THOMPSON RIVERS UNIVERSITY | Education & Social Work

Bachelor of Education (Elementary) & Bachelor of Education (Secondary) STEM Unit Plan Template

Unit Title:	Laws of Motion	Number of Lessons	14	Time (In weeks):	10
Name:	Hannah Parker	Subject(s):	Science	Grade(s):	6

Rationale

This unit is important because learning about the three laws of motion are the building blocks to anything mechanical. Whether a student wants to be a mechanic, engineer, kinesiologist, or astronomer, they need to know how and why objects move.

Overview:

This unit involves learning about the three laws of motion, experimenting with those laws, and ultimately working with the energy skate park to learn about different types of energy and manipulation of that energy. They will be manipulating with that energy by building ramps for their skateboarder. Their summative project will be creating rollercoasters that follow the three laws of motion.

CORE COMPETENCIES

Communication	Thinking	Personal & Social
Collaborating Students will be building off on another ideas and working together to accomplish tasks in group situations.	Creative Thinking Students will be building a ramp through the Energy Skate Park program and manipulating energy. Students will also be taking their knowledge about Newton's three laws to creatively design a roller coaster.	Social Awareness and Responsibility Students will be working together in group learning centers and experiments. They will be recognizing their role in the group process.

BIG IDEAS

(Multiple subject areas for integrated unit)

Subject Name: Science	Subject Name: Math	Subject Name: ADST
Newton's three laws of motion describe the relationship between force and motion.	Data from the results of an experiment can be used to predict the theoretical probability of an event and to compare and interpret.	Design can be responsive to identified needs.

LEARNING STANDARDS

Curricular Competencies	Content

Science Questioning and predicting ● Demonstrate a sustained curiosity about a scientific topic or problem of personal interest Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Processing and analyzing data and information ● Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data Communicating ● Communicate ideas, explanations, and processes in a variety of ways	Science ● Newton's three laws of motion ● Force of gravity
Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas ● Estimate reasonably Communicating and Representing ● Represent mathematical ideas in concrete, pictorial, and symbolic forms	Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships ● one-step equations with whole-number coefficients and solutions
ADST: Applied Design Ideating ● Generate potential ideas and add to others' ideas Prototyping ● Explore and test a variety of materials for effective use ● Construct a first version of the product or a prototype, as appropriate, making changes to tools, materials, and procedures as needed Sharing ● Reflect on their design thinking and processes, and evaluate their ability to work effectively both as individuals and collaboratively in a group, including their ability to share and maintain an efficient co-operative workspace	ADST: Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy

Prerequisite Concepts and Skills:

Students need to know how to read Students need to know how to write Students will have studied heterogenous mixtures already

Teacher Preparation Required:

Lesson #	Teacher Preparation Required (See Unit Plan Sample)
Lesson 1	Have PHET Skatepark activity available on google classroom Have Kinetic vs. Potential Energy Class Review on google docs
Lesson 2	Have class scenarios on a google documents Bring 15 index cards, 15 cups (+ 10 different sized cups), 15 pennies Print and bring 15 elbow penny worksheets
Lesson 3	Have Star Wars Quote on google docs Print and bring 30 Unbalanced vs. Balanced worksheets Have Unbalanced vs. Balanced warmup on google docs
Lesson 4	Have PHET Skatepark Activity 2 on google classroom Bring 5 lb. and 30 lb. weights Have math equation on google docs
Lesson 5	Print 6 copies of Hot Wheels Lab Sheet Have Speed/Velocity/Acceleration Scenarios on google docs Have exit ticket questions on google docs Bring 6 hot wheels cars, 30 textbooks, measuring tape, and wood for lab
Lesson 6	Bring balloons, straws, and tape Print 6 rocket graphic organizers Have exit ticket questions on google docs
Lesson 7	Print and cut out 15 Force + Motion Matching sets Have Three Laws review on google docs
Lesson 8	Bring 40 cans (at least 30 cans the same), 10 water buckets, fishing line, nails, kiddy hammers Print 15 Hero Can Investigative Handouts Have Hero Can Background Information on google docs
Lesson 9	Have rollercoaster groups premade Print 10 Rollercoaster Pre-Building Question Sheet Have Engineering Process Poster on Google docs Have Rollercoaster Physics Reading on Google docs
Lesson 10	Bring Tape, Carboard, and Cardstock Have Journal Graphic Organizer on google classroom Have example rollercoaster base on google docs
Lesson 11	Bring Tape, Carboard, Cardstock, and Marbles Have example rollercoaster track on google docs Have Journal Graphic Organizer on google classroom Have Building tutorials on google classroom
Lesson 12	Bring Tape, Carboard, Cardstock, and Marbles Have Journal Graphic Organizer on google classroom Have Building tutorials on google classroom
Lesson 13	Collect Material Cost sheets Print and bring 30 Peer Assessment Rating Scales Bring highlighter and rollercoaster final rubric Print and bring 30 group contribution sheets
Lesson 14	Have Rollercoaster Reflective Questions on google classroom

Cross-Curricular Connections:

ELA:

- This unit will be cross curricular because students will be reading and writing with materials which means they are working with ELA.

Math:

- Students will be manipulating numbers on the Energy Skate Park which interacts mathematical concepts. They will also be work with graphing and equations related to physics.

ADST:

- Students will be building and designing rollercoasters to investigate and further understanding around Newton's three laws.

Aboriginal Connections/ First Peoples Principles of Learning:

Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).

- Students will be working through the three laws of motion in an experiential way via experimentation. The content will be relational to the students' interests (video game based with the energy skatepark). They will be focused on connectedness with others as they work through activities and communicate findings together.

Circle of Courage: Belonging

- This unit involves a ton of group activities and group work which creates roles and responsibilities within the classroom furthering a sense of belonging to each student.

Universal Design for Learning (UDL)

1.MULTIPLE MEANS OF REPRESENTATION – I provide for multiple means of representation in this unit in the following ways:

- Visual Representation: readings, videos with captions, and experiments are shown in visual format
- Oral Representation: readings are read aloud, experiments are described and demonstrated, videos are read aloud
- Demonstrations, Video Tutorials, and Instructions used for experiments

2.MULTIPLE MEANS OF ACTION AND EXPRESSION – I provide multiple means of action and expression in this unit in the following ways:

- Summative Assessment
    - Rollercoaster creation
    - Peer Feedback
    - Group Contribution
    - Rollercoaster Reflective Questions
- Formative Assignments
    - PHET Skatepark Activities
    - Elbow Penny Activity
    - Worksheets
    - Group Discussion
    - Hot Wheels Lab
    - Balloon Lab Experiment
    - Exit Tickets
    - Reflective Journals
    - Hero Can Investigative Activity

3.MULTIPLE MEANS OF ENGAGEMENT – I provide multiple means of engagement in this unit in the following ways:

- Whole Class Discussion
- Group Discussion
- Individual worktime

- Engaging videos
- Interactive activities
- Experiments
- Group work

Differentiated Instruction (DI):

ESL Learners
- Have a digital version of the readings
- Have google read and write available for students when taking notes

Behavioral Diversability
- Create structured groups for experiments
- Provide wobble chairs for focus during reading
- Provide encouragement to keep these students on task.
- Have scaffolds and instruction sheets to keep students on task and to go back to.
- Move students if distracted (preferential seating)
- Have brain-breaks and pauses during readings to bring students back
- Have google read and write available when taking notes.

Overview of Lessons:

Lesson 1

Name &Time (Minutes Allotted):	Kinetic vs. Potential Energy (45 min)
Learning Standards: Curricular Competencies	Science Questioning and predicting ● Demonstrate a sustained curiosity about a scientific topic or problem of personal interest Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas
Learning Standards: Content	Science ● Newtons Three Laws of Motion ● Force of gravity Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships
Instructional Objectives	Students will be able to differentiate between kinetic and potential energy by working with a Skatepark interactive activity after investigation of the terms and interactions with the skatepark.
Assessment:	Formative ● PHET Skate Park Activity o Question sheet o Scoring completion
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Activate engagement and schema with hook video Class Web to bring class ideas together

	Circulate room during Skatepark activity to provide aid Have student raise hand for support Worksheet available google classroom (submission as well) for easy marking.
Materials:	Chromebooks Smartboard Skateboard video: Japan's Yosozumi claims park Gold in Skateboarding | #Tokyo2020 Highlights – Bing video PHET Skate Park: Energy Skate Park: Basics 1.1.21 (colorado.edu) PHET Skate Park Activity (Appendix A) Kinetic vs. Potential Energy Class Review (Appendix B)
Lesson Activities:	

Introduction/Hook:	Skateboarding Video
	● Japan's Yosozumi claims park Gold in Skateboarding | #Tokyo2020 Highlights – Bing video
	● Ask students:
	  ○ What did you notice?
	  ○ What connections of skateboarding can you make to science? (Make a class web)

Body:	PHET Skate Park Investigation
	● Have students grab their chrome books
	● On the smartboard display which website they can go to
	● Give students 10 minutes of investigation time for the 3 vocab words
	  ○ Force
	  ○ Potential
	  ○ Kinetic
	PHET Skate Park Basics
	● **Learning target: I can differentiate kinetic energy and potential energy**
	● Ask students what they found
	● Energy Skate Park: Basics 1.1.21 (colorado.edu)
	● Explore kinetic and potential energy together
	  ○ Kinetic energy: the energy that is produced by an object due to its motion.
	  ○ Potential energy: stored energy that is in reserve for the future
	● Talking points:
	  ○ "Why would a stretched rubber band aimed at your face, a rock being held over your head, and a live electrical wire on your street make you nervous? All of the objects are in positions that can potentially hurt you. In other words, they have energy ready to be released, and when it is, these objects will do work.
	  ○ Now, imagine a rubber band just sitting in the palm of your hand, a rock on the ground and a wire without any power. These same objects no longer pose a threat. Why? Because they are in different positions and no longer have that energy that has the potential to be released.
	  ○ In science, energy is often described as the ability to do work. So, potential energy is energy that can do work at

	some point in the future. The first scenario described items that all had potential energy. While this potential energy is waiting to do this future work, it must be stored somehow. Due to this, potential energy is also often referred to as stored energy." ○ Energy cannot be created or destroyed. It can only be stored or transferred. PHET Skate Park Activity (see appendix) ● Have students work through an activity sheet (available through google classroom) and experiment with their skate park in relation to the kinetic and potential energy.
Closure:	Review Potential and Kinetic Energy ● Go through follow up questions as a class (see Appendix)

Lesson 2

Name &Time (Minutes Allotted):	Newton's First Law of Motion: Law of Inertia (45 min)
Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Processing and analyzing data and information ● Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data Communicating ● Communicate ideas, explanations, and processes in a variety of ways
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity
Instructional Objectives	Students will be able to experiment with a penny, index card, and cup to further understanding about the law of inertia after discussing the first law of motion.
Assessment:	Formative ● Elbow Penny Activity Sheet (partner work) ○ Question sheet ○ Scoring completion
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Activate engagement and schema with hook video Have student raise hand for support Participation strategy: popcorn participation Group marking strategy: popsicle sticks Circulate room to help students with experiment
Materials:	Smartboard Law of Inertia video: Newton's 3 (three) Laws of Motion - YouTube 15 pennies 15 cups (+ 10 extra different sized cups) 15 index cards 15 Elbow Penny Activity Sheets (Appendix C) Popsicle sticks Class Scenarios on a google document
Lesson Activities:	

Introduction/Hook:	Law of Inertia Video ● Newton's 3 (three) Laws of Motion - YouTube (0-3:30 min) ● Popcorn Participation ○ Get everyone to stand up ○ Have each person say something they got from the video ○ Once they have shared, they can sit down ○ Keep going until all students are sitting down ● Have students write the first law of motion in their notes ○ "An object will stay unchanged unless and until external force acts on it"
Body:	Class Scenarios ● Share a scenario with the class, have students discuss with the person beside them and then answer the question in a class discussion ● 1. Using Newton's first law, explain what happens to your body when an elevator stops between floors. ● 2. Describe 2 safety devices in your car that were designed because of Newton's first law of motion and explain how they work. ● 3. Before the invention of vacuums people use to take their rugs outside and they would beat them. They weren't being cruel or blowing off steam, instead they were using Newton's law of inertia to help keep their homes clean! Explain how beating a carpet got it clean. ● 4. The police are called out to an accident. When they arrive at the scene, they see the following: Describe the science behind why the car didn't make the curve when it hit the patch of ice. Elbow Penny Activity (see Appendix) ● **Learning target: I can explain the law of inertia working in this experiment** ● Summary of activity ○ Penny, Card, Cup Activity ▪ Why does the penny move? ▪ What is the 'path' that the penny moves? ▪ What force is acting on the penny? ● Divide students into groups of 2 via popsicle sticks ● Have materials up at front for groups to grab ● Bring class back together after students worked through first part and made observations ● Have students share their observations (write on board) ● Discuss what a variable is ○ Variable: is any factor that could change or be changed ● Have groups pick one variable to change ○ E.g., cup size, where the penny sits on the index card, roll the penny instead of flick? ● Finish second part of activity ● Come back as a class and share what you changed and did anything happen differently
Closure:	Brainstorm

	● Brainstorm other examples of Newtons First Law of motion with the class.

Lesson 3

Name &Time (Minutes Allotted):	Newton's First Law of Motion: Balanced vs. Unbalanced Forces (45 min)
Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Communicating ● Communicate ideas, explanations, and processes in a variety of ways Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships
Instructional Objectives	Students will be able to contrast balance and unbalanced forces by answering questions individually after watching some videos and a class Venn Diagram activity.
Assessment:	Formative ● Unbalanced vs. Balanced Forces Worksheet (marked completion)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Activate engagement and schema with hook video Have student raise hand for support Call students to put magnets on board via popsicle sticks Participation strategy: Think Pair Share
Materials:	Forces Video: Balanced & Unbalanced Forces | Science Lesson For Kids | Grades 3-5 (generationgenius.com) Magnetic descriptions Whiteboard markers Chromebooks Unbalanced vs. Balanced Forces Worksheet (Appendix D) Unbalanced vs. Balanced Forces Warmup (Appendix E) Star Wars quote on google docs
Lesson Activities:	
Introduction/Hook:	Think pair share ● Have this Star Wars quote on smartboard: "May the force be with you!" ● Have students think about, "When you hear the word force what do you think of?" ● Have students turn to their elbow partner and share ● Come back as a class and take a few examples
Body:	Unbalanced vs. Balanced Forces Video ● Balanced & Unbalanced Forces | Science Lesson For Kids | Grades 3-5 (generationgenius.com)

	● Play the video
	● Have students turn to another elbow partner and tell them one thing they learned from the video
	<u>Class Activity: Venn Diagram</u>
	● **Learning target: I can differentiate between balanced and unbalanced forces**
	● Have some descriptions on magnets
	  o Not equal forces
	  o Opposite directions
	  o Equal in strength
	  o Cause an object to accelerate or decelerate (speed up/slow down)
	  o Object at rest
	  o Act on objects as a push or pull
	  o Equal forces
	  o Cause a change in the direction of the object
	  o Forces
	  o Make the object start up or stop moving
	● Draw a Venn Diagram on the whiteboard
	● Have students one by one come up and put the descriptions in the proper place
	● Once finished check to see if right, have students come up and fix it if necessary
	<u>Unbalanced vs. Balanced Forces Worksheet (see Appendix)</u>
	● Have students grab their chrome books
	● Have students find this worksheet via google classroom
	● They will have to watch two videos and fill in blanks from a word bank based on these videos.

Closure:	<u>Unbalanced vs. Balanced Forces Warmup (see Appendix)</u> ● Bring class back together ● Display a couple of these questions on the board ● Have the class work through these all together

Lesson 4

Name &Time (Minutes Allotted):	Newton's Second Law of Motion: Skatepark Activity (45 min)
Learning Standards: Curricular Competencies	<u>Science</u> Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Communicating ● Communicate ideas, explanations, and processes in a variety of ways <u>Math</u> Communicating and Representing Represent mathematical ideas in concrete, pictorial, and symbolic forms
Learning Standards: Content	<u>Science</u> ● Newton's three laws of motion ● Force of gravity <u>Math</u> ● one-step equations with whole-number coefficients and solutions

Instructional Objectives	Students will be able to solve the skatepark questions by manipulating their skateboarder after spending time learning about mass and its affect on force.
Assessment:	Formative ● PHET Energy Skatepark Activity 2 (scoring completion)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Use popsicle sticks to choose volunteers Have groups of 5 go up to grab chrome books to avoid crowding Chromebook turn around to gain full attention during instructions Demonstrate activity on smartboard before students go Thumbs up/down strategy to check for understanding
Materials:	5 lb. weight 30 lb. weight Smartboard Popsicle sticks Chromebooks PHET Skatepark Activity 2 (Appendix F) Math equation on Google docs
Lesson Activities:	
Introduction/Hook:	Gym Weights Demonstration ● Have a 5 lb. weight and a 30 lb. weight at the front of the classroom ● Ask students: Which weight will be easier to lift up? Why? ● Have two volunteers come to the front and lift the weights. ● Talking points (have students write the second law and formula in notes—write it on the smart board) o This is actually Newton's second law of motion o *Newton's Second Law F=M x A o Acceleration = change in velocity o The greater the mass, the greater the force needed to change the acceleration of an object o Greater mass = harder to get moving and harder to stop
Body:	PHET Skatepark Activity 2 (Appendix) ● **Learning target: I can manipulate force, mass, and acceleration in the PHET skatepark to answer the following questions.** ● Have students grab their chrome books ● Tell them to go to google classroom and they will find an activity in the Science section ● Once they have found it have them turn their chrome books around (toward teacher) ● Demonstrate on smartboard what they are to do ● Thumbs up/down to check for understanding
Closure:	Second Law Math ● A 40 kg baseball is accelerated by 600 m/s2= what force? ● Have students pull out their whiteboards and work with their elbow partner to write out the number sentence. ● Discuss that kg m/s2= N

Lesson 5

Name &Time (Minutes Allotted):	Newton's Second Law of Motion: Hot Wheels Ramp (45 min)

Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Processing and analyzing data and information ● Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas ● Estimate reasonably Communicating and Representing ● Represent mathematical ideas in concrete, pictorial, and symbolic forms
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships ● one-step equations with whole-number coefficients and solutions
Instructional Objectives	Students will be able to predict and record their findings of a car/ramp lab experiment after learning about Newton's second law (impact of mass on acceleration)
Assessment:	Formative ● Hot Wheels Lab Sheet (scoring completion) ● Group Participation (Checklist)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Action participation during hook: creates engagement Use popsicle sticks to make groups Explain instructions before students grab materials Have materials up at front for easy access (have groups pick one person to grab materials) Have students pick one person to record data Bring class back together during experiment for reflection and re-iteration of instructions Cleanup: reward point system for ample clean up in a time limit
Materials:	Hot Wheels Lab Sheet (Appendix G) Smartboard Popsicle Sticks 6 Hot Wheel Cars Wood for ramps Textbooks (6 for each group=30) Measuring tape Exit Ticket questions on google docs Speed/Velocity/Acceleration Scenarios (Appendix H)
Lesson Activities:	
Introduction/Hook:	Speed vs. Velocity vs. Acceleration

	● Tell students the difference between each term is
	● Have them write this in their notes (and the equations)
	● Show Scenarios on Smartboard (see Appendix)
	  o If they think its speed they do "high knees"
	  o If they think its acceleration they do "arm circles"
	  o If they think its velocity they stand and do not move

Body:	Hot Wheels Lab (see Appendix)
	● **Learning target: I can predict findings from a car/ramp experiment using Netwon's second law.**
	● Divide students into groups of four via popsicle sticks
	● Handout the Hot Wheels Lab Sheet to each group
	● Explain instructions
	  o Have groups make a hypothesis first
	  o Come back as a class and read the procedure
	  o Have materials up at the front for the class to grab
	● Have groups come back as a class after experiment
	  o Tell groups based on the data you collected make some estimates if the ramp was raised to 5 books…6 books?
	  o Have groups test those estimations
	● Come back as a class and discuss variables
	  o Talking points:
	  ▪ A couple classes ago we defined what a variable is: is any factor that could change or be changed
	  ▪ There are different types of variables: independent, dependent, and constant variables
	  ▪ Define those (maybe have students write those definitions in their notes)
	● Have groups identify the variables in their experiment and make a concluding statement

Closure:	Exit Ticket
	● Have students return materials to the front and go back to their desks
	● Have students pull out a piece of paper and choose one of these "wonder" questions to reflect on
	  o 1. If we continued to change the angle/steepness/height of the ramp, what do you hypothesize would happen?
	  o 2. If we changed the surface of the ramp, do you think it would have an impact on distance travelled by the Hot Wheels car? Explain why you think that.
	  o 3. If we changed the weight of the Hot Wheels car, do you think it would have an impact on the distance travelled by the car? Explain why you think that.
	  o 4. What could we do to our experiment to determine if the speed of the car was increasing? How could we measure it?

Lesson 6

Name &Time (Minutes Allotted):	Newton's Third Law of Motion (45 min)
Learning Standards: Curricular Competencies	Science

	Questioning and predicting ● Demonstrate a sustained curiosity about a scientific topic or problem of personal interest Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas ● Estimate reasonably
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships
Instructional Objectives	Students will be able to predict and record their findings of a balloon rocket experiment after learning about Newton's third law (a force always has a reaction force).
Assessment:	Formative ● Balloon Rocket Experiment Sheet (scoring completion) ● Group Participation (Checklist)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Action participation during hook: creates engagement Use popsicle sticks to make groups Explain instructions before students grab materials Have materials up at front for easy access (have groups pick one person to grab materials) Have students pick one person to record data Bring class back together during experiment for reflection and re-iteration of instructions Cleanup: reward point system for ample clean up in a time limit Covid Consideration: have only one student blow the balloons up with straw. Have students wash hands and sanitize after activity
Materials:	YouTube video: The Science of Jetpacks and Rockets! - YouTube Smartboard Popsicle sticks Balloon Rocket Experiment (Appendix I) Rocket Graphic Organizer (Appendix J) Tape Balloons Straws Exit ticket questions on google docs
Lesson Activities:	
Introduction/Hook:	Rocket Science Video ● Play The Science of Jetpacks and Rockets! - YouTube ● Follow up question: Based of what you learned from this video what is Newton's third law of motion? ● Answer: For every force there is an equal or opposite reaction

	● Have students write this in their notes
Body:	Balloon Rocket Experiment (see Appendix) ● **Learning target: I can predict findings from a balloon rocket experiment using Newton's third law of motion.** ● Divide students into groups of 4 via popsicle sticks ● Handout the Balloon Rocket Experiment Sheet to each group ● Explain instructions o Procedure: ▪ Students will need balloons, tape, and a straw. ▪ They will discover how they can propel their rocket forward with the instruments using the air from the balloon. ▪ They will test and try things and then adjust their contraption. ▪ They should work together to design and explore with the emphasis on design thinking. ▪ The activity will end with a competition! The teams will line up and race their balloon rockets. (If possible, have someone film the race for a photo finish). o Record your observations o Fill in the blanks on the sheet ● Further Experimentation ● Have students change the independent variable in the experiment (they will need a blank piece of paper to record the following): o Identified the independent variable o Identified the constant variables o Identified the dependent variable o Hypothesis on how you think the change in the independent variable will impact your results o Documented results using scientific vocabulary o Explained how you can clearly see Newton's first and third laws of motion in this activity o Discuss how you could change the experiment to also show Newton's second law of motion ● Race o If there is time have students' race (pick one group member) o Establish rules of cheering (not too loud)
Closure:	Exit Ticket ● Have students return materials to the front ● Have students return to their desks ● Have students grab a piece of paper and answer one of these questions o 1.) You are standing on a raft out in the Shuswap. You dive off the raft. Explain what happens to the diver and the raft.

	○ 2.) Two people are each standing on a skateboard. They push off each other. Explain what happens to the two people. ○ 3.) Create your own scenario and explain the motion using Newton's Three Laws. ● Success Criteria: ○ I have described the motion in the scenario ○ I have used scientific vocabulary ○ I have described all three of Newton's Laws in each answer

Lesson 7

Name &Time (Minutes Allotted):	Review of Newton's Three Laws (45 min)
Learning Standards: Curricular Competencies	Science Communicating ● Communicate ideas, explanations, and processes in a variety of ways Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas ● Estimate reasonably
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Math ● one-step equations with whole-number coefficients and solutions
Instructional Objectives	Students will be able to differentiate between key terms and their meanings by a matching activity after learning about the Laws of Motion in full.
Assessment:	● Formative ○ Force + Motion Matching Activity (observational checklist-who gets it who doesn't) ○ Class Three Laws Reviews (observational checklist-who gets it who doesn't)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Action participation during closure creates engagement Use popsicle sticks to make groups Explain instructions before students go into activity Have students come up with how a bike shows the three laws of motion before playing video (pre-assessment)
Materials:	Ted Talk Video: cf.nearpod.com/neareducation/new/Slide/1009070/iconipad Smartboard 15 Force + Motion Matching Baggies (Appendix K) Popsicle sticks Three Laws Review (Appendix L)
Lesson Activities:	

Introduction/Hook:	Ride a Bike Ted Talk ● cf.nearpod.com/neareducation/new/Slide/1009070/iconipad ● First Law: o Inertia: Every object persists in state of rest or uniform motion in a straight line unless it is compelled to change by a force o It is this inertia that you must overcome to get your bicycle moving ● Second Law: o Force= Mass x Acceleration o The more force you apply the quicker you accelerate ● Third Law: o For every action there is an equal or opposite reaction o Action: As your bicycle wheels spin clockwise the parts of each tire touch the ground push backwards against the Earth o Reaction: The ground pushes forward with the same force against each of your tires
Body:	Force + Motion Matching Activity (see Appendix) ● **Learning target: I can match the terms with their definitions.** ● Divide students into pairs via popsicle sticks ● Give each group a baggy of questions and answers ● Have students match these items together ● Come back as a class and go over the answers and have students fix their matching sets
Closure:	Three Laws Review (see Appendix) ● Have scenarios on the smartboard ● Have the class o Stand up if they think it's the first law of motion o Sit down if they think it's the second law of motion o Put their hands on their head if they think it's the third law of motion

Lesson 8

Name &Time (Minutes Allotted):	Hero Can Experiment (45 min)
Learning Standards: Curricular Competencies	Science Questioning and predicting ● Demonstrate a sustained curiosity about a scientific topic or problem of personal interest Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Processing and analyzing data and information ● Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data Communicating ● Communicate ideas, explanations, and processes in a variety of ways Math Communicating and Representing

	● Represent mathematical ideas in concrete, pictorial, and symbolic forms ADST Ideating ● Generate potential ideas and add to others' ideas Prototyping ● Explore and test a variety of materials for effective use ● Construct a first version of the product or a prototype, as appropriate, making changes to tools, materials, and procedures as needed Sharing ● Reflect on their design thinking and processes, and evaluate their ability to work effectively both as individuals and collaboratively in a group, including their ability to share and maintain an efficient co-operative workspace
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Math ● one-step equations with whole-number coefficients and solutions Power Technology ● power is the rate at which energy is transformed ● devices that transform energy
Instructional Objectives	Students will be able to create a "hero can" to answer an investigative question they created after what they know about Newton's three laws.
Assessment:	Formative ● Participation (Observation: checklist) ● Hero Can Investigative Handout (Scoring Completion)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Use popsicle sticks to make groups Explain instructions before students grab materials Have materials up at front for easy access (have groups pick one person to grab materials) Have students pick one person to record data Bring class back together during experiment for reflection and re-iteration of instructions Cleanup: reward point system for ample clean up in a time limit Covid Consideration: have only one student blow the balloons up with straw. Have students wash hands and sanitize after activity
Materials:	Ton of cans (at least 30 cans plus 10 variety cans) 10 water buckets Fishing line Nails (different sizes at least 10 with the same size) 10 kiddy hammers Hero Can video 10 Hero Can Investigative Handouts (Appendix M) Hero Steam Engine Background information on google docs (Appendix N)
Lesson Activities:	

Introduction/Hook:	<u>Hero Can Video (from last year's class)</u> ● *I cannot add it to this unit plan but can be made available if you need* ● Play video ● Write on the board the investigative questions o Question: Does the hole placement affect motion? Does number of holes affect motion? Do size of holes or can affect motion?
Body:	<u>Hero Can Investigative Experiment</u> ● **Learning target: I can create a hero can to investigate what I know about Newton's three laws.** ● As a class read the background information (see Appendix) o Ask for volunteers to read o We are going to replicate Hero's steam engine with the can's spinning motion ● Class Discussion: Independent vs. Dependent Variable. o What is the difference? o What is a controlled variable? ● Divide students into groups of 3 via popsicle sticks ● Give each group an Hero Can Investigative Experiment Handout (see Appendix) ● Explain Instructions o Part 1: Question: Does the height of hole placement affect motion? ▪ Can #1 = 4 holes placed at the bottom of the can ▪ Can #2 = 4 holes placed near the top of the can ▪ Poke holes into can via a nail (same size) ▪ Place water in can to see motion ▪ Hold can above bucket to avoid spillage ▪ Make observations (depend on your variables chosen) o Part 2: Question: Does the angle of the holes affect motion? ▪ Can #3= 2 holes that are angled one direction and 2 holes that are angled in the opposite direction. ▪ Poke holes into can via nail ▪ Angle nail to right or left after hole is made ▪ Place water in can to see motion ▪ Hold can above bucket to avoid spillage ▪ Make observations o Part 3: Design a Can ▪ Can #4

	▪ Create an investigation to learn more about how the can's motion.
Closure:	Sharing Session ● After each group has designed their can ● Have each group take turns sharing their can's motion ● Have the groups share their question, hypothesis, and observation Graphing ● If there is time have students make bar graphs representing their four cans throughout the experiment ● Go through outline for their bar graph together

Lesson 9

Name &Time (Minutes Allotted):	Roller Coaster Building: Introduction (45 min)
Learning Standards: Curricular Competencies	Science **Questioning and predicting** ● Demonstrate a sustained curiosity about a scientific topic or problem of personal interest **Communicating** ● Communicate ideas, explanations, and processes in a variety of ways ADST: Applied Design **Ideating** ● Generate potential ideas and add to others' ideas
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity ADST: Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy
Instructional Objectives	Students will be able to prepare for their rollercoaster building by participating in discussion after their groups and roles for the rollercoaster project are decided.
Assessment:	Summative ● Rollercoaster building (anecdotal notes) Formative ● Group Question Discussion (observational-anecdotal notes)
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Have an engaging video to raise interest about final project Have groups pre-made (ensure a good leader is in at least every group if possible) Ask volunteers to read to engage students in reading Pause during reading to bring back students Create roles for the final project that switch each day Circulate around the room to pop in during groups' discussions.
Materials:	Roller Coaster Video: Hook - 4K Awesome Twister Roller Coaster Video Smartboard Engineer Process Poster (Appendix O)

	Roller Coaster Physics Reading (Appendix P) Roller Coaster Pre-Building Questions (Appendix Q)
Lesson Activities:	
Introduction/Hook:	Twister Roller Coaster Video Hook - 4K Awesome Twister Roller Coaster Video ● Play the video ● Discussion: Do you see the three laws of motion in this video? ○ First Law: This states that an object at rest stays at rest, or an object in motion stays in motion until acted on by unbalanced force(s). Roller coasters are ruled by the Law of Inertia. Since an object at rest, stays at rest, at the beginning of the ride a stationary roller coaster is at rest and will need to be pushed or pulled along to get it started. Most are pulled up a large hill called a lift hill. The first hill in a conventional roller coaster is always the biggest hill. As the cars go uphill, they store potential energy. Once the cars are put into motion (potential is allowed to be converted into kinetic energy), they will not stop again until the brakes are applied at the end of the ride. The cars are slowed (negative acceleration) eventually to a stop, because of unbalanced forces due to friction acting on them. The riders, which have inertia, are also acted on by unbalanced forces throughout the ride causing them to change their motion. At the top of hills riders rise up in their seats and at the bottom of hills are pushed down deeper into their seats. Inertia might throw a passenger from a car even, but thankfully, the seats belts or safety bars act as an unbalanced force too, on the riders and holds them down to the seat. When a rider gets to the bottom of a hill, the body is still moving downwards, but the seat starts pushes back holding your body in place. Going around turns the riders are acted on by the cars and seat belts, and again overcome inertia to halt the motion of the body from side to side. ○ Second Law: Law is that of Force equaling mass multiplied by acceleration (F=ma). The law states that the acceleration of an object depends on the object's mass and magnitude (strength) or the force acting upon it. You feel this second law when you start going down the hills. Coaster cars and your body have mass. Gravity exerts a force on that mass, which can then cause it to accelerate. The rider feels that force as one moves along the coaster track. The track directs this force on the cars as you race along. The mass of the cars and your body are a constant, thus remain the same from start to finish. The amount of force a rider experiences, varies only with the acceleration of the cars along the track. As the roller coaster speeds up (positive acceleration) racing downhill or turning abruptly, the amount of force a rider fells increases. As the roller coaster slows down (deceleration) due to friction between the wheels and the track or air rushing by, the forces a rider feels ease off.

	Variables an engineer might consider changing the force experienced by the rider include, heightening the coaster, added loops, and sharp turns or increasing the mass of the cars. Regardless of the coaster design aspects or variables one may consider, all of these variables fall into the category of acceleration or mass when calculating the force experienced by a rider. ○ Third Law: states that for every action there is an equal and opposite reaction. This means that as you are pushed down, further, and further in your seat, the seat is pushing back at you. This law comes into play with newer roller coasters too that expose riders to higher G-forces. "G-forces" relate to the acceleration on a body to due to gravity. What happens to your body in a 2 G-force turn? Your body accelerates so rapidly that it experiences forces twice that of the normal force of gravity. Older coasters did not expose riders to very many G-forces as they relied typically only on the force of gravity to accelerate riders. Newer coasters may catapult, sling or use hydraulic or jet forms of propulsion to accelerate riders along faster and faster. These newer coasters have created exciting ways to create action, which you in turn the rider experience as a reaction on your body. ● Introduce the engineering process ○ Show poster (see Appendix) ○ Have students write the steps in their notes
Body:	<u>Roller Coaster Physics Reading (see Appendix)</u> ● Ask for volunteers to read each paragraph <u>Introduction to Building</u> ● **Learning target: I can work with my group to discuss and prepare for rollercoaster building.** ● Have students group made up ahead of time (groups of 3) ● Tell students each day they have a different role ○ Leader= leads the group in decisions (does not always make the decisions but takes everyone's perspectives into consideration) ○ Documenter= records observations, findings, and materials used ○ Materialist= grabs materials for the group (cleans up after lesson) ● Tell students about the building process ○ You need to document all your materials ○ You get a roll of tape and then the rest of the materials are priced (you only have a certain budget to buy materials with) ● Handout discussion questions to groups (see Appendix) ○ Have groups discuss these questions (jot down notes if needed)
Closure:	<u>Class Discussion</u> ● Ask groups what they discussed about the questions

	● Possible exit ticket (if there is time: What potential challenge do you see occurring during the roller coaster building processes? How can you combat this problem?)

Lesson 10

Name &Time (Minutes Allotted):	Roller Coaster Building: Building the Frame (45 min)
Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Communicating ● Communicate ideas, explanations, and processes in a variety of ways ADST Prototyping ● Explore and test a variety of materials for effective use
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy
Instructional Objectives	Students will be able to express their group's teamwork ability by reflecting in a journal entry after constructing the base of their rollercoaster.
Assessment:	Summative ● Rollercoaster Building (anecdotal notes) Formative ● Journal Response: Completion Mark
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Have groups pre-made (maybe roles pre-made for the day if conflict is suspected) Show rollercoaster base examples Demonstrate specific skills needed to create the base Circulate around the room to pop in during groups' discussions and building processes
Materials:	Smartboard Tape Carboard Cardstock Frame/Base Examples (Appendix R) Chromebooks Journal Graphic Organizer (Appendix S)
Lesson Activities:	
Introduction/Hook:	Exit Ticket Discussion ● Ask students to reflect on the problems they see occurring during the rollercoaster building they thought of. ● Lead into a discussion about "What makes an effective team"

	○ Brainstorm web
Body:	Building the Frame ● **Learning target: I can work with my group effectively by participating in my role.** ● Show students examples from last year (Appendix ● Introduce vocab words: ○ Beam ○ Support ○ Brace ○ column ● Demonstrate how to score, cut, tape columns, beams, supports, and braces ● Have students go into the groups, they need to: ○ Decide their roles today ○ Document their materials ○ Build their base ● Talk about each of their individual skills in the group
Closure:	Journal Entry ● Have students grab their chrome books ● Have them find their journal graphic organizer on google classroom (see Appendix) ● Have them make their first entry

Lesson 11

Name &Time (Minutes Allotted):	Roller Coaster Building: Planning the Track (45 min)
Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Communicating ● Communicate ideas, explanations, and processes in a variety of ways ADST Prototyping ● Explore and test a variety of materials for effective use
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy
Instructional Objectives	Students will be able to express their group's teamwork ability by reflecting in a journal entry after planning their rollercoaster's track out.
Assessment:	Summative ● Rollercoaster Building: Anecdotal notes Formative ● Journal Response: Completion Mark
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen

	Have students raise hand for support Have groups pre-made (maybe roles pre-made for the day if conflict is suspected) Show rollercoaster track example Circulate around the room to pop in during groups' discussions and building processes Create specific rules for Chromebook use and investigation time
Materials:	Smartboard Paper Rollercoaster Video Chromebooks Building Tutorial Links (Appendix T) Marbles Carboard Cardstock Tape Journal Graphic Organizer (Appendix S)
Lesson Activities:	
Introduction/Hook:	<u>Paper Rollercoaster Video (from last year)</u> ● Play a video of a paper rollercoaster from last year ● Class Discussion: What did you notice?
Body:	<u>Investigation</u> ● **Learning target: I can work with my group and participate in my role to design a plan for the rollercoaster build.** ● Students switch roles from last class ● Have students go online and research track ideas ● Provide students will a building tutorials link (see Appendix) ● Goals of the Paper Rollercoaster o Marble in motion the longest o Most cost-efficient build o Exciting for 'passengers' (jumps, some speed in places, complexity i.e. stairs, rotating arm) ● Have students in their investigation time think about: o Think about Newton's Laws = what do we need to think about in the design? ▪ Curves ▪ Loop d' loop ▪ Jumps ● After investigation have students draw or write a design plan (detailed! Also include full price for materials) ● If there is time have students practice some techniques (the curve for example on scrap paper)
Closure:	<u>Journal Entry</u> ● Have students grab their chrome books ● Have them find their journal graphic organizer on google classroom (see Appendix) ● Have them make their second entry

Lesson 12

Name &Time (Minutes Allotted):	Roller Coaster Building: Track Building (45 min)

Learning Standards: Curricular Competencies	Science Planning and conducting ● With support, plan appropriate investigations to answer their questions or solve problems they have identified Communicating ● Communicate ideas, explanations, and processes in a variety of ways ADST Prototyping ● Explore and test a variety of materials for effective use ● Construct a first version of the product or a prototype, as appropriate, making changes to tools, materials, and procedures as needed
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy
Instructional Objectives	Students will be able to express their group's teamwork ability by reflecting in a journal entry after
Assessment:	Summative ● Rollercoaster Building (anecdotal notes) Formative ● Journal Response: Completion Mark
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Have groups pre-made (maybe roles pre-made for the day if conflict is suspected) Remind students of the engineer process Brain break to combat problems and frustrations in groups Circulate around the room to pop in during groups' discussions and building processes Have students test techniques before implementing them in rollercoaster project
Materials:	Smartboard YouTube: Engineering Design Process Final Video - Bing video Chromebooks Building Tutorial Links (Appendix T) Marbles Carboard Cardstock Tape Journal Graphic Organizer (Appendix S) Design Plans
Lesson Activities:	
Introduction/Hook:	Review Engineer Process ● Ask students if they remember the steps ● Play Video: Engineering Design Process Final Video - Bing video
Body:	Building the Track

	● **Learning target: I can work with my group and participate in my role to start creating the rollercoaster.** ● Have students go into the groups and switch their roles ● Have them pull out their design plan ● Have them document materials used ● Remind them to take breaks and reflect on their teamwork ● Test out things before adding them to the larger rollercoaster ● Reflect on Newton's 3 Laws (especially law 1 on the curves) ● Take pictures along the way to put into your journal Brain Break ● During the track building grab students attention and participate in calm breathing strategies
Closure:	Journal Entry ● Have students grab their chrome books ● Have them find their journal graphic organizer on google classroom (see Appendix) ● Have them make their third entry

Lesson 13

Name &Time (Minutes Allotted):	Roller Coaster Building: Wrap Up (45 min)
Learning Standards: Curricular Competencies	Science Communicating ● Communicate ideas, explanations, and processes in a variety of ways ADST Sharing ● Reflect on their design thinking and processes, and evaluate their ability to work effectively both as individuals and collaboratively in a group, including their ability to share and maintain an efficient co-operative workspace
Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy
Instructional Objectives	Students will be able to present their rollercoasters by a class sharing session after finishing up the creation and designing process. Students will be able to evaluate their classmates' rollercoaster by a rating scale after a presentation of their rollercoasters (thrill, complexity, length of track).
Assessment:	Formative ● Journal Response: Completion Mark Summative ● Rollercoaster Final Project: Rubric ● Peer Assessment: Rating Scale ● Group Contribution: Rating Scale
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support

	Use popsicle sticks to decide the order of presentation Have students walk around to build excitement and get more in close look at their classmate's structures
Materials:	Smartboard Rollercoaster Structures (completed) Material Cost Sheets (completed) 30 Peer Assessment Rating Scales (Appendix U) Rollercoaster Final Project Rubric (Appendix V) Highlighter 30 Group Contribution Sheets (Appendix W) Popsicle sticks
Lesson Activities:	
Introduction/Hook:	Walk Around ● Have groups take some time to set up their rollercoaster ● Have groups walk around and check out each other's structure ● Come back as a class: o What did you notice? o Did you do something different?
Body:	Sharing Process ● **Learning target: I can present my rollercoaster with my group and evaluate others rollercoasters.** ● Have groups come up and take turns sharing their rollercoaster ● Before placing the marble in the rollercoaster have groups share what different aspects are within the track. ● Have other students vote for complexity, thrill, and timing of the length of track ● Have groups hand in their material cost list ● Have groups fill out a group contribution rating scale of their fellow group members.
Closure:	Journal Entry ● Have students grab their chrome books ● Have them find their journal graphic organizer on google classroom (see Appendix) ● Have them make their fourth and final entry

Lesson 14

Name &Time (Minutes Allotted):	Roller Coaster Building: Report + Reflection
Learning Standards: Curricular Competencies	Science Communicating ● Communicate ideas, explanations, and processes in a variety of ways Math Reasoning and Analyzing ● Use reasoning and logic to explore, analyze, and apply mathematical ideas ADST Sharing ● Reflect on their design thinking and processes, and evaluate their ability to work effectively both as individuals and collaboratively in a group, including their ability to share and maintain an efficient co-operative workspace

Learning Standards: Content	Science ● Newton's three laws of motion ● Force of gravity Power Technology ● power is the rate at which energy is transformed ● forms of energy ● energy is conserved ● devices that transform energy Math ● increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships
Instructional Objectives	Students will be able to analyze their rollercoasters by answering reflective questions in paragraph form after an entire unit on force and motion.
Assessment:	Summative ● Rollercoaster Reflection Questions: Scoring Completion
Teaching Strategies:	Call and Response: 3, 2, 1 Stop and Listen Have students raise hand for support Only tell the voting winner (not the list of who won and who lost) Ask students to fill in class web via popsicle sticks Have 6 students go to the chrome book cart at time to avoid dysfunction Allow students to use their notes and look at their rollercoasters to help them answer their reflective questions
Materials:	Smartboard Chromebooks Drum roll background music Rollercoaster Reflection Questions (Appendix X)
Lesson Activities:	
Introduction/Hook:	Voting Results ● Tell students the results of the voting (who's rollercoaster had the most points?) ● Drum roll….
Body:	Rollercoaster Reflection Questions (see Appendix) ● **Learning Target: I can analyze my rollercoaster to answer questions regarding Newton's laws.** ● Have students grab their chrome books ● Have them go onto google classroom and find the roller coaster reflection questions ● Have them answer the questions by reflecting on their notes, looking at the rollercoasters
Closure:	Class Web ● Have each student come up to the board and write down their favorite part of the rollercoaster process ● Call students up via popsicle sticks

Resources:

Teacherpayteachers.com https://phet.colorado.edu/en/simulations/energy-skate-park Val Silvester

Extensions to Unit:

Roller Coaster Building

- Students could do a field trip to the Playland (would be a multi-day fieldtrip with many expenses). Students would be analyzing and calculating rollercoasters at the Playland. These roller coasters would be analyzed to discover the connect to the laws of motion (physics) and display those connections with mathematical concepts such as tables, graphs, and pictorial charts.

Reflections and Revisions

N/A

Appendix

Appendix A: PHET Skate Park Activity 1

Force, Motion & Energy Skate Park Simulation Investigation 1

Vocabulary

Gravitational Potential Energy: energy STORED in an object as a result of its *vertical* position (HEIGHT).

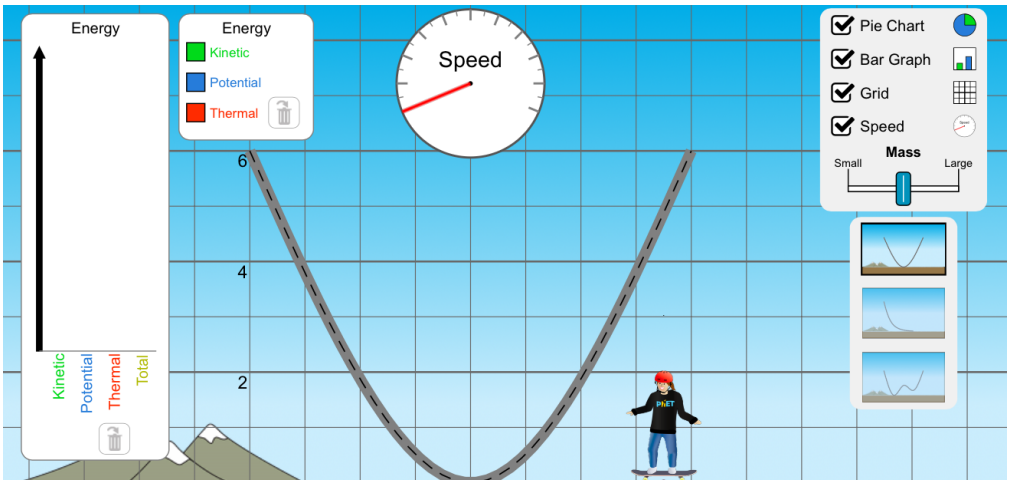
Kinetic Energy: the energy of MOTION

Goals:

- Examine how kinetic and potential energy interact with each other.
- Interpret graphs of data to describe the relationships of kinetic energy to to the speed of an object
- Describe how energy can be transformed and apply to real world situation.

Click

Skate Park Simulation Basics



Set up your screen so that it looks just like the picture.

Answer the following questions in point form

1. Where is potential energy the greatest?

290959568. As the skater goes down the ramp, explain what is happening to the energy. (Watch the pie chart carefully)

290958848. When the skater is ½ down and ½ up the ramp, what do you notice about the potential and kinetic energy?

290961488. Start the skater at 3 different points (6, 4, 2) and explain how changing the starting point height affects the energy levels.

290960688. Increase and decrease the MASS of the skater. Explain how increasing the mass of the skater affects the energy. What is the same and what is different?

290963408. If you were to drop the skater from higher so that they 'dropped' down onto the track, predict what would happen to the skater as they 'skate' the track.

Now try it!

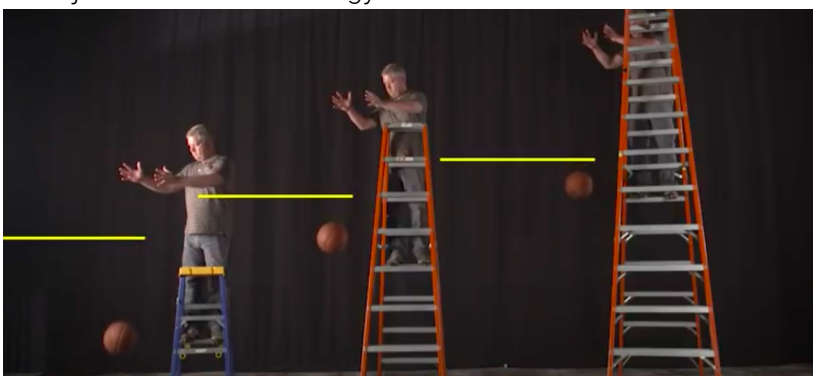
Play with the different tracks and document any observations or questions/wonders.

*** If you know how to do a screenshot, don't forget that you can take a 'picture' to help explain your thinking/learning.

Appendix B: Kinetic vs. Potential Class Review
STEMonstrations: Kinetic and Potential Energy

Kinetic energy is the energy that an object has because of its _____

An object can store its energy based on its _____. This is called potential energy.



The farther from the earth the basketball is released, the

_____ the ball bounced because of its greater GRAVITATIONAL potential energy.

ELASTIC potential energy occurs when objects are _____ or

_____

Our World: Potential and Kinetic Energy

The science of forces, energy and motion is called _____.

At the start of a roller coaster, there is always a tall _____ where the cars are pulled up to the top.

As a roller coaster car goes over the hill and starts moving down, the _____

energy is transferred (changed) into _____ energy. On a roller coaster,

The potential and kinetic energy rely on the force of _____.

STEMonstrations: Kinetic and Potential Energy (Answers)

Kinetic energy is the energy that an object has because of its MOTION.

An object can store its energy based on its POSITION. This is called potential energy.

The farther from the earth the basketball is released, the

HIGHER the ball bounced because of its greater GRAVITATIONAL potential energy.

ELASTIC potential energy occurs when objects are STRETCHED or COMPRESSED.

Our World: Potential and Kinetic Energy (Answers)

The science of forces, energy and motion is called PHYSICS.

At the start of a roller coaster, there is always a tall HILL where the cars are pulled up to the top.

As a roller coaster car goes over the hill and starts moving down, the POTENTIAL

energy is transferred (changed) into KINETIC energy. On a roller coaster,

The potential and kinetic energy rely on the force of GRAVITY.

Appendix C: Elbow Penny Activity

Name:_____ Date:_____

Newton's First Law Of Motion (Law of Inertia)

Materials: pennies, index card, cup

Procedure:

- Place the index card on top of the cup
- Place the penny in the middle of the index card
- Using 3rd finger and thumb, carefully flick the card STRAIGHT with a firm flick

(Safety… be sure no one is sitting across from you)

Hypothesis: When I flick the card, I think the penny will _____

_____

_____

Observations:

A change to a *variable* that I might try is, _____

_____

Observations:

Newton's first law of motion states _____

_____

Using what you have learned about Newton's first law of inertia, scientifically explain what happened in the experiment.

Conclusion: _____

_____

_____

_____

_____

Brainstorm with your classmates examples of Newton's First Law of Motion.

Appendix D: Unbalanced vs. Balanced Worksheets

Newton's Triple Play - Baseball Science

Watch the videos AND read the transcripts to help you. Don't forget to use the GLOSSARY to help you with some of the vocabulary.

Pg. 1

Big Idea: Without forces there would be no _____.

Force is a scientific word for the _____ or _____ on an object that causes a change in the object's position or location.

One force that pulls objects towards the centre of the earth is _____.

FRICTION is a force caused by one object _____ on the surface of another.

Balanced and Unbalanced Forces - Mighty Owl

Forces always have _____ and _____

Forces can be _____ or _____

A BALANCED FORCE is two forces _____ in size acting in

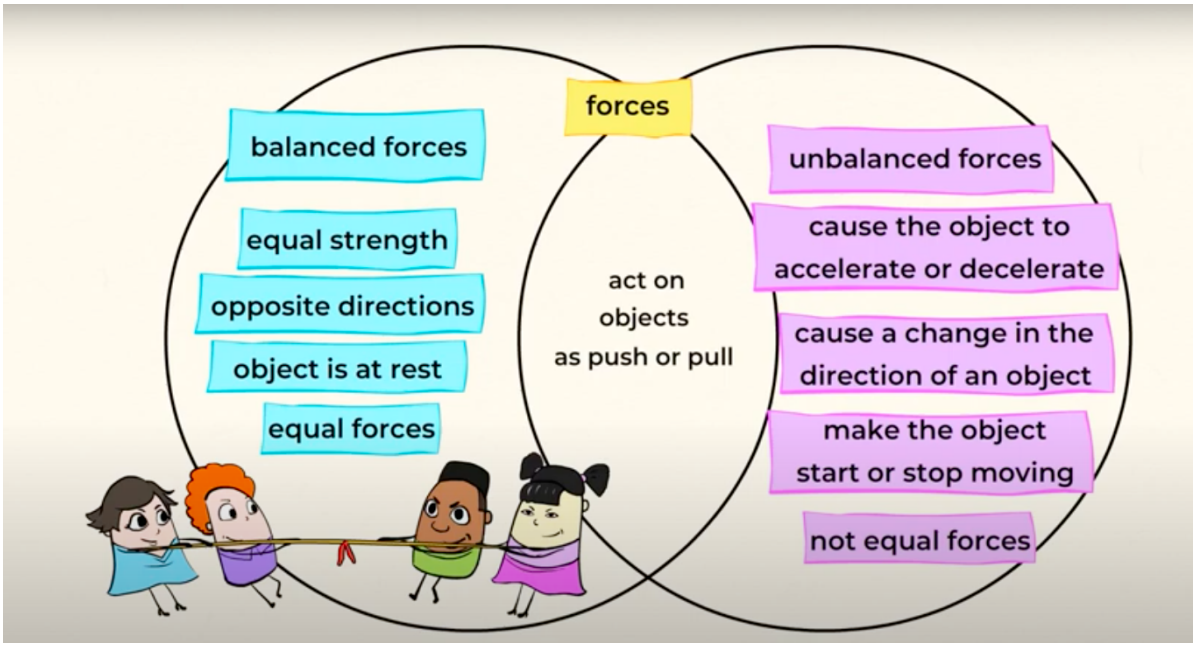
_____ directions. When forces are balanced, they

_____ each other out. There will NOT be a change in an

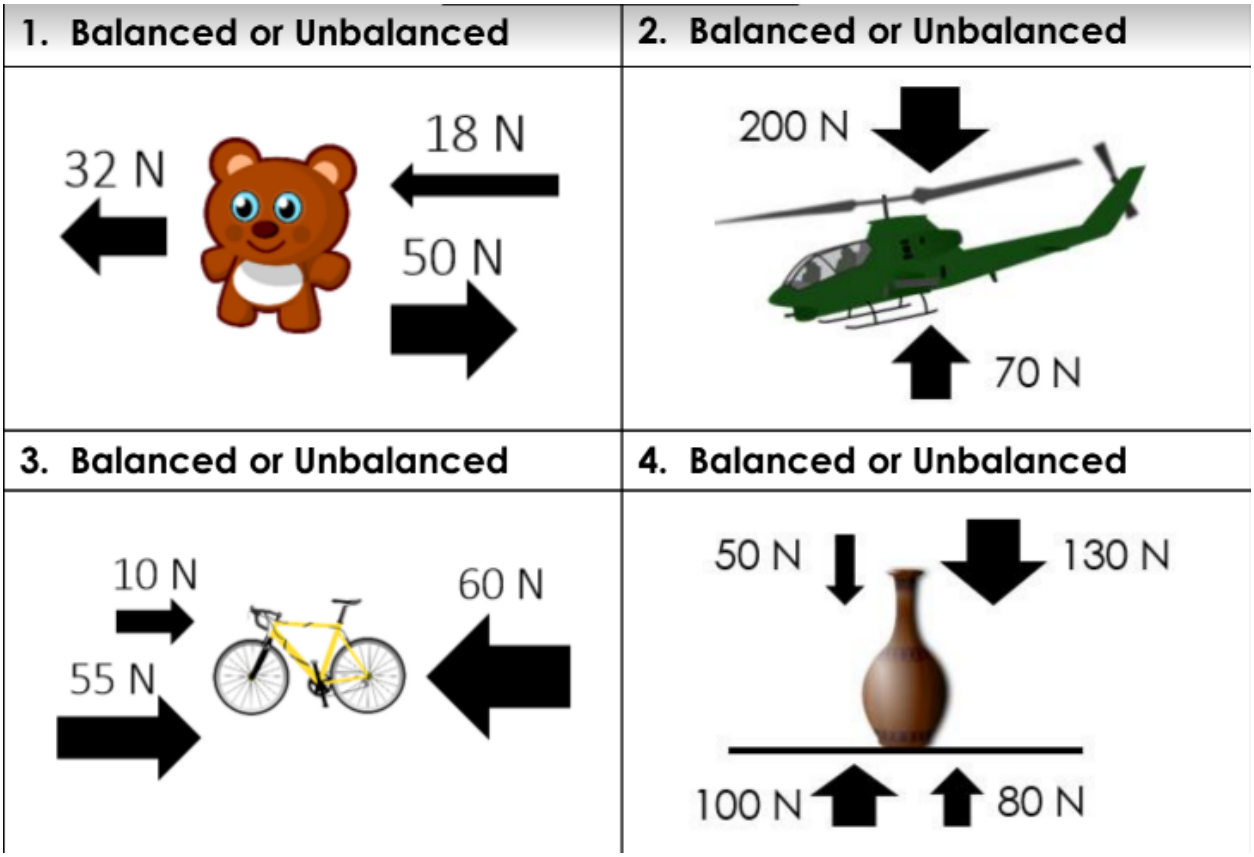
object's position or direction.

UNBALANCED forces have different _____. When forces are

unbalanced, there WILL be a change in an object's position (movement) or direction.



Appendix E: Unbalanced vs. Balanced Warmup

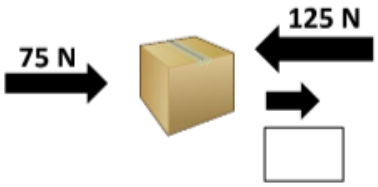


Fill in the missing force to make each statement true. Show your work in the box provided.

1. The box will move to the right with a force of 50 N.

Show your work

2. The box will not move.



Show your work

Write "B" for Balanced or "U" for Unbalanced for the following questions.

1. _____ A person jogging at a constant speed.
2. _____ A car accelerating at a green light.
3. _____ Pushing a lawnmower across the yard.
4. _____ A cookie sitting on a plate.
5. _____ Slowing down to stop at a red light.
6. _____ A bowling ball knocking over pins.
7. _____ A book sitting on a shelf.
8. _____ A linebacker tackling a running back.
9. _____ A person sitting on a chair.
10. _____ A plane flying at a constant speed.

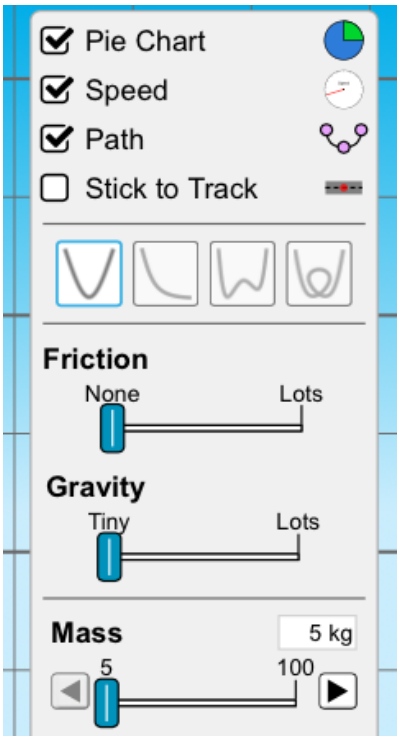
Calculate the net force and write the direction of movement for questions 1-4.

1. Net Force: Direction:	2. Net Force: Direction:
	
3. Net Force: Direction:	**4. Net Force: Direction:**
	

Appendix F: PHET Skatepark Activity 2

Investigating Forces, Motion & Energy - Skate Park Simulation

Goal: Use an interactive simulation to investigate how changes in friction, gravity and mass affect



Review:
Potential energy: stored energy
Kinetic energy:

Step 1.) <u>Setting Up</u>
Clink on the link to go to the simulation [PHET Skate Park Simulation]

1. Pick your 'skater'

290961568. Set up the right side choices to show:
- Pie chart
- Speed
- Path
- Friction = none
- Gravity = Tiny
- Mass = 5 kg

290962528. Click the + symbol on Energy (left side). It will open up a bar graph so that you can watch the energy transfer.
- At the bottom magnifying glass, hit the + button all the way up

290962608. Click GRID at the bottom left corner of the screen as will as the SLOW button i

Step 2: PLAY, OBSERVE, THINK, LEARN

1.) Start with the skater at 5kg and observe the energy graph, then change the mass to 50 kg and finally 100 kg. How does changing the mass affect the energy?

2.) Skater = 50 kg and **FRICTION =** slide to the ½ way point. Describe what you see happening to the path, energy and speed of the skater. What happens when you slide the FRICTION all the way (lots)?

3.) Start the skater from different heights on the track and explain any changes that you see happening.

4.) Keep the skater at 50 kg, friction ½ way and now play with the gravity. Does increasing the gravity have any changes on the energy or speed of the skater?

Show your understanding

Appendix G: Hot Wheels Lab Sheet
Name: Date:

Newton's Second Law of Motion - Hot Wheels Lab

Question: Does the height/steepness/angle of a ramp affect the distance travelled of a Hot Wheels car?

Hypothesis: As I increase the angle/height/ steepness of the ramp, I think_____

_____

Materials: wood for ramp, Hot Wheels car, measuring tape, math textbooks

Procedure:

1. Build a ramp that is 1 text book high
2. Put the car on the ramp so that the back wheels are right at the edge of the ramp
3. Release the car, measure the distance travelled and record the distance in cm
4. Repeat step the third step, 2 more times
5. Find the average of all for launches
6. Now make the ramp 2 textbooks high.

7. Repeat steps 2-5
8. Repeat procedure for 3 and 4 textbooks
9. Compare your results with at least 2 other groups in the class
10. Write a concluding statement based on your results

Newton's Second Law of Motion - Hot Wheels Lab

Hot Wheels Data Table							
Ramp	**Trial 1 Distance cm**	**Trial 2 Distance cm**	**Trial 3 Distance cm**	**My Average Distance cm**	**Class Average Distance cm**	**Class Range cm**	**Class Median cm**
1 book							
2 books							
3 books							
4 books							

Observations based on the data:

Based on the data and the graph that you created, make an estimate on how far you would expect a Hot Wheels car to travel if the ramp was raised to:

5 books:_____

6 books:_____

Carry out the experiment and record your data

Hot Wheels Data Table							
Ramp	**Trial 1 Distance cm**	**Trial 2 Distance cm**	**Trial 3 Distance cm**	**My Average Distance cm**	**Class Average Distance cm**	**Class Range cm**	**Class Median cm**
5 books							

6 books							

Identify the following:

What was the independent variable in the experiment? _____

What was the dependent variable?_____

What were the constant/controlled variables?_____

_____

Write a concluding statement based on your data:

_____

_____

_____

_____

Appendix H: Speed/Velocity/Acceleration Scenarios

Write "S" for Speed, "V" for Velocity, or "A" for Acceleration for each of the following.

S = Speed
V = Velocity
A = Acceleration

1. _____ A snail moving 10 miles per hour.
2. _____ Slowing down at a stop sign.
3. _____ Turning a corner on a bike.
4. _____ Speed in a given direction.
5. _____ Flying 350 miles per hour West.
6. _____ A cheetah running 70 kilometers per hour.
7. _____ A runner speeding up at the start of a race.
8. _____ A snake slithering 20 meters per minute.
9. _____ Kicking a soccer ball 15 meters per second North.
10. _____ The distance an object travels per unit of time.

Appendix I: Balloon Rocket Experiment

Newton's Third Law of Motion

Materials: pencil with eraser on top, pin, balloon, tape, flexible straw

Procedure:

1. Attach the mouth of the balloon to the long end of the straw using a piece of tape
2. Test that the balloon inflates by blowing slightly into the straw
3. Test and try things to move your rocket forward
4. Work together to design and explore your best Balloon Rocket.
5. Make some observations about your Balloon Rocket.
6. The activity will end with a competition! The teams will line up and race their balloon rockets.

Observations:

The Science:

The balloon powered rocket moves because of the **action-reaction** principle that is Newton's third law:

_____

_____

In this activity, the action is_____

The reaction is_____

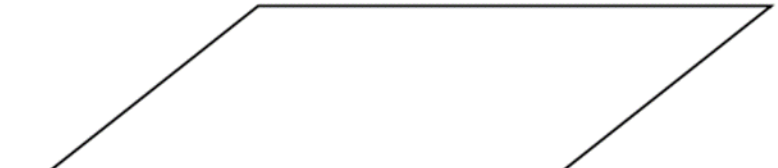
Further Experimentation

It is your turn to do some experimenting by changing some of the **variables** in the experiment. It is important that you clearly document what variable you changed, how you changed it and what impact it had on your results.

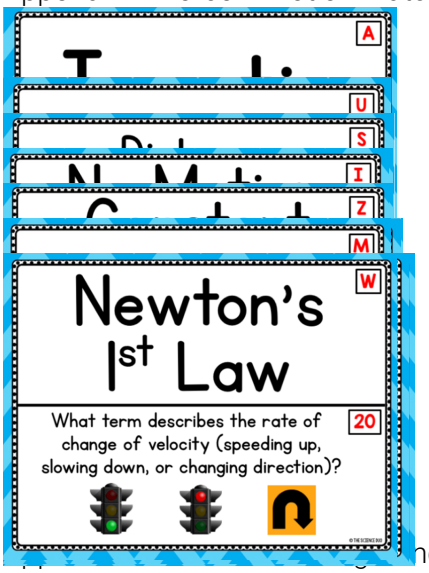
Include the following:

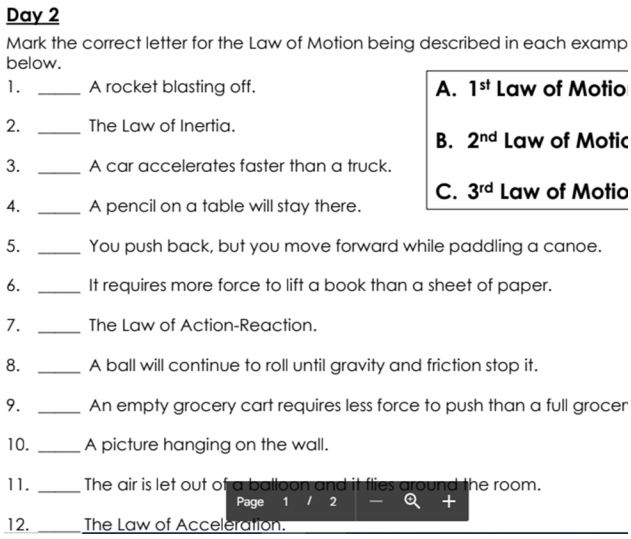
- Identified the independent variable
- Identified the constant variables
- Identified the dependent variable
- Hypothesis on how you think the change in the independent variable will impact your results
- Documented results using scientific vocabulary
- Explained how you can clearly see Newton's first and third laws of motion in this activity
- Discuss how you could change the experiment to also show Newton's second law of motion

Appendix J: Rocket Graphic Organizer



Appendix K: Force + Motion Matching Cards




Day 2

Mark the correct letter for the Law of Motion being described in each examp below.

1. ____ A rocket blasting off.
2. ____ The Law of Inertia.
3. ____ A car accelerates faster than a truck.
4. ____ A pencil on a table will stay there.
5. ____ You push back, but you move forward while paddling a canoe.
6. ____ It requires more force to lift a book than a sheet of paper.
7. ____ The Law of Action-Reaction.
8. ____ A ball will continue to roll until gravity and friction stop it.
9. ____ An empty grocery cart requires less force to push than a full grocer
10. ____ A picture hanging on the wall.
11. ____ The air is let out of a balloon and it flies around the room.
12. ____ The Law of Acceleration.

A. 1st Law of Motio
B. 2nd Law of Motic
C. 3rd Law of Motio

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Appendix L: Background Information

Hero of Alexandria Invented the Steam Engine

Although many people seem to give Thomas Savery the credit for inventing the steam engine in 1698, it was actually invented much earlier than that in Alexandria in Ancient Greece. Although Savery created the first modern steam engine and held the patent for its use, it actually wasn't the first that the world had seen. The credit for that goes to the Ancient Greeks.

What the Steam Engine Is

In its most basic form, a steam engine is a type of engine that uses hot steam to enable it to do its work. In other words, the steam compels the mechanical parts within the engine to move. The invention of the steam engine eventually led to the invention of the train in the 1800's, and it all wouldn't have been possible without the work of the early inventors.

All About Hero of Alexandria

Hero of Alexandria was alive from around 10 – 70 AD. He was a mathematician, engineer, and inventor who was fascinated with the mechanical world and was always looking for ways to improve things. He is considered one of the finest inventors, scientists, and mathematicians of his day. Besides the first steam engine, he had many other inventions to his credit including the first vending machine, a wind-powered organ, and a type of fountain that could stand alone.

Inventing the Steam Engine

Hero's steam engine was rather simple, and some believe that he built it as an amusement or a toy for children. It was called the Aeolipile, and is also referred to as Hero's Engine. This initial engine was a very simple engine that is considered a "radial steam turbine". It also didn't have any blades. When steam left the engine, it caused the center of the device to spin, which generated torque. This is a similar design that is currently being used in rockets.

It is interesting to note that evidence of a device called the Aeolipile was present in writings that came well before Hero's time. For example, Vitruvius mentioned the device by name in one of his works. However, there was no mention of what the device was or what it looked like, so the credit for the first steam engine goes to Hero and not Vitruvius.

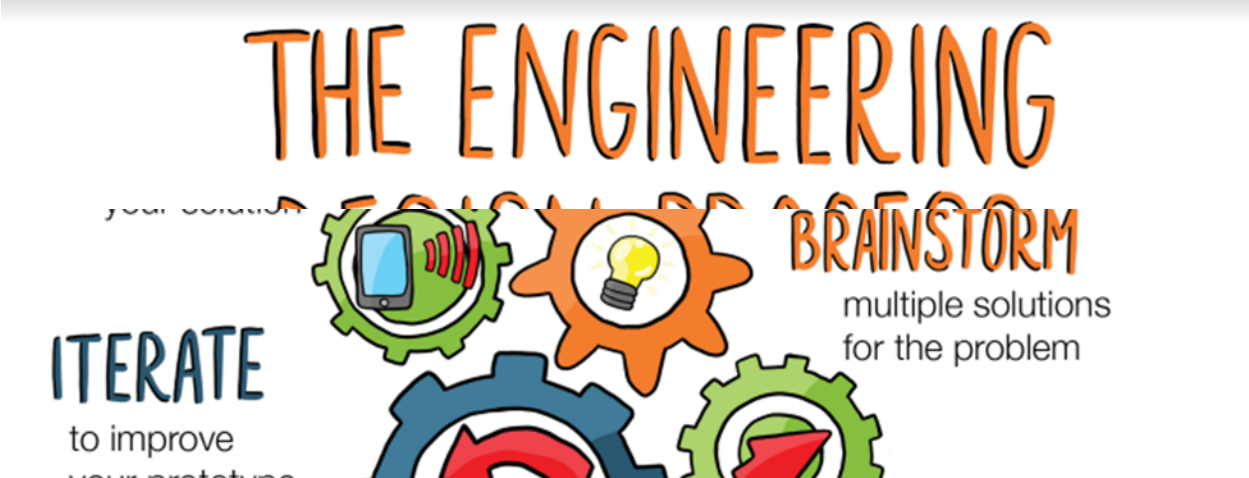
Why the First Steam Engine is Important

What's interesting about Hero's invention is that he created it well before the Industrial Revolution that took place in parts of the world in the 1700's and 1800's. This means that the Ancient Greeks were capable of advanced mathematical, scientific, and mechanical thought, which enabled them to see the world differently. They understood that mathematical and scientific theories provided the foundation to create these wonderful devices.

Although it would be some time before the steam engine was applied in a more practical way, the implications of what Hero accomplished are great. He showed that man is capable of creating great inventions, even when the use of them isn't immediately obvious.

https://www.greekboston.com/culture/inventions/steam-engine/

Appendix O: Engineering Process Poster



King of the THRILL RIDES

There's one theme park ride that's just about everyone's favorite. It's the kinetic/potential energy-shifting g-force/acceleration machine. You probably know it as a roller coaster.

Roller coasters are based on so much physics that it's almost scary! Both the original creaking wooden coasters and the high-tech steel versions demonstrate many important scientific ideas.

Let's start with potential and kinetic energy. Potential energy is stored-up energy. It can be transformed into kinetic energy, or motion.

On a roller coaster, potential energy is stored up as the cars take their long, slow trip up the first and biggest hill. On some coasters, a chain drive connected to a motor hauls the cars up. Others use magnetism or a system of wheels. The moment of greatest potential energy takes place when the car is perched at the very top of the first hill. When the cars go over the top, the potential energy is changed into kinetic energy.

Sir Isaac Newton was an English scientist who lived 300 years ago. He made many discoveries about the science of objects and their motion. His first law describes the state of inertia. Inertia is the tendency of objects at rest to stay at rest, and objects in motion to stay in motion. It takes an outside force to start objects moving or make them stop once they get going.

The first hill on a roller coaster is usually the tallest. As the cars plunge down, they are gaining enough speed to propel them through the rest of the ride.

DID YOU KNOW?

The world's fastest coaster is the Formula Rossa in Abu Dhabi in United Arab Emirates. It reaches a top speed of 149 miles per hour (240 kph).

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Connecting Passage

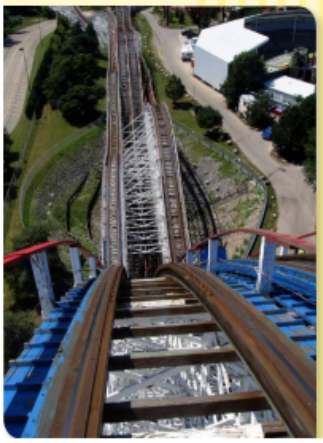
Credits: © iStockphoto.com/Marcio Silva

1

As you descend, you'll feel two forces at work in different ways because of your body's inertia. One is gravity, the force that pulls you and everything else down toward the center of Earth. The other is acceleration, or a change in speed or direction. These two forces combine to make every moment you're on the coaster a thrilling experience.

As the roller coaster gains speed, the seat pushes you forward. But, because of your body's inertia, you feel a force coming from in front of you, pushing you back into the seat. Gravity pulls you down and, at the same time, acceleration seems to be pushing you up.

Inertia plays some funny tricks on your body as you ride the coaster. The moment the car tips over the top of the hill,



At this point on the ride, potential energy has just changed to kinetic energy.

This coaster has enough ups and downs and curves to keep everyone screaming!

it starts down. But your body is separate from the car, so it doesn't head down quite as soon. You may actually lift out of your seat for an instant. Coaster fans call this "air time."

Inertia also causes the organs inside your body to move. Normally your organs feel as if they are anchored in place. But, they're really not. In fact, in a rapid change of acceleration, they separate from each other and feel as if they're floating inside you!

Connecting Passage

Appendix Q: Roller Coaster Pre-Building Questions
Next Steps

Question 1:

- Knowing the law of inertia, what do you need to think about when constructing a roller coaster?
    - What do you need to do in the design to keep the marble going the direction that you want?
    - Where on a roller coaster can Newton's law of inertia be a problem (marble's inertia wants to go in a direction that you don't want it to).
    - How is height of a drop related to potential energy and why is that important for a roller coaster?

Question 2:

- Understanding tweek Kinetic energy
- Reread the definition in the first paragraph and pay attention to the word BECAUSE and think about what that means
- What increases the kinetic energy in the roller coaster?

* in order to fully understand kinetic energy, you need to understand the terms velocity and speed

Question 3:

- Common **misunderstanding** = that potential energy is only at the top of the roller coaster when the marble isn't moving
- Re watch the roller coaster lab if you need to and pay attention to the kinetic and potential energy bars.
- Why is potential energy the greatest at the highest point?

Skate Park Lab

Question 4:
Another Centripetal Force Video

- Make the link in your paragraph to which law centripetal force is connected to
- Watch the video to continue to grow your understanding about this 'centre seeking' force
- Have you answered WHY understanding centripetal force is important to a roller coaster? Think about if you didn't have centripetal force, how that would impact roller coaster design.

*** digging deeper = understanding what is meant by NET forces

Cool Centripetal Force activity to try!

Question 5:

- Thinking about the forces on a marble (will affect a change in speed)
- There are a few words from your vocabulary list that are connected to this question

Question 6:

- Review the challenges brainstorming list to help you think about some of the different ways in which you were challenged

Appendix R: Rollercoaster Frame/Base Example

Appendix S: Journal Graphic Organizer

Paper Roller Coaster Reflections

Applying and Innovating

- Contribute to care for self, others, and community through personal or collaborative approaches
- Cooperatively design projects
- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving

Communicating

- Communicate ideas, explanations, and processes in a variety of ways
- Express and reflect on personal, shared, or others' experiences

Above are some of the *curricular competencies* that we are working on during our roller coaster building. Cooperation, problem solving, innovation (creating a new roller coaster of your own design) and communication. **During the process, you will be reflecting on your own experience.** When asked, you will complete a journal response written in PARAGRAPH form.

- I jotted down brainstorming before I wrote my paragraph

- I documented the date of my reflection
- I edited for capitals and punctuation
- I wrote about something I learned in the building process
- I reflected on my contribution to the group (look at the rubric)
- I reflected on a next step that I can take to improve my contribution
- I reflected on how my group is working as a team (strengths and weaknesses)

E.g. January 1

Appendix T: Building Tutorials

Paper Roller Coaster Tutorials

Tips

- Creating loops, curves, hills, etc. will take practice. EXPECT struggle and frustration at the start because you are learning a new skill that is complex
    - Breath
    - Watch the videos more than once
    - Remind yourself that it won't be perfect, especially the first try
    - It is okay to not use your first try… don't get stuck on 'wasting' money because THIS IS PART of the design process!!! Sometimes this is necessary as you figure things out.
- During the taping process work together to hold and tape
    - Precut small pieces of tape and have them ready to go
    - Think about the different strengths of your team and find a job that they excel at

- Remind yourself that FAILURE is a part of the design process and learning
    - Good failure = figuring things out, realizing what works and doesn't
        - Leads to feeling accomplished when you stick at it
        - Leads to eventual success
    - Giving up
        - 0 growth
        - Leads to negative feelings

Tutorial Videos

Loops

*** If a loop isn't secure and stable, the loop will wiggle and the marble may fall off the loop. If this is happening to you, find a way to give your loop greater stability.

Wide Curves

Sharp Curves

Funnel

Switch

Staircase

Hills, Jumps, Corkscrews, Bumps

Many different track parts

Half Pipe

Elevator Part 1
Elevator Part 2

Inspiration
Completed Coaster

- Kid created

Attack on Dragon Castle Coaster

- Created by the person who created the templates and project (so he's an EXPERT)

Appendix U: Peer Assessment Rating Scales

Group 1:_____

Thrill: How exciting and engaging was this group's rollercoaster?

1. 2. 3. 4. 5.

Complexity: How complex was this group's rollercoaster? (Curves, loops?)

1. 2. 3. 4. 5.

Length: How long did this track last for?

_____seconds

Appendix V: Rollercoaster Final Project Rubric

Student Proficiency	**Undeveloped**	**Developing**	**Accomplished**	**Advanced**
Group Communication	Little if any talking with group. Not actively listening to the speaker. Body language does not reflect engagement.	Uses voice, body language, and listening to communicate most of the time.	Voices opinions and ideas throughout the task. Voice, body, and mind are fully engaged when speaking and listening.	Additionally, uses energy, patience, and inquiry to encourage group members to communicate as well.
Role	Does not know role in the collaborative task.	Knows role, but relies on team members to assign and clarify it.	Knows own role and also the role of other team members. Uses roles of each individual to maximize collaboration.	Additionally, can assign self roles based on own strengths and weaknesses.
Contribution of Ideas	Did not contribute ideas that helped the group achieve success.	Shares ideas and acknowledges others'. However, some ideas lack detail and support.	Contributes ideas to the group and has strong reasoning and support to justify the use of those ideas.	Along with own ideas, builds on others' ideas and incorporates them in the final product.
Self Advocacy	Does not seek assistance from group when necessary.	Asks questions and for assistance from group members as a last resort.	Confidently seeks help from group members whenever necessary.	Additionally, asks others if they need assistance throughout the task.
Work Ethic	Completes few if any of the assigned tasks. Often off-task.	Completes most tasks by the deadline. Mostly on-task.	Completes all tasks by the deadline, and the work is quality and adds significantly to the group's effort.	Along with completing own work, inspires and leads group members to work hard and meet deadlines.

Appendix W: Group Contribution Sheets

Name of Evaluator _____

Evaluee:_____

FOCUS

- Off task
- Little work accomplished
- Actions distract others

1 2 3 4 5

- Always on task
- Amazing amount accomplished
- Words and actions remained on the task

COOPERATION

- Argued, silly, negative
- Didn't listen to ideas of others
- Put others down
- Did own thing
- Focussed on self (took over)

1 2 3 4 5

- Encouraging, supportive, positive
- Listened to the ideas of others
- Built others up with comments
- Excellent effort to help others work well
- Focus on team (helping **all** succeed)

Contribution

- Did not complete daily job
- Did not offer ideas / suggestions solving
- Did not put forth best work

1 2 3 4 5

- Completed daily job with high degree of effectiveness
- Excellent at brainstorming, problem
- High quality work

Ineffective Team Member

1 2 3 4 5

Highly Effective Team Member

Appendix X: Rollercoaster Reflection Questions

Roller Coaster Learning & Reflection

Thinking about what is happening in our roller coasters.

Vocabulary List

You should be including all of these words below. Check them off as you use them.

• Motion	• Resistance
• Force	• Kinetic energy
• Gravity	• Potential energy
• Friction	• Centripetal Force
• Direction	• Newton's 1st law of inertia
• Position	• Newton's 2nd law of acceleration
• Momentum	• Newton's 3rd law of action / reaction

ALL ANSWERS MUST BE IN PARAGRAPH FORM (SENTENCES, CAPITALS, PUNCTUATION)

1.) What is inertia and how does it apply to your roller coaster?

2.) What is kinetic and potential energy? Where does the marble have potential energy in your track?

3.) Where is the potential energy in your coaster? Where is the potential energy the greatest on your rollercoaster?

4.) What causes changes in acceleration in your roller coaster?

5.) What did you learn about yourself during this project (strength & weaknesses)?

6.) In building our roller coasters, we can look at creation and be in awe. Explain your awe of God that stood out in this project.

7.) This project was an opportunity to be a mirror and community builder. Think about your contributions to the project and how you interacted with your group. What specific actions can you think of that reflected these throughlines?

- I have read each sentence carefully and have a capital at the start
- I have edited for 'baby i' errors
- I have used the vocabulary from the list and checked it off
- I have reread each sentence to make sure it is a 1 complete thought
- If I finished early, I have researched more and searched for ways to improve my understanding

FURTHER REDING & REVIEW

Rollercoaster Forces Explained by 8th Grade Students

Daily Testing of Rollercoasters

Extension Project Idea