smaller objects will go faster and larger objects will go slower.

Misconception #2: Students do not see motion as belonging to a number of different categories – at rest, constant velocity, speeding up, slowing down, changing direction, etc. Instead, they see motion as moving or not moving. (Driver)

Misconception #3: If the speed is increasing than acceleration is also increasing. (Driver)

Misconception #4: Speed and velocity are the same thing. (Common)

Common Student Misconceptions. (2013). In *Ohio Resource Center*. Retrieved January 27, 2013, from http://www.ohiorc.org/pm/science/SciCDMisconceptions.aspx?cid=5

Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (1994). Making sense of secondary science: Research into children's ideas. In *Misconceptions about Motion*. Retrieved January 27, 2013, from http://www.physicsfirstmo.org/files/Misconceptions.pdf

Pacing Guide

Week 1					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Pre-Test	How Fast is Fast?	How Fast is Fast?	How Fast is Fast?	How Fast is Fast?
GLCE's:	n/a	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43

Week 2					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	How Fast is Fast?	How Fast is Fast?	How Fast is Fast?	How Fast is Fast?	How Fast is Fast?
GLCE's:	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43

Week 3					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	How Fast is Fast?	Understanding the Relationship between Speed, Distance, and Time	Understanding the Relationship between Speed, Distance, and Time	Understanding the Relationship between Speed, Distance, and Time	Locomotor Movements and Their Effects on Heart Rate
GLCE's:	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.41 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.13 S.RS.05.11 D.RE.05.01 D.RE.05.02 D.AN.05.03 M.UN.05.04 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.13 S.RS.05.11 D.RE.05.01 D.RE.05.02 D.AN.05.03 M.UN.05.04 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.14 S.IP.05.15 S.IA.05.13 S.RS.05.11 D.RE.05.01 D.RE.05.02 D.AN.05.03 M.UN.05.04 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.43 M.MS.05.02 A.AN.05.04 D.RE.05.01 D.RE.05.02

Week 4					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Locomotor Movements and Their Effects on Heart Rate	Locomotor Movements and Their Effects on Heart Rate	K'NEX in Motion - Engage	K'NEX in Motion- Engage	K'NEX in Motion - Explore
GLCE's:	S.IP.05.12 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.43 M.MS.05.02 A.AN.05.04 D.RE.05.01 D.RE.05.02	S.IP.05.12 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.IA.05.13 S.RS.05.11 P.FM.05.43 M.MS.05.02 A.AN.05.04 D.RE.05.01 D.RE.05.02	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15

Week 5					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	K'NEX in Motion - Explore	K'NEX in Motion - Explain	K'NEX in Motion - Explain	K'NEX in Motion - Elaborate	K'NEX in Motion - Elaborate
GLCE's:	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15

Week 6					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	K'NEX in Motion - Explore	K'NEX in Motion - Explain	K'NEX in Motion - Explain	K'NEX in Motion - Elaborate	K'NEX in Motion - Elaborate
GLCE's:	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15

Week 7					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	K'NEX in Motion - Elaborate	K'NEX in Motion – Elaborate/Eval	K'NEX in Motion - Evaluation	K'NEX in Motion - Evaluation	Research Paper
GLCE's:	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	P.FM.05.41 P.FM.05.43 S.IP.05.11 S.IP.05.13 S.IP.05.15 S.IA.05.11 S.RS.05.15	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41

Week 8					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Research Paper	Research Paper	Research Paper	Research Paper	Research Paper
GLCE's:	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41	W.PR.05.01 W.PR.05.02 W.PR.05.05 W.GN.05.04 P.FM.05.41

Week 9					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Fieldtrip	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts
GLCE's:		S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43

Week 10					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts
GLCE's:	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43

Week 11					
	Monday	Tuesday	Wednesday	Thursday	Friday
Activity/ Lesson Name:	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Effects of Racecar Seatbelts	Post Test	Post Test due on Monday
GLCE's:	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	S.IP.05.12 S.IP.05.13 S.IA.05.11 S.IA.05.12 S.IA.05.13 S.RS.05.11 P.FM.05.42 P.FM.05.43	n/a	n/a

Parent Letter

Speed

Dear Parents/Guardians,

We are starting a six-week unit on speed. During this unit, our class will be participating in numerous inquiry based science lessons and activities to help each student enhance their ability to think through different questions and experiments. We want to maximize student involvement and understanding though hands-on instruction.

As you know a collective collaboration between students, teachers, and parents is necessary to insure your children are successful. During this unit I ask that you remain involved. This can be accomplished simply by having your child explain what they are learning each day or by asking them to restate the different experiments we are currently doing. Periodically asking different speed related questions or discussing current events related to speed can also be helpful. Information on our unit and different facts about speed can be found posted on our classroom web page. Feel free to post questions or new discoveries on our newly started Speed forum!

If anyone would like to volunteer or if you have any experience related to this unit you would like to share, please do not hesitate to contact me. We are also looking for at least 2-3 volunteers to accompany us on our class field trip to Discount Tire. The more involvement parents have the better for the students.

I am looking forward to exploring this unit with the class over the next few weeks. If you have any questions or would like more information please feel free to contact me at kal.mich@gmail.com or call (734)-845-4430. Attached are different student resources that are extremely helpful in learning more about this unit.

Student Resources

Speed Games:

http://www.brainpop.com/science/motionsforcesandtime/distancerateandtime/preview.weml

Information about Speed Machines:

http://www.pbs.org/wgbh/nova/barrier/machines.html

Mechanics and Motion Information:

http://www.physics4kids.com/files/motion_intro.html

Speed Topic Resources:

http://www.scilinks.org/Harcourt_Hsp/HspStudentRetrieve.aspx?Code=HSP508

Design a Rollercoaster:

http://www.learner.org/interactives/parkphysics/coaster/

Sincerely,

Kal Michigan
5th Grade Science Teacher

Field Trip

Name:

Community Resource Information Sheet

Site/Speaker: Discount Tire

Street Address: 3809 South Rochester Road

City, State, Zip: Rochester Hills, MI, 48307

Telephone: (248) 844-8294

Web Site/Email: www.discounttire.com

Field Trip Information

Description: Our 5th grade classroom will visit a local tire shop to help learn about Speed. Discount Tires is a national company that specializes in automobile tires and have numerous experts and mechanics working for them. We will visit Discount Tire during the school day to have a short lecture/discussion on how speed is affected by pressure, temperature, and tire width. This will be followed by different visuals and examples by the employees of Discount Tire.

Objective/Purpose of the Field Trip: This field trip will utilize the information provided by the employees of Discount Tire Company. The tires of a vehicle play a crucial role in the speed of the vehicle. There are numerous variables relating to tires that will greatly affect the speed of the car. Working with tire mechanic and experts will help our students make the connections between what we are learning about in our unit and how this affects our daily lives.

Fees: N/A

Advance Notice Required: Yes

Age Group Range/Limits: 4th-12th grade

Available Times: Mon-Fri 10AM-1:30PM

Group Size Limit: 20-35 students

Length of Tour: 1-2 hours

Guides Available: Yes

Dining Facilities: No

Restroom Facilities: Yes

Adult/Student Ratio Required: 10-1

Miscellaneous Information/Notes: If students would like to bring snacks or food there will be a break provided.

North Hill Elementary School -Field Trip Permission Form

To the Parent(s)/Guardian of:

_____

The science class, under the supervision of _____ will be taking a Field Trip To: Discount Tire

Address: 3809 South Rochester Road, Rochester Hills, MI 48307

Date: _____ Departing: _____ Returning: _____

My child _____ has permission to attend the above field trip. I authorize any medical treatment in case of an emergency, and agree that I am responsible for the cost of such treatment. Current Medical Information:

Ins._____ Policy #_____

Special Health Concerns:

_____

_____

During this field trip, in the event of emergency, I can be reached at (phone #)

_____

Alternative contact: _____

(Name, Phone Number)

I agree to release, hold harmless and indemnify North Hill Elementary, its agents, representatives and employees from any and all liability, loss, damages, claims or actions for bodily injury and/or property damage arising out of participation in this trip, in accordance with current state and federal law.

Parent/Guardian Signature_____ Date: _____

Please return signed form no later than: _____ Fax # (248) 203-7335

(Date)

This signed form must be submitted for the student to participate in this field trip.

Teacher Resources

Michigan Department of Education. (2010). Fifth grade science grade level content expectations. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/Complete_Science_GLCE_12-12-07_218314_7.pdf

Michigan Department of Education. (2010). 5-7 Science grade level content expectations companion document. Retrieved January 26, 2013, from http://www.michigan.gov/documents/mde/5-7_Science_GLCE_Companion_Document_v.1.09_2_264472_7.pdf

Lesson Plans Using K'Nex Related to Speed:
http://www.knex.com/Educators/

Exploration of Speed Lesson:

http://www.teach-nology.com/lessons/lsn_pln_view_lessons.php?action=view&cat_id=9&lsn_id=25570

Balloon Race Car Lesson on Speed:

http://www.middleschoolscience.com/balloonracers.htm

Student Resources

Speed Games:

http://www.brainpop.com/science/motionsforcesandtime/distancerateandtime/preview.weml

Information about Speed Machines:

http://www.pbs.org/wgbh/nova/barrier/machines.html

Mechanics and Motion Information:

http://www.physics4kids.com/files/motion_intro.html

Speed Topic Resources:

http://www.scilinks.org/Harcourt_Hsp/HspStudentRetrieve.aspx?Code=HSP508

Design a Rollercoaster:

http://www.learner.org/interactives/parkphysics/coaster/

Assessments

IN THIS SECTION:

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- Unit Pre-Test Answer Key.....26
- Unit Post-Test.....29
- Unit Post-Test Rubric.....30

Unit Pre-Test

Short Answer-

1. Name as many different types of speed that you can?

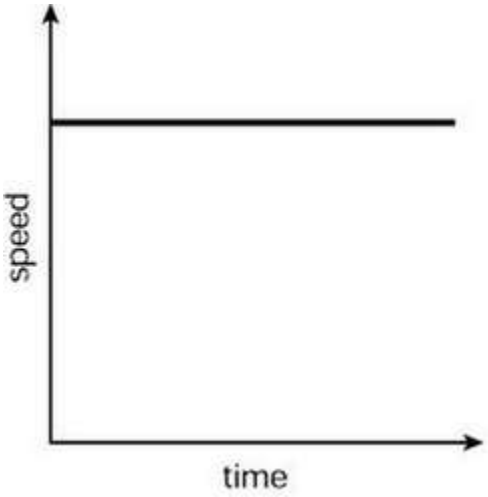
2. How do you use speed on a daily basis?

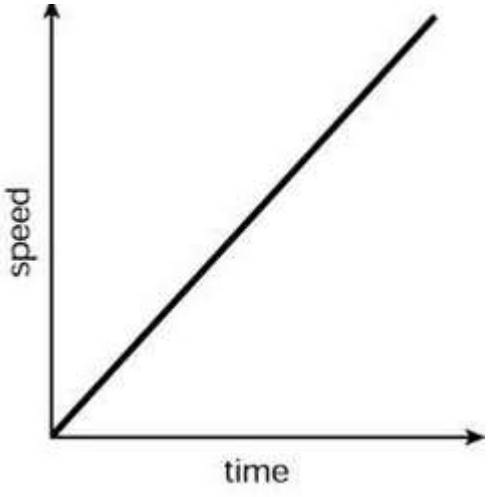
3. What is the difference between speed and velocity?

4. Tell me everything you know about speed in relation to distance and time.

Graphs-

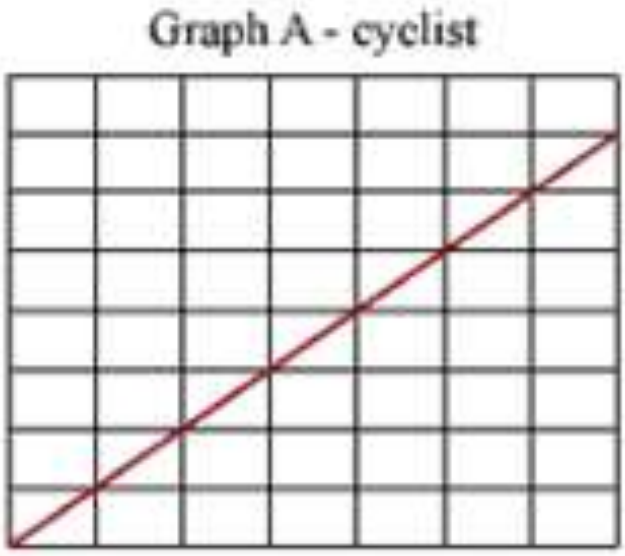
What do the following graphs represent?





_____ _____

If the average speed of a cyclist is 10 km/hr, label the following graph appropriately:



<u>Define the following terms:</u>

Speed: _____

_____

Change of Direction: _____

_____

Change of Motion: _____

_____

Change of Speed: _____

_____

Relative Position: _____

_____

Constant Speed: _____

_____

Direction of Motion: _____

_____

Acceleration: _____

_____

Velocity: _____

_____

Deceleration: _____

_____

Average Speed: _____

_____

Point of Reference: _____

_____

An airplane is flying at a speed of 170 meters per second (m/s) relative to the ground. A flight attendant is walking at a speed of 2 meters per second to the rear of the plane. Relative to the ground, what is the speed of the flight attendant?

Train A is moving west at 10 mph and collides with train B moving east at 30 mph. What speed and direction will Train A move immediately after the collision?

Unit Pre-Test Answer Key

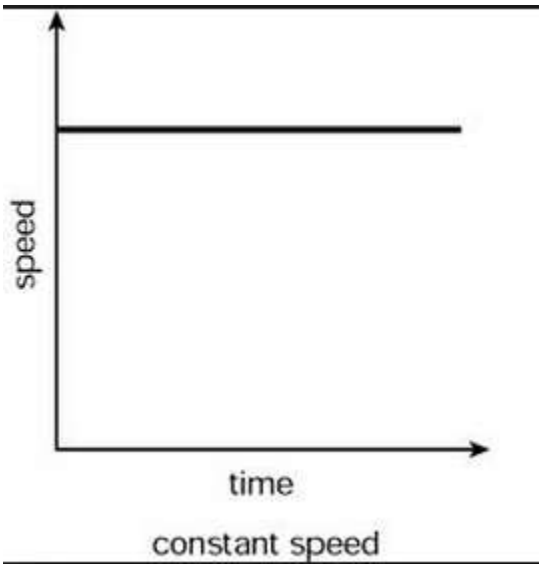
Short Answer-
Name as many different types of speed that you can?

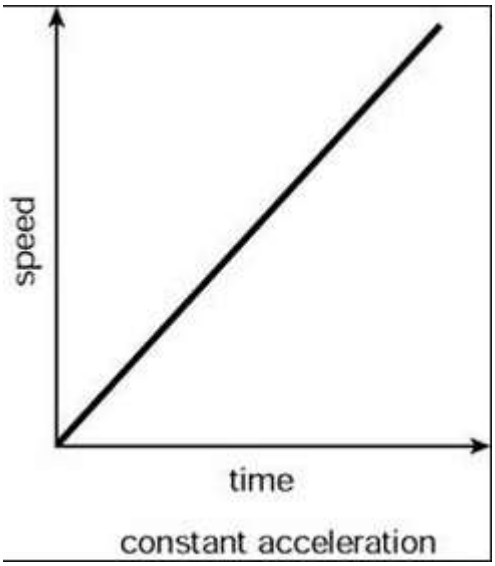
How do you use speed on a daily basis?

What is the difference between speed and velocity?

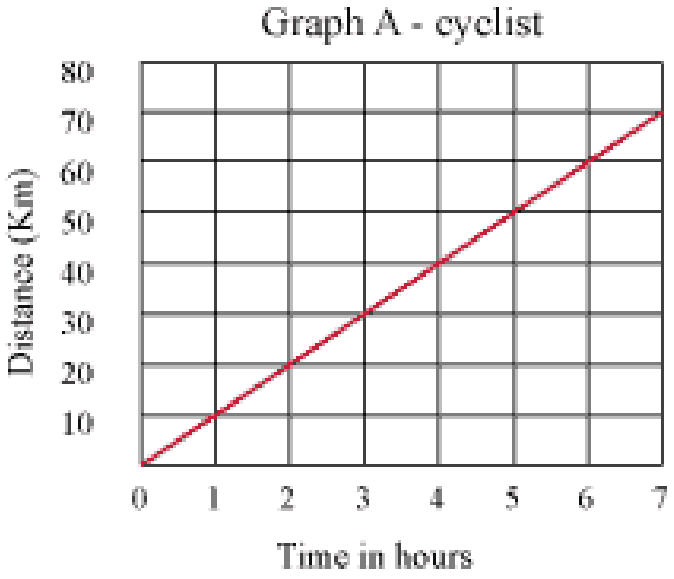
Tell me everything you know about speed in relation to distance and time.

Graphs-
What do the following graphs represent?





If the average speed of a cyclist is 10 km/hr, label the following graph appropriately:



Define the following terms:

Speed- Distance travelled per unit time.

Change of Direction- the act of **changing** the **direction** in which something is oriented.

Change of Motion- A change in position compared to the starting location, which happens over a period of time.

Change of Speed-

Relative Position-

Constant Speed- Distance travelled per unit time at a constant rate.

Direction of Motion-

Acceleration- the change in velocity, per unit time.

Velocity- is a vector measurement of the rate and direction of motion or, in other terms, the rate and direction of the change in the position of an object.

Deceleration- A negative acceleration is called a deceleration.

Average Speed- The average speed of a vehicle is calculated over the whole distance and time of the journey.

Point of Reference- A point that does not change; is used to calculate from.

An airplane is flying at a speed of 170 meters per second (m/s) relative to the ground. A flight attendant is walking at a speed of 2 meters per second to the rear of the plane. Relative to the ground, what is the speed of the flight attendant?

168 m/s

Train A is moving west at 10 mph and collides with train B moving east at 30 mph. What speed and direction will Train A move immediately after the collision?

20 mph east

Some questions adapted from:

http://www.scribd.com/doc/41454492/5th-Grade-Measure-Change-in-Motion

Unit Post-Test

Tic-Tac-Toe Menu
Speed

Directions: Choose activities in a Tic-Tac-Toe design. When you have completed the activities in a row – horizontally, vertically, or diagonally, you may choose to be finished. Or you may decide to complete more activities. Star the activities you plan to complete. Color in the box when you finish the activity.

Select 3 examples from movies or television where the concept of Speed is unrealistically portrayed and write a one-page summary and what you found. **(P.FM.05.41)** **(S.RS.05.12)**	Research the Speed of 5 different types of Boats. Create a bar graph comparing/contrasting the differences and present it to the class. **(P.FM.05.43)** **(S.IP.05.15)**	Write a song about Speed and perform it for the class. **(P.FM.05.41)** **(S.RS.05.15)**
Interview a representative from a local Speed Awareness Program and present your findings to your classmates. **(P.FM.05.41)** **(S.RS.05.19)**	YOUR CHOICE Think of your own way to demonstrate the knowledge in this chapter. Check with me before you begin.	Research 3 animal's maximum speeds and create a poster comparing them to the maximum speed a human runner. **(P.FM.05.43)** **(S.IA.05.13)**
Design and conduct a scientific experiment on Speed. Present your experiment and findings to the class. **(P.FM.05.42)** **(S.IP.05.12)**	Compare how fast cars are going on a road with the posted speed limited. You must construct an experiment to measure how fast the cars are going. **(P.FM.05.42)** **(S.IP.05.12)**	Research how a Policeman's Radar gun calculates speed and write a short paragraph about how it works. **(P.FM.05.41)** **(S.IA.05.13)**

Unit Post-Test Rubrics

Select 3 examples from movies or television where the concept of Speed is unrealistically portrayed and write a one-page summary and what you found Rubric

P.FM.05.41
S.RS.05.12

	Possible Points	Points Earned
Student picks an appropriate movie or Television Show	**1**	
3 Examples of how speed is incorrectly used	**6**	
Examples are typed or neatly written in pen	**3**	
Total:	**10**	
Comments:		

Research the Speed of 5 different types of Boats. Create a bar graph comparing/contrasting the differences and present it to the class Rubric

P.FM.05.43
S.IP.05.15

	Points Possible	Points Earned
5 different types of Boats	**5**	
Bar Graphs correctly display the differences in speed	**10**	
Presentation to class	**5**	
Total:	**20**	
Comments:		

Research 3 animal's maximum speeds and create a poster comparing them to the maximum speed a human runner Rubric

P.FM.05.43
S.IA.05.13

	Points Possible:	Points Earned:
Student's research facts are correct	**6**	
Uses 3 different animals	**6**	
Student uses proper use of graphs	**6**	
Poster is colorful and creative	**2**	
Total:	**20**	
Comments:		

Interview a representative from a local Speed Awareness Program and present your findings to your classmates Rubric

P.FM.05.41
S.RS.05.19

	Possible Points:	Points Earned:
Interview of Representative	**10**	
Notes on Interview	**5**	
Presentation to class	**5**	
Total:	**20**	
Comments:		

Write a song about Speed and perform it for the class Rubric

P.FM.05.41
S.RS.05.15

	Possible Points	Points Earned
Song has accurate facts about speed	**5**	
Performance to class	**5**	
Total:	**10**	
Comments:		

Compare how fast cars are going on a road with the posted speed limited. You must construct an experiment to measure how fast the cars are going Rubric

P.FM.05.42
S.IP.05.12

	Points Possible	Points Earned
Construction of Experiment	**20**	
Performance of Experiment	**15**	
Presentation to class	**5**	
Total:	**40**	
Comments:		

Design and conduct a scientific experiment on Speed. Present your experiment and findings to the class Rubric

P.FM.05.42
S.IP.05.12

	Possible Points	Points Earned
Construction of Experiment	**20**	
Performance of Experiment	**15**	
Presentation to class	**5**	
Total:	**40**	
Comments:		

Research how a Policeman's Radar gun calculates speed and write a short paragraph about how it works Rubric

P.FM.05.41
S.IA.05.13

	Possible Points	Points Earned
Research	**5**	
Paragraph is typed or neatly written in pen	**5**	
Correct spelling and grammar	**5**	
Information is accurate	**5**	
Total	**20**	
Comments:		

Speed

5E Lesson Plans

IN THIS SECTION:

- How Fast is Fast?.....39
- K'NEX in Motion.....46
- Effects of Racecar Seatbelts.....50

How Fast is Fast?

Teacher: Lesley Righetti

Unit title / Lesson Title/ grade level: Speed/ How Fast is Fast? / 5th Grade

Benchmarks GLCE's for this lesson:

S.IP.05.12 Design and conduct scientific investigations.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
S.IP.05.14 Use metric measurement devices in an investigation.
S.IP.05.15 Construct charts and graphs from data and observations.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments, and data.

P.FM.05.41 Explain the motion of an object relative to a point of reference.
P.FM.05.43 Demonstrate how motion can be measured and represented on a graph.

Lesson objective(s):

SWBAT:

S.IP.05.12 Design a scientific investigation to analyze the speed of different items. (high)
S.IP.05.13 Demonstrate appropriate use of scientific instruments. (medium)
S.IP.05.14 Choose appropriate metric measurement devices to use during the experiment. (medium)
S.IP.05.15 Create appropriate data tables to display the data collected. (high)

S.IA.05.11 Examine the information from the graph created during the experiment. (medium)
S.IA.05.13 Explain the relationship between speed, distance and time. (low)

S.RS.05.11 Identify possible sources of error in the data collection from the experiment. (low)

P.FM.05.41 Report the motion of the cars in relation to each other from a point of reference. (low)
P.FM.05.43 Create a distance vs. time graph. (high)

Materials:

- ✓ Assorted toy cars (or balls- Anything that can be rolled down a ramp and across a floor may be used for this investigation.) The number of cars given to each team will depend on the number available and how much time can be devoted to the investigation. The more cars a team has, the more time it will take for students to collect their data.
- ✓ Measuring tapes, heavy cords, meter sticks of assorted sizes, as well as devices that would be inappropriate for measuring distance and time. A selection of these materials should be available, so students can make choices of which devices they will use to measure. The idea is to make students think about how to complete the task, not simply to follow the very specific directions that are given to them. They should determine which items are the best choices for the assignment that is given.
- ✓ Stop watch or other device to measure time (one per group).
- ✓ Ramp and object to be used to prop up one end of the ramp (one per team)
- ✓ Plastic race tracks from Hot Wheels® or similar toys are available, they may be used. If not, boards may be propped onto stacks of books. The playground slide may also serve this purpose. Save yourself some money, use what you have.
- ✓ Clipboards
- ✓ Pencils

Time needed to complete entire lesson : 10 Days

ENGAGEMENT: The Catch

- ✓ Read *What's Faster Than a Speeding Cheetah?* by Robert E. Wells
  Publisher: Albert Whitman & Company
  ISBN-10: 0807522813 and ISBN-13: 978-0807522813

- ✓ Watch video of cheetah running http://www.youtube.com/watch?v=S-zcA_mOa94&feature=endscreen&NR=1
- ✓ A discussion will follow, and the teacher will guide the students to the question, "What is speed?"

EXPLORATION: The Do

- ✓ Give students cars, balls anything that will roll down a ramp and have them experiment with the speeds of the different objects.
- ✓ Provide materials for ramps and have students predict which objects will

have the faster speed.
- ✓ Have students collect data for time and distance for one of the cars (should be the same for each group). Five trials should be taken for each group.

EXPLANATION: The Lesson

- ✓ Define speed, distance and time.
- ✓ Introduce $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$ equation.
- ✓ Watch video to reinforce how to calculate speed: http://www.youtube.com/watch?v=_nAKwhZyXnw
- ✓ Have student's complete Speed Machines Worksheet; review answers and answer questions.
- ✓ Students should then individually calculate the speed from the data collected for each trial.
- ✓ Average speed should be calculated and then compared with the group members before recording an average speed for their group on the board.
- ✓ Remind students of the 5 critical elements of a graph; title, scale, labels, points and line. (choral response is fine).
- ✓ Distance vs. Time graphs will then be individually created using the average speeds from the entire class (and individually evaluated eventually).
- ✓ Have students compare their distance vs. time graph with their group members.
- ✓ Create a Distance vs. Time graph for the class using the data for students to compare their graphs.

ELABORATION: The Enrich

- ✓ Students will work in teams to create an experiment testing a new quantifiable independent variable in relation to speed. Possible Independent Variables students may wish to investigate: Height of ramp, weight of car, length of ramp, etc…
- ✓ Students bring materials from home to test or create a list for the teacher to supply.
- ✓ Students complete additional testing on speed.
- ✓ Students construct data table of quantifiable analysis.
- ✓ Students graph their results using 5 critical elements of a graph.
- ✓ Students will write a qualitative analysis of data using speed differences.
- ✓ Students will present their findings to the rest of the class in graph form.

EVALUATION: The Proof

S.IP.05.12 *Design a scientific investigation to analyze the speed of different items. (high)*
Evaluation: Lab Design-Teacher will evaluate for appropriate elements of lab write up including hypothesis, problem, independent variable, dependent variable, constant variables, results and conclusion.

S.IP.05.13 *Demonstrate appropriate use of scientific instruments. (medium)*

Evaluation: Teacher observations during lab and lab write up.

S.IP.05.14 *Choose appropriate metric measurement devices to use during the experiment. (medium)*
Evaluation: Teacher observations during lab and lab write up; they will record length in meters, time in seconds, etc.

S.IP.05.15 *Create appropriate data tables to display the data collected. (high)*
Evaluation: Individual data tables include title, variables, measurable units, repeated trials and accurate data.

S.IA.05.11 *Examine the information from the graph created during the experiment. (medium)*
Evaluation: Individual lab write-up includes analysis of graphs, data analysis and conclusion. (is the speed constant?, is it accelerating?, decelerating?)

S.IA.05.13 *Explain the relationship between speed, distance and time. (low)*
Evaluation: Exit slips from class discussion, Speed Machines Worksheet, verbal description through presentation to classmates.

S.RS.05.11 *Identify possible sources of error in the data collection from the experiment. (low)*
Evaluation: Individual lab write-up includes identification of three possible sources of error.

P.FM.05.41 *Report the motion of the cars in relation to each other from a point of reference. (low)*
Evaluation: Individual lab write-up includes comparison of motion of objects tested during lab, did new variables affect the speed?

P.FM.05.43 *Create a distance vs. time graph for each set of data they collected in their experiment. (high)*

Evaluation: Individual lab write-up includes graphs of experiment results (using 5 critical elements of a graph).

Name _____

Speed Machines

FORMULA : SPEED = Distance ÷ Time

Round answers to the nearest tenth (one decimal place)!

1. NASCAR fans love race day when they get a chance to cheer on their favorite team! If a driver was able to travel 600 miles in 3 hours, what was his average speed?

2. The fastest car on Earth, a British-made *Thrust SSC*, would win every NASCAR race in America. If it takes 0.5 hours (30 minutes) to travel 380 miles, what is its speed?

3. The fastest train on Earth, the *TGV* from France, can travel at faster speeds than trains in the United States. During a speed test, the train traveled 800 miles in 2.5 hours. What is its speed?

4. *Spirit of Australia*, a hydroplane boat, made speed records by traveling 239 miles in 0.75 hours (45 minutes). What is its record-breaking speed?

5. The fastest plane ever made, the *Lockheed SR71*, was able to travel 2200 miles per hour. Based on this speed, how far could it travel in:

a. 2 hours? b. 3 hours? c. 5 hours?

Challenge:
Which machine on this page is the fastest? _____

6. Fill in the boxes and use a calculator to determine how long it would take each machine to get to travel 60 miles. Use the speeds you calculated in miles per hour on the front of this worksheet. Round answers to the nearest tenth (one decimal place)!

60 miles	÷		=		X	60 minutes	=	
		↑ Speed (mph)						

A. Jeff Gordon's Car = _____ minutes

B. *Thrust SSC* Car = _____ minutes

C. *TGV* Train = _____ minutes

D. *Spirit of Australia* Boat = _____ minutes

E. *Lockheed SR71* Airplane = _____ minutes

Speed Machine Answers:

1. 600 ÷ 3 = 200 mph

2. 380 ÷ .5 = 760 mph

3. 800 ÷ 2.5 = 320 mph

4. 239 ÷ .75 = 318.67 mph

5. a. 2200 x 2 = 4400 miles, b. 2200 x 3 = 6600 miles, c. 2200 x 5 = 11,000 miles

Challenge: Lockheed SR71

6. A. 18 minutes, B. 4.7 minutes, C. 11.3 minutes, D. 11.3 minutes, E. 1.6 minutes

Adapted from: http://sciencespot.net/Pages/classphys.html#Anchor-49575

http://wveis.k12.wv.us/teach21/public/iblp/GuideV.cfm?rtype=SSLP&tsele1=3&tsele2=104&upid=3610

K'NEX in Motion

Teacher: Kristin Herderich

Unit title / Lesson Title/ grade level: Speed/K'NEX In Motion/5th Grade

Benchmarks GLCE's for this lesson (not the entire unit):

P.FM.05.41 Explain the motion of an object relative to its point of reference.
P.FM.05.43 Illustrate how motion can be measured and represented on a graph.

S.IP.05.11 Generate scientific questions based on observations, investigations, and research.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
S.IP.05.15 Construct charts and graphs from data and observations.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.

S.RS.05.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

Lesson objective(s):

SWBAT:

P.FM.05.41 Explain the concepts of Speed and Motion
P.FM.05.41 Describe the relationship between speed, distance, and time
P.FM.05.43 Create a graph showing how speed can be measured

S.IP.05.11 Construct a K'NEX car that can go faster than the original u sing observation and research
S.IP.05.13 Design a K'NEX car using the appropriate tools and equipment
S.IP.05.15 Sketch a chart comparing the differences in speed

S.IA.05.11 Compare/Contrast the differences in speed using a graph or chart

S.RS.05.15 Recognize the differences in speed through K'NEX models and graphs

Materials:

- ✓ K'NEX Car kits for each group (http://www.knex.com/Shop/product.php?productid=16853)
- ✓ Meter/Yard sticks
- ✓ Stop watch
- ✓ Balloons
- ✓ String, paper clips, scissors, tape (things that can be used to hold objects to the car)
- ✓ Hand-held fans or small oscillating fans
- ✓ Different kinds of cloth/fabric
- ✓ Scrap paper
- ✓ Boards/Planks
- ✓ Cardboard
- ✓ Any random materials lying around

Time needed to complete entire lesson : 12 days

ENGAGEMENT: The Catch

- ✓ Show YouTube video "World's Fastest Cars in History" http://www.youtube.com/watch?v=dTVZqxAffCw
- ✓ Introduce Speed and define its meaning
- ✓ Talk about different objects in our everyday life that use speed to their advantage (i.e. what goes fast? Slow?)
- ✓ Explain the idea and concept of K'NEX
- ✓ Have students break into groups of 4 or 5 and build a car out of K'NEX
- ✓ The students will experiment/play with their cars around the room (pushing, pulling, etc.)

EXPLORATION: The Do

- ✓ Assemble students in same groups
- ✓ Students will determine how fast their car travels by using *speed = distance/time*
- ✓ Each group will use a meter/yard stick to measure the distance their car traveled
- ✓ Have the students use a stop watch to time how long it took their car to travel 4 meters
- ✓ The students will do this 5 -10 times and record it in a chart in their Science Notebook

EXPLANATION: The Lesson

- ✓ Have students share their results with the class
- ✓ Introduce the equation speed = distance/time and define speed, distance, and time
- ✓ Relate speed with Miles Per Hour
- ✓ Have students figure out the speed of each test they ran

- ✓ Students will average their speeds and write on board
- ✓ Show the students how to create a graph (bar and/or pie) using the data recorded on the board
- ✓ Demonstrate how to compare/contrast graphs using two different data from randomly chosen groups (this also reinforces how to create a graph)
- ✓ Answer any questions students might have and correct misconceptions about speed

ELABORATION: The Enrich

- ✓ Students will use other materials around the classroom to see what could make their car go faster
- ✓ The students will use different objects of their choice and measure the time it took their car to go 4 meters. They should do this approximately 5-10 times (it should be the same number of times as their first test). Times should be recorded in their Science Notebooks
- ✓ After the experiments and testing are complete, they will calculate the new speeds of their car using the distance formula. They will record these answers in their Science Notebooks
- ✓ Ask students what else they can use the speed formula for in real life. What real life lessons can they learn? Where do they see speed? (some answers may include: driving, airplanes, speed limits on roads, runners, NASCAR races, speed of a baseball, basketball, football, etc)
- ✓ New Variables can include, but are not limited to: Balloons, string, paper clips, scissors, tape (things that can be used to hold objects to the car), hand-held fans or small oscillating fans, different kinds of cloth/fabric, scrap paper, boards/planks, cardboard

EVALUATION: The Proof

Explain the concepts of Speed and Motion (P.FM.05.41)
Evaluation: students share original speed with class and through choral responses

Describe the relationship between speed, distance, and time (P.FM.05.41)
Evaluation: Exit Slips and averages of speed on white board

Create a graph showing how speed can be measured (P.FM.05.43)
Evaluation: Students will create a bar graph comparing their initial speeds with the final speeds of their car

Sketch a chart comparing the differences in speed (S.IP.05.15)
Evaluation: Evaluate the chart in their Science Notebooks

Construct a K'NEX car that can go faster using observation and research (S.IP.05.11)
Evaluation: Compare the data tables the students made in their Science Notebooks

Design a K'NEX car using the appropriate tools and equipment (S.IP.05.13)
Evaluation: Teacher observation through the construction process

Compare/Contrast the differences in speed using a graph or chart (S.IA.05.11)
Evaluation: Students will create a poster comparing the two speeds of their cars using a pie chart or bar graph. They will explain to the class the differences between the two speeds and why the second car went faster

Recognize the differences in speed through K'NEX models and graphs (S.RS.05.15)
Evaluation: Teacher observation during poster presentations

Adapted From: http://www.middleschoolscience.com/balloonracers.htm

Effects of Racecar Seatbelts

Teacher: Kallen Molnar

Unit title / Lesson Title/ Grade level:
Speed/ Effects of Racecar Seatbelts / 5th Grade

Benchmarks GLCE's for this lesson:

S.IP.05.12 Design and conduct scientific investigation.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigation.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
S.IA.05.12 Evaluate data, claims, and personal knowledge through collaborative science discourse.
S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments and data.

P.FM.05.42 Describe the motion of an object in terms of distance, time and direction, as the object moves and in relationship to other objects.
P.FM.05.43 Demonstrate how motion can be measured and represented on a graph.

Lesson objective(s):

SWBAT

S.IP.05.12 Design a scientific investigation to analyze the effects of speed during a car crash. (high)
S.IP.05.13 Demonstrate appropriate use of scientific instruments. (medium)

S.IA.05.11 Analyze the information from the graph created during the experiment. (medium)
S.IA.05.12 Discuss car accidents they have witnessed in movies, television shows, videos, or in real life. (low)
S.IA.05.13 Describe the relationship between speed, distance and time. (low)

S.RS.05.11 Identify possible sources of error in the data collection from the experiment. (low)

P.FM.05.42 Explain how a racecar works and moves in terms of its distance, time and direction in relation to other objects. (low)
P.FM.05.43 Create a distance vs. time graph. (high)

Materials:

- ✓ Assorted toy cars/matchbox cars or a small cart like vehicle. The number of cars/carts given to each group will vary depending on the size of each group and the amount of time available for each cars/carts experiment.
- ✓ Clay- this will be used to create their "people" or the drivers of the cars.
- ✓ Thin wire/thick wire/ribbon- this will be used to construct different types of seatbelts for their cars/carts.
- ✓ Wall space
- ✓ Pencils/Pens.
- ✓ Paper- used for recording information on each experiment as they are being conducted.
- ✓ Stop watch

Time needed to complete entire lesson : 12 Days

ENGAGEMENT: The Catch

- ✓ Students discuss car accidents they have witnessed in movies, television shows, videos, or in real life.
- ✓ Show students pictures of car crashes (both regular cars and racecars).
- ✓ Have students view videos of crash test dummies during automobile accidents:
  http://www.youtube.com/watch?v=ToAIpT-JJxo - Seatbelt
  http://www.youtube.com/watch?v=V2kO8AxKbrM – Seatbelt
- ✓ Class will discuss the situations seen in the videos and how seatbelt configurations affect the crash dummies.
- ✓ Have students brainstorm questions they have about car crashes relating to speed and what role seatbelts play.

EXPLORATION: The Do

- ✓ Students will form small groups to make clay figures for their "driver". All students will be given the same amount of clay so that mass is a constant variable. Students will place drivers on their cars/carts and construct seatbelts for them so they can be saved when they crash the cars/carts into the wall.
- ✓ Students will construct different types of seatbelts for their vehicles using different sizes and tension of the wires and ribbon. They will

crash their vehicles into the wall at different speeds by the amount of force used to push the cars. Students will be able to test differences in speed by using their stop watches to measure the distance covered in the amount of time for each trial.

- ✓ Students will see the difference between using thin wire during the crash and ribbon during the crash and see how different types of seatbelts affect the drivers differently. Students will not be able to combine the different types of seatbelt materials at this time, they will only be able to create their seatbelts from one material in order to test these materials individually and see how they react during the crash. (In the elaboration stage students will be able to combine materials in order to make operational and effective seatbelts).
- ✓ Students will create a data table to record each trial and the materials and variable's used for each trial. Students will measure time and distance and will record this in the data table. They will have to record what they used for a seatbelt, a design of the seatbelt (drawing a picture of this), the relative speed (fast or slow), and how much damage was done to their driver. They will be measuring the damage by seeing how much seatbelt cuts in to the clay "driver".

EXPLANATION: The Lesson

- ✓ Students will be given a name for the observations they have been making, Newton's First Law, which states that, "Objects at rest stay at rest; objects in motion stay in motion unless acted upon by force."
- ✓ Show students the actual seatbelts and materials used for cars and racecars.
- ✓ Students will discuss the types of seatbelts they created and how their materials compared to the actual materials. Students should be able to come to the conclusion that wider seatbelts inflict less damage. They should also be able to realize that a faster speed into the wall the more damage is inflicted. This can be used to introduce how pressure, area and force all relate to one another, pressure being the force per unit area.
- ✓ Teacher should direct the classes focus on speed and how one material can be used in a slow crash but in fast crash's cause damage. The discussion on materials will focus on the fact that when seatbelts stretch they slow down the acceleration of the driver.
- ✓ Students should list other variables that would affect the car, seatbelt and driver of the car and be able to design an experiment to test these new variables. These variables can include, weather conditions, size of driver, size of car, make of car, tire size/pressure, seatbelt material.

- ✓ Students will place their collected data on the board or something that can be viewed by the entire class.
- ✓ Have students compare their group's data to that of the rest of the groups.
- ✓ Students will create Distance vs. Time graphs for each of their groups and eventually each student will create their own lab write-up including this information.

Reinforcing with a Video:
http://www.youtube.com/watch?v=bZKoDd8unPQ –Seatbelt Strength

Discuss this video and how it relates to the lesson and experiments that the students completed. Have students comment on what they related to in the video and any questions they may have of what they saw in the clip.

ELABORATION: The Enrich

- ✓ Students will be challenged to build the best seatbelt for higher speed crashes as well as other possible variables (weight of driver, weather conditions, etc.)
- ✓ Students will test possible variables for each experiment such as weight of the person (clay driver bigger/smaller), the conditions (weather, rain, sludge, ice, etc.), larger/stronger seatbelts, or mixing together different materials to make the seatbelt.
- ✓ Students can either bring in new materials from home or use what is available from the classroom.
- ✓ Students complete the additional testing and experiments and record data (size of drivers, seatbelt materials used, weather conditions) from additional trials.
- ✓ Students will use larger coverage for their seatbelts because of what was discussed in explain stage. Each new seatbelt or variable will be tested in groups and the groups will explain to the class why they created their seatbelts the way they did and how the seatbelts changed the impacts of the crash.

EVALUATION: The Proof

S.IP.05.12 *Design a scientific investigation to analyze the effects of speed during a car crash. (high)*
Evaluation: Teacher will evaluate for appropriate elements of lab write-up including problem, independent variable, hypothesis, dependent variable, constant variables, results and conclusion.

S.IP.05.13 *Demonstrate appropriate use of scientific instruments. (medium)*
Evaluation- Teacher observations through lab, experiments and lab write-up.

S.IA.05.11 *Analyze the information from the graph created during the experiment. (medium)*
Evaluation- Individual lab write-up includes analysis of data tables and conclusion. (How fast are the cars going, what amount of damage is inflicted on driver, what type of seatbelt is used.)

S.IA.05.12 *Discuss car accidents they have witnessed in movies, television shows, videos, or in real life. (low)*
Evaluation- Teacher will evaluate through observation during class discussion and individual exit slips.

S.IA.05.13 *Describe the relationship between speed, distance and time. (low)*
Evaluation- Use individual exit slips from class discussion, verbal description during group presentations, and individual lab write-ups.

S.RS.05.11*Identify possible sources of error in the data collection from the experiment. (low)*
Evaluation- Individual lab write-ups include identification of possible sources of error.

P.FM.05.42 *Explain how a racecar works and moves in terms of its distance, time and direction in relation to other objects. (low)*
Evaluation- Individual lab write-ups will include students data information from additional experiments, group oral presentations, exit slips from class discussion.

P.FM.05.43 *Create a distance vs. time graph. (high)*
Evaluation- Students will create a distance versus time graph.

Adapted from:
http://edu360sciencemethods.wikispaces.com/file/view/BSCS7ERJ.pdf

Curriculum Connection Lesson Plans

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Mathematics Connection

Understanding the Relationship between Speed, Distance, and Time

Subject/Course: Science
Topic: Speed
Grade: 5th Grade
Designer: Lesley Righetti

Objective:

Established Goal(s):

S.IP.05.12 Design and conduct scientific investigations.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
S.IP.05.14 Use metric measurement devices in an investigation.
S.IP.05.15 Construct charts and graphs from data and observations.

S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments, and data.

Content Statement:

Mathematics:
D.RE.05.01 Read and interpret line graphs, and solve problems based on line graphs, e.g. distance - time graphs, and problems with two or three line graphs on same axes, comparing different data.
D.RE.05.02 Construct line graphs from tables of data; include axis labels and scale.
D.AN.05.03 Given a set of data, find and interpret the mean (using the concept of fair share) and mode.
M.UN.05.04 Convert measurements of length, weight, area, volume, and time within a given system using easily manipulated numbers.

Science:
P.FM.05.42 Describe the motion of an object in terms of distance, time and direction, as the object moves, and in relationship to other objects.
P.FM.05.43 Demonstrate how motion can be measured and represented on a graph.

SWBAT:
S.IP.05.12 Design a scientific investigation to analyze the speed of different items. (high)
S.IP.05.13 Demonstrate appropriate use of scientific instruments. (medium)
S.IP.05.14 Choose appropriate metric measurement devices to use during the experiment. (medium)
S.IP.05.15 Create appropriate data tables to display the data collected. (high)

S.IA.05.13 Explain the relationship between speed, distance and time. (low)

S.RS.05.11 Identify possible sources of error in the data collection from the experiment. (low)

Mathematics:
D.RE.05.01 Compare data displayed in each graph. (medium)
D.RE.05.02 Create a speed vs. height line graph. (high)
D.AN.05.03 Report the mean speeds for each height and ball used.
M.UN.05.04 Demonstrate how to convert centimeters to meters. (medium)

Science:
P.FM.05.42 Compare the distance and time of the ball in relation to the different height of release and the two balls chosen. (medium)
P.FM.05.43 Create a distance vs. time graph. (high)

Anticipatory Set

- ✓ Explain to the students that the first activity with the K'NEX Education Amusement Park set will involve using an inclined plane model (ramp) to develop building skills, to gain practice in taking various types of measurements, and to acquire knowledge of some basic scientific and mathematical concepts.
- ✓ Have students build the ramp out of K'NEX and then experiment with the balls.
- ✓ Gather the students after experimentation and ask them questions about which balls went faster. If the balls were released from different heights, how did it affect their speed?

Input

- ✓ Review how to convert centimeters to meters.
- ✓ Discuss speed and how to calculate it with the equation speed=distance/time.
- ✓ Discuss how to calculate average speed and how this helps our data become more reliable.

Guided Practice

- ✓ Distribute the K'NEX Education Amusement Park Experience sets to groups and allow time for construction. Make sure that all students are familiar with how to use the materials.
- ✓ Have students measure the length of the ramp in centimeters
    - Students will convert to meters when making their calculations. Students should show example calculations for this process.
- ✓ Students will use a water-based marker to label the following 5 positions on the model: the 3rd, 5th, 7th, 9th, and 11th bright green supports. (These green supports are directly above the main support beams.)
- ✓ In groups of three or four, students record the time it takes the ball to go from the top marker to the bottom. Five trials will be recorded; calculate the speed for each and then find the average speed.
- ✓ Students will record results on the board and use the averages from the entire class to individually construct line graphs with height on the y-axis and time on the x-axis.
- ✓ Graphs with height on the x-axis and speed on the y-axis will also be created. Compare results with group members.
- ✓ Have a student volunteer show graphs and analyze the results as a class.

Individual Practice

- ✓ In this activity, students will investigate whether or not the height at which a ball is released down a ramp affects distance over time.
- ✓ Have students measure the distance from each of the remaining labeled points in centimeters to the end of the ramp and record these values in their table.
- ✓ Students should release a ball from the remaining positions five times.
- ✓ Calculate the speed of the ball from each of the positions and then calculate the average speed for each of the positions.
    - ✓ Students should individually construct and analyze their data by:

- ✓ Drawing a line graph of their data with the height on the y-axis and time on the x-axis.
- ✓ Students should also draw a line graph of their data with the height on the x-axis and the speed on the y-axis.
- ✓ Describing the shape of the line that is formed.
- ✓ Stating if the shape of the line was expected or if it was a surprise.
- ✓ Describing what the shape of the line indicates.
- ✓ Students should analyze each of the graphs that they constructed in a paragraph below.
- ✓ Predict whether or not they will get the same shaped line when they make graphs using one of the other balls that have been provided.
- ✓ Compare results with their group members.

Have students repeat this process with one of the other balls that is provided to see if their predictions were correct. Then write an explanation of why their predication was either correct or incorrect.

Adapted from: http://knex.com/Educators/pdf/lesson-plans/78890-Amusement-Park-Experience.pdf

Mathematics Connection Rubric

Understanding the Relationship between Speed, Distance and Time Rubric

	Possible Points	Points Earned
Calculations: Conversions were performed accurately and example calculations were shown for each type of calculation.	**5**	
Data: Individual data tables include title, variables, measurable units, repeated trials and accurate data.	**5**	
Graph Neatness: The graphs are well designed, neat and attractive. Colors that go well together are used to make the graph more readable. A ruler and graph paper (or graphing computer program) are used.	**5**	
Graph Accuracy: All points are plotted correctly and are easy to see. A ruler is used to neatly connect the points, if not using a computerized graphing program.	**5**	
Graph Completeness: The five critical elements of a graph are included: title, scale, labels, points and line.	**5**	
Conclusion: The conclusion is clearly stated and shows an understanding of the concepts introduced.	**5**	
Total Points:	**30**	
Comments:		

Physical Education Connection

Locomotor Movements and Their Effects on Heart Rate

Subject/Course: Science
Topic: Speed
Grade: 5th Grade
Designer: Lesley Righetti

Objective:

Established Goal(s):

S.IP.05.12 Design and conduct scientific investigations.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
S.IP.05.15 Construct charts and graphs from data and observations.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments, and data.

Content Statement:

Science:
P.FM.05.43 Demonstrate how motion can be measured and represented on a graph.

Physical Education:
M.MS.05.02 demonstrate mature form of locomotor skills of walk, run, leap, slide, gallop, hop, skip, flee, and dodge using movement concepts in controlled settings.
A.AN.05.04 utilize physiological indicators associated with moderate to vigorous physical activity (e.g., sweating, increased heart rate, increased respiration, palpating pulse) to adjust participation/effort in controlled settings.

Mathematics:
D.RE.05.01 Read and interpret line graphs, and solve problems based on line graphs, e.g., distance-time graphs, and problems with two or three line graphs on same axes, comparing different data.
D.RE.05.02 Construct line graphs from tables of data; include axis labels and scale.

SWBAT:
S.IP.05.12 Design a scientific investigation to analyze the speed of different locomotor movements. (high)
S.IP.05.13 Demonstrate appropriate use of scientific instruments. (medium)
S.IP.05.15 Create appropriate data tables to display the data collected. (high)

S.IA.05.11 Examine the information from the graphs created during the experiment. (medium)
S.IA.05.13 Explain the relationship between speed, distance and time. (low)

S.RS.05.11 Identify possible sources of error in the data collection from the experiment. (low)

Content Statement:

Science:
P.FM.05.43 Create a distance vs. time graph. (high)

Physical Education:
M.MS.05.02 Demonstrate mature form of locomotor skills using movement concepts in controlled settings. (medium)
A.AN.05.04 Examine the effects of locomotor movements on heart rate. (medium)

Mathematics:
D.RE.05.01 Compare data displayed in each graph. (medium)
D.RE.05.02 Create a speed vs. heart rate line graph. (high)

Anticipatory Set:

- ✓ Ask students to name different types of movements (running, skipping, walking, etc.) and then ask them which one they think is the fastest.
- ✓ Have students pair up, run 100m, and time each other, then show them a video of the fastest man in the world running (he can run 100m in 9.58s).

  http://www.youtube.com/watch?v=By1JQFxfLMM

Input:

- ✓ Introduce the equation speed = distance/time and define speed, distance, and time.
- ✓ Show students the proper usage of the heart rate monitors.
- ✓ Review how you would like their data tables and line graphs to look.
- ✓ Answer any questions students have about the experiment.

Guided Practice:

- ✓ Have a premeasured distance for students to walk, jog, run and sprint.
- ✓ Students should calculate their resting heart rate.
- ✓ In groups of 3 or 4 students will record the time it takes for each of them to travel the distance by walking, jogging, running and sprinting.
- ✓ Students will also be wearing heart rate monitors to measure their heart rate. They will record this data in a data table.
- ✓ Students should alternate who is performing the exercise so that their heart rate can return to its resting level in between trials.
- ✓ Students should recalibrate their resting heart rate in between each round of exercise.
- ✓ Students will create a data table with distance, time, calculated speed and heart rate.
- ✓ Students will then create a line graph, using their own data, and comparing their speeds and heart rate from the data they collected.
- ✓ Students will analyze the graph describing the effects of the speed of different movements on heart rate.
- ✓ If students finish early, they can calculate the groups average speed and create data tables and graphs using this information for additional practice.

Individual Practice:

- ✓ Students will design an experiment using the movements above and heart rate but they must introduce a new variable. It could be introducing new movements, different distances, different types of footwear, etc.
- ✓ Students should still alternate who is performing the exercises so that their heart rate can return to its normal level before taking the new measurements.

- ✓ Students will create a data table and line graph to represent their new variables.
- ✓ Students must then compare new data with the data collected in the first experiment in relation to speed.
- ✓ Teacher will walk around to the different groups answering questions and making sure students are on task.

Physical Education Connection Rubric

Locomotor Movements and Their Effects on Heart Rate Rubric

	Possible Points	Points Earned
Calculations: Conversions were performed accurately and example calculations were shown for each type of calculation.	**5**	
Data: Individual data tables include title, variables, measurable units, repeated trials and accurate data.	**5**	
Graph Neatness: The graphs are well designed, neat and attractive. Colors that go well together are used to make the graph more readable. A ruler and graph paper (or graphing computer program) are used.	**5**	
Graph Accuracy: All points are plotted correctly and are easy to see. A ruler is used to neatly connect the points, if not using a computerized graphing program.	**5**	
Graph Completeness: The five critical elements of a graph are included: title, scale, labels, points and line.	**5**	
Conclusion: The conclusion is clearly stated and shows an understanding of the concepts introduced. Includes three sources of error identified through experiment.	**5**	
Total Points:	**30**	
Comments:		

Writing Connection

Subject/Course: Science
Topic: Speed
Grade: 5th Grade
Designer: Kristin Herderich

Objectives:
Writing:
W.PR.05.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.
W.PR.05.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., role and relationships of characters, settings, ideas, relationship of theory/evidence, or compare/contrast).
W.PR.05.05 proofread and edit writing using grade-level checklists and other appropriate resources both individually and in groups.
W.GN.05.04 use the writing process to produce and present a research project; use a variety of resources to gather and organize relevant information into central ideas and supporting details for a teacher-approved narrowed focus question and hypothesis.

Science:
P.FM.05.41 Explain the motion of an object relative to its point of reference.

Students will be able to:
- ✓ Defend their point of view on Speed Limits using a Thesis Statement to set the purpose of the paper
- ✓ Apply a variety of pre-writing strategies in their rough drafts to develop their research paper
- ✓ Evaluate their research paper by proofreading and editing, both individually and in a group
- ✓ Use the writing process to produce and present a research paper on Speed Limits
- ✓ Explain the motion of an object through research and the written word

Anticipatory Set:
- ✓ Watch a movie or YouTube clip on speed limits and speeding in your area or state. Talk about speeding and the implications and consequences it might have in real life
- ✓ Speed Limits: Why Do We Have Them? http://www.youtube.com/watch?v=8edH-toBesM
- ✓ Do You Know How They Set Speed Limits? http://www.youtube.com/watch?v=j5pzYoX1cTw

Input:

- ✓ Introduce Research Papers. What are Research Papers? Why do we write them? Make copies and pass out an example research paper done by a previous 5th Grade student (on a different topic). Highlight (literally) the important parts of the research paper (intro/thesis, middle, and conclusion) and talk about how the student got to those parts. Discuss how to conduct research and what websites are acceptable and unacceptable.

Guided Practice:

- ✓ Practice writing a thesis statement as a class.
- ✓ Then have students practice writing a thesis statement on their own.
- ✓ As a class, the students will go to the library to start the research process. Remind students which websites they cannot use (Wikipedia, Yahoo Answers, etc).
- ✓ After two days of research, meet with students individually to see what research they have collected.
- ✓ After the students have conducted their research, begin the writing process for the paper.
- ✓ Students will create a web/outline/graphic organizer to show how they will start their research paper
- ✓ After the outline, students will focus on their Thesis Statement. Meet with each student and review their Thesis Statement
- ✓ Either in the library or in the classroom, students will start the first draft of their research paper
- ✓ Have students Peer Edit papers in groups. While students are in groups, the teacher will meet with students individually to Edit and Revise. Remind students that Editing is looking for grammar and Revision is correcting the content.

Independent Practice:

- ✓ After students have edited and revised, they will type up a final copy and turn it in.

Writing Connection Rubric

Rubric

	Possible Points	Points Earned
Thesis is well-written and states the student's opinion.	**10**	
Student uses evidence to back-up thesis	**5**	
3 rough drafts are attached; one edited/revised by me, one edited/revised by a peer, one edited/revised by yourself	**5**	
Works Cited Page	**5**	
The paper has few spelling errors and is typed and double-spaced	**5**	
Total Points:	**30**	
Comments:		