CoMPASS – Fun with Roller Coasters
Work, Energy, Forces & Motion

Content, Activities, Practices & Standards (CAPS) Guide

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CoMPASS
Concept Mapped Project-based Activity Scaffolding System

Overall Challenge				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Initial Roller Coaster Ideas Page 7	All areas of the Content are addressed in the design of the roller coaster (see individual coaster sections for details)	**PS2.A; PS3.A – D; ETS1.A-C** All Relevant Content Standards are Addressed by the Roller Coaster Design Process	Developing models & designing solutions	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop Roller Coaster Ideas Check-In Page 52 **Hills and Loops Roller Coaster Ideas Check-In** Page 73			Refining models, redesigning solutions & obtaining evaluating and communicating information	**Integration of Knowledge and Ideas 7**: combine words and text with visual representations **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.5:** plan, revise, edit, rewrite and try new approach **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Final Letter - Design Proposal Pages 90 - 95			Developing and using models, engaging in argument from evidence & communicating information	**Integration of Knowledge and Ideas 7:** combine words and text with visual representations **WHST.6-8.1.A,B,C,D:** write arguments focused on discipline specific content **WHST.6-8.2.A,B,C,D,E,F:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.5:** plan, revise, edit, rewrite and try new approach **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Unit Framing				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Concept Map Pages 3 - 4	Eliciting students' prior knowledge and misconceptions about physics content related to roller coasters; content dependant on students' prior knowledge	**PS2.A; PS3.A – D** This activity provides the teacher with an understanding of students' current knowledge in relation to all relevant content standards Standards covered will depend on student prior knowledge	Determining prior knowledge	**Integration of Knowledge and Ideas 7:** combine words and text with visual representations
Design Challenge Introduction Page 5	Content and design expectations are identified	**ETS1.A**: defining a design task involves identifying constraints and relevant science concepts	Obtaining (evaluating) information, determining design constraints & determining prior knowledge	
Dream Team Page 6	Group work expectations		Collaboration	
Initial Roller Coaster Ideas Page 7	Eliciting students' prior knowledge and misconceptions about content related to roller coasters; content dependant on students' prior knowledge	**PS2.A; PS3. A – D** This activity provides the teacher with an understanding of students' current knowledge in relation to all relevant content standards and their application to the design task	Developing models, designing solutions, talking in the genre of science & using evidence to back up ideas	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
CoMPASS Introduction Page 8 - 9	Visual relationships between core science ideas important in the domain of physics through the use of concept maps in CoMPASS, content dependant on student navigation choices		Learning to use available tools and information sources & using expert maps and models of the domain of physics	

Explorations Overview				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Car Lift Pages 10 - 31	**Concepts:** Mass, Weight, Speed, Velocity, Force, Types of Forces, Force Vectors, Net Force, Work, Energy, Height, Potential Energy, Friction, Efficiency, Law of Conservation of Energy, Energy Transfer **Relationships:** Mass & Weight, Speed & Velocity, Work & Potential Energy, Applied force, Mass & Applied Force, Mass & Potential Energy, Mass & Work, Height & Applied Force, Height & Potential Energy, Height & Work, Friction & Applied Force, Friction & Potential Energy, Friction & Work, Friction & Efficiency, Law of Conservation of Energy & Energy Transfer	**PS2.A:** if total force is not zero, motion will change; greater mass needs greater force for same change in motion; to share information with others directions of forces must be described **PS3.A:** potential (stored) energy depends on relative positions; raising an object increases PE **PS3.B:** when motion energy changes, other energy changes happen as well; friction can cause transfer to heat energy; making an object move requires energy **PS3.C:** objects can transfer energy between them **PS3.D:** machines can be more efficient by reducing friction; friction increases energy transfer through heat **ETS1.A:** constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; it is necessary to explain solutions to others; models, specifically computers, are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Obtaining (evaluating) information, learning to use available tools and information sources, determining prior knowledge, asking questions, defining problems, planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, developing and using models, constructing explanations and designing solutions, presenting information, talking in the genre of science, using expert maps and models of the domain of physics & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 2:** find central ideas of text and summarize **Key Ideas and Details 3:** follow multistep procedure in experiments **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.B,D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

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Initial Drop Pages 32 - 52	**Concepts:** Mass, Height, Velocity, Gravity, Acceleration, Energy, Potential Energy, Kinetic Energy, Friction, Law of Conservation of Energy, Energy Transfer, **Relationships:** Mass & Velocity, Mass & Kinetic Energy, Height & Velocity, Height & Kinetic Energy, Velocity & Acceleration, Law of Conservation of Energy & PE/KE	**PS2.A:** if total force is not zero motion will change (here force is gravity) **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls **ETS1.A:** more precise constraints provide better solutions; constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Obtaining (evaluating) information, learning to use available tools and information sources, integrating multiple sources of information, determining prior knowledge, asking questions, defining problems, planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, developing and using models, constructing explanations and designing solutions, presenting information, talking in the genre of science, using expert maps and models of the domain of physics & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 2:** find central ideas of text and summarize **Key Ideas and Details 3:** follow multistep procedure in experiments **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 7:** integrate information from text with visual representations **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.B,D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Explorations Overview				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Hills Pages 53 - 73	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Newton's 3rd Law, Height, Direction, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy **Relationships:** Newton's 1st Law & Acceleration (change in direction), Newton's 2nd Law & Acceleration, Velocity & Acceleration, Acceleration & Force, Direction & Velocity, Direction & Acceleration, Direction & Force	**PS2.A:** Newton's 3rd law; changes in motion are determined by the sum of forces (net force); a larger net force causes a larger change in motion; forces can change direction; information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **ETS1.A:** more precise constraints provide better solutions; constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions; how they were developed and why they work	Obtaining (evaluating) information, learning to use available tools and information sources, integrating multiple sources of information, determining prior knowledge, asking questions, defining problems, planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, developing and using models, constructing explanations and designing solutions, presenting information, using and comparing multiple models and representations, talking in the genre of science, using expert maps and models of the domain of physics & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 2:** find central ideas of text and summarize **Key Ideas and Details 3:** follow multistep procedure in experiments **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 7:** integrate information from text with visual representations **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.B,D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Explorations Overview				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Stop That Car Pages 74 - 86	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Mass, Height, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy, Law of Conservation of Energy, Energy Transfer, Friction **Relationships:** Force & Acceleration in both 1st and 2nd law, KE & Velocity, Mass & Force, Height & Velocity, Velocity & Acceleration, Velocity & Stopping Distance, Height & PE, PE & Velocity	**PS2.A:** motion is determined by total forces; heavier objects require greater force for same change in motion; larger forces cause larger changes in motion; information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion changes there is some other change in energy; friction causes transfer of energy to heat; friction causes slowing by transferring energy away **PS3.C:** when two objects interact forces can transfer energy between them **ETS1.A:** more precise constraints provide better solutions; constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions; how they were developed and why they work	Obtaining (evaluating) information, learning to use available tools and information sources, integrating multiple sources of information, determining prior knowledge, asking questions, defining problems, planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, developing and using models, constructing explanations and designing solutions, presenting information, talking in the genre of science, using expert maps and models of the domain of physics & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 2:** find central ideas of text and summarize **Key Ideas and Details 3:** follow multistep procedure in experiments **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 7:** integrate information from text with visual representations **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.B,D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Final Design				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Final Design Hands On Fun Experiment Page 87 - 88	Exploration of physics ideas learned in the unit by checking designs and adding additional elements for fun	**PS2.A; PS3.A – D; ETS1.A-C** All Relevant Content Standards are Addressed by the Final Design Process	Designing and evaluating solutions, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, talking in the genre of science, using models of the domain of physics & developing, refining and using models	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience
Final Design Whole Class Discussion Page 89	Eliciting students' final understanding of physics content related to roller coasters and the relationship between different models		Presenting information, asking questions, defining problems, engaging in argument from evidence, talking in the genre of science & evaluating the affordances of different models	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Final Design Proposal Framing and Instructions Page 90	Content and design expectations are reiterated		Obtaining (evaluating) information, determining design constraints & determining prior knowledge	
Final Design Proposal Diagram Page 91	Eliciting students' final understanding of physics content related to roller coasters and the relationship between the content and the design task		Developing and using models, engaging in argument from evidence, communicating information, using visual representations, talking in the genre of science & using models of the domain of physics	**Integration of Knowledge and Ideas 7:** combine words and text with visual representations
Engineer Proofs Pages 92 - 93	Eliciting students' final understanding of physics content related to roller coasters and the relationship between the content and the design task			**Integration of Knowledge and Ideas 7:** combine words and text with visual representations **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.A,B,D:** write informative texts **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Written Design Proposal Pages 94 - 95	Eliciting students' final understanding of physics content related to roller coasters and the relationship between the content and the design task			**WHST.6-8.1.A,B,C,D:** write arguments focused on discipline specific content **WHST.6-8.2.A,B,C,D,E,F:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.5:** plan, revise, edit, rewrite and try new approach **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Final Concept Map Page 96	Eliciting students' final understanding of physics content related to roller coasters		Communicating understanding of science concepts, using visual representations & using maps and models of the domain of physics	**Integration of Knowledge and Ideas 7:** combine words and text with visual representations; Integration of Knowledge and Ideas 9 **WHST.6-8.2:** write informative texts

Car Lift – Detail				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Reading Excursion #1 Pages 10 - 13	**Concepts:** Mass, Weight, Mass vs. Weight, Speed, Velocity, Speed vs. Velocity, Force, Types of Forces, Force Vectors, Net Force, Work, Energy	**PS2.A:** to share information with others directions of forces must be described **PS3.C:** objects exert forces on each other	Obtaining (evaluating) information & learning to use available tools and information sources	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Car Lift Introduction and Brainstorming Page 14	Eliciting students' initial understanding of and misconceptions about physics content relevant to the Car Lift	**ETS1.A**: defining a design task involves identifying constraints and relevant science concepts	Obtaining (evaluating) information, determining design constraints, determining prior knowledge, talking in the genre of science & using evidence to back up ideas	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience
Car Lift Brain Warm Up Page 15	Eliciting students' initial understanding of and misconceptions about physics content relevant to Car Lift, introduction to concepts and relationships relevant for the Car Lift.	**PS2.A:** greater mass needs greater force for same change in motion **PS3.A:** potential (stored) energy depends on relative positions; raising an object increases PE **PS3.B:** when motion energy changes, other energy changes happen as well; friction can cause transfer to heat energy; making an object move requires energy **PS3.C:** objects can transfer energy between them **PS3.D:** machines can be more efficient by reducing friction; friction increases energy transfer through heat	Determining prior knowledge	
Car Lift Questions Page 16	Eliciting students' initial understanding of and misconceptions about physics content relevant to Car Lift	Standards covered will be based on student choices	Asking questions, defining problems & talking in the genre of science	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Car Lift CoMPASS Research Page 17 - 18	Visual relationships between core science ideas in the domain of physics important to the design of the Car Lift through the use of concept maps in CoMPASS, content dependant on student navigation choices	Standards covered will be based on student choices	Obtaining (evaluating) information & using expert maps and models of the domain of physics	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Car Lift Mass Hypothesis Page 19	**Concepts:** Mass, Applied Force, Work, Potential Energy **Relationships:** Mass & Applied Force, Mass & Work, Mass & Potential Energy, Work & Potential Energy	**PS2.A:** if total force is not zero motion will change; greater mass needs greater force for same change in motion; to share information with others directions of forces must be described **PS3.A:** potential (stored) energy depends on relative positions; raising an object increases PE **PS3.B:** making an object move requires energy **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; it is necessary to explain solutions to others; models, specifically computers, are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Car Lift Mass Simulation Experiment Page 20 - 22			Carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in argument from evidence & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Car Lift Height Hypothesis Page 23	**Concepts:** Height, Applied Force, Work, Potential Energy **Relationships:** Height & Work, Height & Potential Energy, Work & Potential Energy	**PS2.A:** if total force is not zero motion will change; and to share information with others directions of forces must be described **PS3.A:** potential energy depends on relative positions; raising an object increases PE **PS3.B:** making an object move requires energy **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; it is necessary to explain solutions to others; models, specifically computers, are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Car Lift Height Simulation Experiment Pages 24 - 25			Carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in argument from evidence & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Car Lift Surface Hypothesis Page 25 (at end of "Thinking about Roller Coaster Ramp Height")	**Concepts:** Friction, Applied Force, Work, Potential Energy, Efficiency **Relationships:** Friction & Applied Force, Friction & Work; Friction & Potential Energy, Friction & Efficiency, Work & Potential Energy	**PS2.A:** if total force is not zero motion will change; and to share information with others directions of forces must be described **PS3.B:** when motion energy changes other energy changes happen as well; friction can cause transfer to heat energy; making an object move requires energy **PS3.C:** objects can transfer energy between them **PS3.D:** machines can be more efficient by reducing friction; friction increases energy transfer through heat **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; it is necessary to explain solutions to others; models, specifically computers, are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Car Lift Surface Simulation Experiment Pages 26 - 27			Carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in argument from evidence & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Reading Excursion #2 Page 28	**Concepts:** Efficiency, Friction, Energy Transfer, Force, Work, Potential Energy **Relationships:** Efficiency & Friction, Efficiency & Energy Transfer, Efficiency & Force, Efficiency & Work, Efficiency & Potential Energy; Work & Potential Energy	**PS3.B:** when motion energy changes other energy changes happen as well; for example friction can cause transfer to heat energy; also making an object move requires energy **PS3.C:** objects can transfer energy between them **PS3.D:** machines can be more efficient by reducing friction; friction increases energy transfer through heat	Obtaining (evaluating) information, analyzing and interpreting data, engaging in argument from evidence & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Car Lift What did we Learn Page 29	**Concepts:** Height, Mass, Friction, Potential Energy, Work, Efficiency **Relationships:** Height & Potential Energy, Mass & Potential Energy, Friction & Work, Friction & Potential Energy, Efficiency & Friction	**PS3.A:** potential (stored) energy depends on relative positions; raising an object increases PE **PS3.B:** when motion energy changes, other energy changes happen as well; friction can cause transfer to heat energy; making an object move requires energy **PS3.C:** objects can transfer energy between them **PS3.D:** machines can be more efficient by reducing friction; friction increases energy transfer through heat	Analyzing and interpreting data, engaging in argument from evidence, talking in the genre of science & using mathematics, information and computer technology, and computational thinking	**Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1:** write arguments focused on discipline specific content **WHST.6-8.2:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Design Specification Statement Page 29 (at end of What did we Learn)	Eliciting students' current understanding of and misconceptions about physics content relevant to the Car Lift and its relationship to the design task	**ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process	Developing and using models, constructing explanations, designing solutions, talking in the genre of science & using evidence to back up ideas	
Car Lift Whole Class Discussion Page 30 - 31	Eliciting students' current understanding of and misconceptions about physics content relevant to the Car Lift	Standards covered will be guided by student input; please refer to the above standards for ideas on content that can be addressed during the whole class discussion	Presenting information, asking questions, defining problems, engaging in argument from evidence & talking in the genre of science	**Key Ideas and Details 2:** find central ideas of text and summarize **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.8:** assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Initial Drop – Detail				
Activities:	**Core science ideas and relationships addressed**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Initial Drop Introduction and Brainstorming Page 32	Eliciting students' developing understanding of and misconceptions about physics content relevant to the Initial Drop	**ETS1.A:** defining a design task involves identifying constraints and relevant science concepts	Obtaining (evaluating) information, determining design constraints, determining prior knowledge, talking in the genre of science & using evidence to back up ideas	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience
Initial Drop Brain Warm Up Page 33	Eliciting students' developing understanding of and misconceptions about physics content relevant to the Initial Drop, introduction to concepts and relationships relevant for the Initial Drop	**PS2.A:** if total force is not zero motion will change (here force is gravity) **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls	Determining prior knowledge	
Initial Drop Questions Page 34	Eliciting students' developing understanding of and misconceptions about physics content relevant to the Initial Drop	Standards covered will be based on student choices	Asking questions, defining problems & talking in the genre of science	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop CoMPASS Research Pages 35 - 36	Visual relationships between core science ideas in the domain of physics important to the design of the Initial Drop through the use of concept maps in CoMPASS, content dependant on student navigation choices	Standards covered will be based on student choices	Obtaining (evaluating) information & using expert maps and models of the domain of physics	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Initial Drop Height Hypothesis Page 37	**Concepts:** Height, Velocity, Gravity, Acceleration, Energy, Potential Energy, Kinetic Energy, Law of Conservation of Energy, Energy Transfer **Relationships:** Height & Velocity, Height & Kinetic Energy, Velocity & Acceleration, Law of Conservation of Energy & PE/KE	**PS2.A:** if total force is not zero motion will change (here force is gravity) **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop Height Simulation Experiment Pages 38 - 40			Carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in arguments from evidence & using mathematics, information and computer technology, and computational thinking,	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop Mass Hypothesis Page 41	**Concepts:** Mass, Velocity, Energy, Potential Energy, Kinetic Energy, Law of Conservation of Energy, Energy Transfer **Relationships:** Mass & Velocity, Mass & Kinetic Energy, Law of Conservation of Energy & PE/KE	**PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning Investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop Mass Simulation Experiment Page 42 - 44			Carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in arguments from evidence & using mathematics, information and computer technology, and computational thinking,	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Initial Drop Hands On Fun Experiment Pages 44 - 46	**Concepts:** Mass, Height, Velocity, Gravity, Acceleration, Energy, Potential Energy, Kinetic Energy, Friction, Law of Conservation of Energy, Energy Transfer, **Relationships:** Mass & Velocity, Mass & Kinetic Energy, Height & Velocity, Height & Kinetic Energy, Velocity & Acceleration, Law of Conservation of Energy & PE/KE Note: They will not be able to make quantitative evaluations of velocity, acceleration or kinetic energy, however they should be able to make qualitative observations	**PS2.A:** if total force is not zero motion will change (here force is gravity) **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning and carrying out investigations, comparing models, talking in the genre of science, using evidence to back up ideas, using models of the domain of physics & designing models	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Reading Excursion #3 Pages 47 - 48	**Content:** Law of Conservation of Energy, Energy Transfer, Potential Energy, Kinetic Energy **Relationships:** Law of Conservation of Energy & PE/KE, Energy Transfer & PE/KE	**PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **PS3.C:** gravitational force allows storing of energy as potential when an object is raised; potential energy is converted to kinetic energy as an object falls		**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research

Initial Drop What did we Learn Pages 49	Eliciting students' current understanding of and misconceptions about physics content relevant to the Car Lift and the Initial Drop and its relationship to the design task	**ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Constructing explanations, designing and redesigning solutions, talking in the genre of science, using evidence to back up ideas & developing, refining and using models,	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Initial Drop Whole Class Discussion Pages 50 - 51	Eliciting students' current understanding of and misconceptions about physics content relevant to the Initial Drop	Standards covered will be guided by student input; please refer to the above standards for ideas on content that can be addressed during the whole class discussion	Presenting information, asking questions, defining problems, engaging in argument from evidence & talking in the genre of science	**Key Ideas and Details 2:** find central ideas of text and summarize **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.8:** assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Roller Coaster Ideas Check-In Page 52	Eliciting students' current understanding and misconceptions about content related to the Car Lift and the Initial Drop, and about the relationship between the content and the design task; content dependant on students' prior knowledge	**ETS1.A:** more precise constraints provide better solutions; constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Developing and refining models, designing and redesigning solutions, obtaining evaluating and communicating information, using visual representations, talking in the genre of science, using evidence to back up ideas & using models of the domain of physics	**Integration of Knowledge and Ideas 7:** integrate information from text with visual representations **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.5:** plan, revise, edit, rewrite and try new approach **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Hill – Detail				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Reading Excursion #4 Pages 53 - 54	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Newton's 3rd Law, Force, Acceleration **Relationships:** Newton's 2nd Law & Acceleration, Acceleration & Force	**PS2.A:** Newton's 3rd law; changes in motion are determined by the sum of forces (net force); a larger net force causes a larger change in motion		**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Our Hill Introduction and KWL Brainstorm Page 55 and 56	Eliciting students' developing understanding of and misconceptions about physics content relevant to the Hill, introduction to concepts and relationships relevant for the Hill	**PS2.A:** Changes in motion are determined by sum of forces (net force); larger net force causes larger change in motion; forces can change direction **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time	Obtaining (evaluating information, determining design constraints, determining prior knowledge & talking in the genre of science	**WHST.6-8.1.A:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Our Hill CoMPASS Research Pages 57 - 58	Visual relationships between core science ideas in the domain of physics important to the design of the Hill through the use of concept maps in CoMPASS, content dependant on student navigation choices	Standards covered will be based on student choices	Obtaining (relevant) information & using expert maps and models of the domain of physics	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Hill Height Hypothesis Page 59 - 60	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Height, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy, Law of Conservation of Energy **Relationships:** Newton's 2nd Law & Acceleration, Velocity & Acceleration, Acceleration & Force	**PS2.A:** changes in motion are determined by the sum of forces (net force); a larger net force causes a larger change in motion; forces can change direction; information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best, promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Hill Height Simulation Experiment Pages 61 - 62			Carrying out investigations, talking in the genre of science, analyzing and interpreting data, engaging in argument from evidence, using expert models of the domain of physics & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Hill Shape Hypothesis Page 63	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Direction, Shape, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy **Relationships:** Newton's 1st Law & Acceleration (change in direction), Newton's 2nd Law & Acceleration, Velocity & Acceleration, Acceleration & Force, Shape & Direction, Direction & Acceleration, Direction & Velocity	**PS2.A:** change in motion determined by sum of forces; a larger force causes a larger change in motion; forces can change direction; information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1:** write arguments focused on discipline specific content **WHST.6-8.2:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Hill Shape Simulation Experiment Page 64 - 65			Planning and carrying out investigations, talking in the genre of science, using expert models of the domain of physics, analyzing and interpreting data, engaging in argument from evidence & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Our Hill What did we Learn Pages 66	Eliciting students' current understanding of and misconceptions about physics content relevant to the Car Lift, Initial Drop and the Hill, and its relationship to the design task	**ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Constructing explanations, designing and redesigning solutions, talking in the genre of science, using evidence to back up ideas & developing, refining and using models,	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Hill Hands On Fun Experiment Pages 67 - 68	**Concepts:** Height, Shape, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy, Friction **Relationships:** Newton's 1st Law & Acceleration (change in direction), Newton's 2nd Law & Acceleration, Velocity & Acceleration, Acceleration & Force Note: They will not be able to make quantitative evaluations of velocity, acceleration or kinetic energy, however they should be able to make qualitative observations	**PS2.A:** forces can change direction **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning and carrying out investigations, comparing models, talking in the genre of science, using models of the domain of physics & designing models	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research
Optional Loop Hands On Fun Experiment Pages 69 - 70	**Concepts:** Circular Motion and Experimentation with Loops in General, Friction Note: They will not be able to make quantitative evaluations of velocity, acceleration or kinetic energy, however they should be able to make qualitative observations	**PS2.A:** forces can change direction **PS3.B:** when motion of an object changes there is a change in another form of energy at the same time **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning and carrying out investigations, comparing models, talking in the genre of science, using models of the domain of physics & designing models	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1:** write arguments focused on discipline specific content **WHST.6-8.2:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research

Hills Whole Class Discussion Pages 71 - 72	Eliciting students' current understanding of and misconceptions about physics content relevant to the Hill	Standards covered will be guided by student input; please refer to the above standards for ideas on content that can be addressed during the whole class discussion	Presenting information, asking questions, defining problems, engaging in argument from evidence & talking in the genre of science	**Key Ideas and Details 2:** find central ideas of text and summarize **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.8:** assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Roller Coaster Ideas Check-In Page 73	Eliciting students' current understanding and misconceptions about content related to the Car Lift, the Initial Drop and the hill, and about the relationship between the content and the design task; content dependant on students' prior knowledge	**ETS1.A:** more precise constraints provide better solutions; constraints of a design include scientific principles **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Developing and refining models, designing and redesigning solutions, obtaining evaluating and communicating information, using visual representations, talking in the genre of science, using evidence to back up ideas & using models of the domain of physics	**Integration of Knowledge and Ideas 7:** integrate information from text with visual representations **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.5:** plan, revise, edit, rewrite and try new approach **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Stop That Car				
Activities:	**Core science ideas and relationships addressed:**	**Science Framework Standard:**	**Science and Engineering Practices:**	**Common Core Literacy and Writing Standards:**
Stop That Car Introduction and Brainstorming Page 74	Eliciting students' developing understanding of and misconceptions about physics content relevant to Stop That Car	**ETS1.A:** defining a design task involves identifying constraints and relevant science concepts	Obtaining (evaluating) information, determining design constraints, determining prior knowledge & talking in the genre of science	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car Questions Page 75	Eliciting students' developing understanding of and misconceptions about physics content relevant to Stop That Car	Standards covered will be based on student choices	Asking questions, defining problems & talking in the genre of science	**WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car CoMPASS Research Page 76 - 77	Visual relationships between core science ideas in the domain of physics important to the design of Stop That Car through the use of concept maps in CoMPASS, content dependant on student navigation choices	Standards covered will be based on student choices	Obtaining (evaluating) information & using expert maps and models of the domain of physics	**Key Ideas and Details 2:** find central ideas of text and summarize **Craft and Structure 4:** determine meaning of symbols, key terms and domain specific words and phrases **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **Range of Reading and Level of Text Complexity 10:** comprehend science/technical text at 6 – 8 level **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Stop That Car Friction Hypothesis Page 78	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Force, Acceleration, Velocity, Kinetic Energy, Law of Conservation of Energy, Energy Transfer **Relationships:** Force & Acceleration in both 1st and 2nd law, KE & Velocity, Velocity & Acceleration, Velocity & Stopping Distance	**PS2.A:** motion is determined by total forces, larger forces cause larger changes in motion, information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion **PS3.B:** when motion changes, there is some other change in energy, friction causes transfer of energy to heat, friction causes slowing by transferring energy away **PS3.C:** when two objects interact forces can transfer energy between them **ETS1.B:** solutions need to be tested; evaluation of solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car Friction Simulation Experiment Page 79 - 80			Planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, talking in the genre of science, constructing explanations, designing and redesigning solutions, using expert models of the domain of physics, developing and refining models & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1,A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car Mass and Height Content Review Page 81	**Concepts:** Newton's 1st Law, Newton's 2nd Law, Mass, Height, Force, Acceleration, Velocity, Potential Energy, Kinetic Energy, Law of Conservation of Energy, Energy Transfer **Relationships:** Force & Acceleration in both 1st and 2nd law, KE & Velocity, Mass & Force, Height & Velocity, Velocity & Acceleration, Velocity & Stopping Distance	**PS2.A:** motion is determined by total forces; heavier objects require greater force for same change in motion; larger forces cause larger changes in motion; information about positions and forces must be described to share with others **PS3.A:** kinetic energy is energy of motion; potential energy is energy of position; potential energy decreases when an object is lowered **PS3.B:** when motion changes; there is some other change in energy; friction causes transfer of energy to heat; friction causes slowing by transferring energy away **PS3.C:** when two objects interact forces can transfer energy between them **ETS1.B:** solutions need to be tested; evaluation of	Determining prior knowledge & talking in the genre of science	**Key Ideas and Details 2:** finding central ideas of text and summarizing **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.2.B,D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks

Stop That Car Mass and Height Hypothesis Pages 82 - 83		solutions should be done systematically; sometimes solutions can be combined; it is necessary to explain solutions to others; models of all kinds are helpful for testing solutions; simulations allow prediction and improvements **ETS1.C:** systematically evaluate solutions based on criteria and constraints; compare designs and test to see which is best; promising solutions are found through an iterative process; it is important to describe solutions, how they were developed, and why they work	Planning investigations	**WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car Mass and Height Simulation Experiment Pages 84 - 85			Planning investigations, carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, talking in the genre of science, constructing explanations, designing and redesigning solutions, using expert models of the domain of physics, developing and refining models & using mathematics, information and computer technology, and computational thinking	**Key Ideas and Details 3:** follow multistep procedure in experiments **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.2.D:** write informative texts **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.7:** research to answer a question using several sources and develop questions that allow for exploration **WHST.6-8.8:** gather information from print and digital sources; assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks
Stop That Car Whole Class Discussion Page 86	Eliciting students' current understanding of and misconceptions about physics content relevant to Stop That Car	Standards covered will be guided by student input; please refer to the above standards for ideas on content that can be addressed during the whole class discussion	Presenting information, asking questions, defining problems, engaging in argument from evidence, talking in the genre of science & using models of the domain of physics	**Key Ideas and Details 2:** find central ideas of text and summarize **Integration of Knowledge and Ideas 9:** compare information from experiments with text on the same topic **WHST.6-8.1.A,B:** write arguments focused on discipline specific content **WHST.6-8.4:** produce clear and coherent writing with development organization and style appropriate to task, purpose and audience **WHST.6-8.8:** assess credibility and accuracy and paraphrase **WHST.6-8.9:** draw evidence from text to support analysis, reflection and research **WHST.6-8.10:** write over extended and short time frames for discipline specific tasks