THOMPSON RIVERS UNIVERSITY | Education & Social Work

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

Unit Title:	Simple Machines	**Number of Lessons**	8	**Time (in weeks):**	2
Name:	Katie Ellis and Lacee Smith	**Subject(s):**	Science	**Grade(s):**	5 / 6

Rationale

This unit is important for students in grades 5/6 because it provides students the opportunity to connect their understanding of simple machines and forces to the machines they interact with in their daily life. Through a mix of guided and open-inquiry, students will explore how simple machines can create different force effects. Students will engage in hands on explorations of simple machines, and practicing manipulating one variable at a time and making observations. At the end of the unit students gets to combine their previous experiences with simple machines and their imaginations to create and design a complex machine.

Overview:

Lesson 1: Pre-assessment

- Jeopardy: small groups, small white board for each group to record answers
- Assessing understanding of forces and simple machines, identifying misconceptions
- Questions about: simple machines, identifying real-world connections, “machines are devices that transfer force and energy”, review law of energy conservation, review different types of energy (kinetic, static), balanced and unbalanced forces
- Brief explanation/introduction to tomorrow’s plan to save time for centres

Lesson 2: Forces activity centres

- Explain centres, complete the 5 centres (10 minutes at each station)
- 25 students divided into 5 premade groups of 5
- As students move through the centres, they have a worksheet that they fill out
- Centres are comprised of:

- Friction: Sandpaper
- Gravity*: Feather and rock
- Magnetism: Magnets and metal items
- Pushing: Springs
- Pulling: Elastic bands

Students fill out a worksheet as they complete the centres.

Lesson 3:

Lever Launcher

Hook/Intro: Get ready to fly today! Today we are going to make mini-rocket launchers!

Introduce levers: Ask students if they have any ideas on how to multiply the amount of force they can apply to an object without any complex machinery? Can they identify any real-world examples of levers being used? Ie. a seesaw, garlic press, claw end of a hammer.
Challenge: Launch your rockets over the wall (a stack of books or a binder standing up).
Students will measure and record the height of the wall, the distance from the wall to the level launcher, and the success of the flight (ie. did the projectile make it over the wall).
Bonus challenge: Target practice, try to hit a target (with or without the wall).
Questions to consider: What adjustments can you make to your lever launcher to get your rockets over the wall? How consistent is the flight path of your projectile?

Lesson 4 *(EARTH DAY)*:
All about the wedge

- Show first section of this video: Rock cutting, using only hammer - YouTube
- Connection to Indigenous ways of knowing here as wedges are present in many old technologies such as arrowheads and antler wedges.
- Pose the question: Where else do we find wedges? What happens when the angle of the wedge changes?

Students in their groups exploring different materials and how wedges are helpful for manipulating materials. Students completing lab worksheet as a group.
Choices:
Potato (cut in half): golf tees, rocks, popsicle sticks
Playdough: cookie cutters, plastic knife, popsicle stick, elastic bands

Lesson 5: Archimedes Screw
Hook: If you were a farmer and needed to get water from the river up the hill to your land, how would you do that? (Imagine electricity and motors do not exist yet, remember water is very heavy)
Activity: Archimedes Screw. Through the Archimedes Screw lab, students will manipulate one aspect of the screw at a time: the incline plane of the screw and the length of the tube that circulates the screw. From this they will discover which scenario maximizes water transport.
Slideshow for lessons 5 – 8 https://docs.google.com/presentation/d/1-ZwV51UxmNH06xyJ51TXfl9-JL1fWRUFFP8y8PHq9kA/edit?usp=sharing

Lesson 6: Rubber Band Racer
Hook: ask the question, “What is one way that I could move a pile of rocks in one go from point A to point B?” The answer we are looking for is a wheelbarrow! Introduce students to the wheel and axle and explain how mechanical advantage works in this system.
Activity: Rubber Band Racer. Each group will build a rubber band racer while filling out the lab report. At the end of the activity, students will have a competition to see whose racer goes the farthest. To close, students will discuss what factors made the winning racer win.

Lesson 7: Pulley on my Heart Strings
Hook: “How does one get water out of a deep well without ever going into it?”
Get students to discuss possible answers with their elbow partners for 2 minutes. After the 2 minutes, see if anyone came up with a pulley as their solution.
Explain mechanical advantage that a pulley system provides.

Activity: Build a flagpole. “You have recently become the leader of a new land! Name your land and create a flag for your new country. Then build a flagpole equip with a pulley system!”
In the lab, students will be able to choose their own materials from a selection provided by the teachers to create a personal flagpole using a working pulley system.

Lesson 8: Complex Machine Design
How can simple machines help us solve problems? How can we combine simple machines to meet the needs of individuals and communities?
Design your own compound machine using at least 2 different simple machines of your choosing. Interview a partner to brainstorm ideas for a machine. Decide on a problem to address and think about functionality and purpose of the complex machine. Students will work in partners to design a complex machine (2D representation), label their diagram, and write a brief paragraph explaining how it works and what it is used for.

CORE COMPETENCIES

Communication	**Thinking**	**Personal & Social**

Connecting and engaging with others - Students engage in informal and structured conversations in which they listen, contribute, develop understanding and relationships, and learn to consider diverse perspectives *Students will be communicating in class wide discussions, in their groups, and also through written word and illustrations throughout the unit* **Focusing on intent and purpose** - Students communicate with intention and purpose. *Students will be communicating in a direct and scientific manner in oral discussion and on paper* **Acquiring and presenting information** - Students communicate by receiving and presenting information. *Students will be receiving information from the teachers and also through the building and testing process of each machine. They will present the information they discovered in a lab report and use that information to inform their final complex machine project.*	• <u>Critical thinking</u> **Creating and innovating** - Students get creative ideas that are novel and have value. *In the flagpole activity, students create their own using materials of their choice. They also create a flag for their imagined country.* • <u>Creative thinking</u> **Analyzing and critiquing** - Students learn to analyze and make judgments about a work, a position, a process, a performance, or another product or act. They reflect to consider purpose and perspectives, pinpoint evidence, use explicit or implicit criteria, make defensible judgments or assessments, and draw conclusions. Students have opportunities for analysis and critique through engagement in formal tasks, informal tasks, and ongoing activities. *Students will analyze data they gather from each activity to come up with a conclusion about the relationship between the forces, motion, the machine, and its variables.* **Questioning and investigating** - They develop and refine questions; create and carry out plans; gather, interpret, and synthesize information and evidence; and	• <u>Positive personal and cultural identity</u> **Identifying personal strengths and abilities** - Students acknowledge their strengths and abilities, and they intentionally consider these as assets, helping them in all aspects of their lives. *Students will be given specific roles to choose from within their groups: scribe, materials manager, checker, builder, and motivator. Of these roles, students will decide for themselves which role would suit their unique personal strengths.* • <u>Social responsibility</u> **Building relationships** - Students build and maintain diverse, positive peer and intergenerational relationships. They are aware and respectful of others' needs and feelings and share their own in appropriate ways. They adjust their words and actions to care for their relationships *Students will be working in groups with self-assigned roles. Students will practice speaking to each other and sharing their ideas in a respectful manner. Students will practice compromising and disagreeing respectfully to maintain their relationships with their peers.*

	reflect to draw reasoned conclusions. *Students will hypothesize what will happen when they change a variable and then test it to find an outcome.* **Designing and developing** - Students think critically to develop ideas. Their ideas may lead to the designing of products or methods or the development of performances and representations in response to problems, events, issues, and needs. *In the last lesson, students develop an imaginary complex machine made up of the simple machines that they learned about and state a purpose or function of the machine they designed.*	

BIG IDEAS

(Multiple subject areas for integrated unit)

Subject Name	**Subject Name**
Grade 5 Science: Machines are devices that transfer force and energy.	**Grade 6 Science:** Effects of balanced and unbalanced forces [balanced forces are equal and opposite forces (e.g., sitting in a chair). Unbalanced forces are unequal; one force is larger (e.g., race cars on different ramps, mousetrap cars, rockets)] in daily physical activities (examples of effects of balanced and unbalanced forces in school sports and physical education activities)

LEARNING STANDARDS

Curricular Competencies	**Content**

Questioning and predicting • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry - *Students will be encouraged to change variables one at a time and record their findings in their lab reports* • Make predictions about the findings of their inquiry - *Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Decide which variable should be changed and measured for a fair test - *Students will be told to change one variable at a time* • Choose appropriate data to collect to answer their questions - *Students will need to decide what information is important and relevant to each variable chance* • Observe, measure, and record data, using appropriate tools, including digital technologies - *Students will fill out a lab report for each activity*	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature

- Use equipment and materials safely, identifying potential risks
  - *Safety will be discussed before each activity*

Processing and analyzing data and information

- Identify First Peoples perspectives and knowledge as sources of information
  - *Examples of Indigenous uses of certain simple machines will be presented*
- Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data
  - *Students will show how changes in a variable affect the outcome*
- Identify patterns and connections in data
  - *Students will identify relationships and patterns between variables and affects*
- Compare data with predictions and develop explanations for results
  - *Students will make a hypothesis, change a variable, and then define a connection and explanation for a result within the lab report*

Communicating

- Communicate ideas, explanations, and processes in a variety of ways
  - Lab f*indings will be reported through written and illustrative means*
  - *The final project will be a sketch and explanation*

Grade 6

- Effects of balanced and unbalanced forces in daily physical activities
- Force of gravity

Prerequisite Concepts and Skills:

Content Knowledge:

- Students must have a basic understanding of forces on earth
- Students understand energy can be transformed by devices that change input energy into a different output energy
- Students understand that energy can be described in these ways: the energy of motion (kinetic), light, sound, thermal, elastic, nuclear, chemical, magnetic, gravitational, and electrical
- Students are aware of the law of energy conservation

Social Skills:

-Able to communicate effectively
-Able to disagree respectfully
-Encourages all voices to be heard
-Aware of how their words impact their relationships

Teacher Preparation Required:

Lesson #	Teacher Preparation Required (See Unit Plan Sample)
Lesson 1	Prep Jeopardy questions and slides https://docs.google.com/presentation/d/1FwcPRTy1np1hh97gKHP1yQMW2DZYh1iJbjBwirGxoyI/edit?usp=sharing Get whiteboard markers for students
Lesson 2	Create centers worksheets and make copies Obtain and organize materials for each center
Lesson 3	Print copies of Simple Machines lab Obtain and organize materials for wedges activity
Lesson 4	Print copies of Simple Machines lab Obtain and organize materials for Lever launchers
Lesson 5	Print copies of Simple Machines lab Obtain and organize materials for Archimedes screw
Lesson 6	Print copies of Simple Machines lab Obtain and organize materials for rubber band racers
Lesson 7	Print copies of Simple Machines lab Obtain and organize materials for flag pulleys
Lesson 8	- Copy of Maker Day Editable Template - Google Docs for each student - Graph paper and blank paper for design - Pencils, pencil crayons, erasers, rulers, and a compass

Cross-Curricular Connections:

ADST: Lessons 3-8 encourage iterative, creative, and experimental processes, students practice revising designs based on observations, results, and feedback. Through this lab students will learn that the choice of their tools will depend on the task.

Arts: Lessons 3-8 make space for students to draw diagrams to show their learning and observations. Students practice using visual arts to communicate their ideas.

English Language Arts: Students will sharpen their writing skills when discussing and creating written descriptions of the learning experience.

Aboriginal Connections/ First Peoples Principles of Learning:

- Learning Recognizes the Role of Indigenous Knowledge:

Traditional Indigenous tools will be explored through simple machines like wedges, for example the antler wedge. Students will be prompted to think about how natural, simple tools were used historically to solve problems.

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

Students are connecting their learning to real-life examples and functions of simple tools. Students will be reflecting on their learning experiences and will change their actions in response to observations and feedback from others in their learning community.

Universal Design for Learning (UDL)

Multiple Means of Representation:
Visual aids: Pictures and visuals to demonstrate activities
Oral explanations to accompany written instructions
Visually appealing slides, large/simple font
Videos to demonstrate simple tools being used for big jobs

Accessing prior knowledge/activating schemas through finding connections to real-life examples of simple tools

Multiple Means of Expression:
Open ended design: Students free to create and find out what works (*within reason ie. safe)
Range of structure in activities (some activities guided; some inquiry based)
Choice of manipulatives when appropriate
Students can draw/illustrate or write their observations
Students provided with lab template to guide learning process
Students provided with checklist for Forces centers to organize thinking

Multiple Means of Engagement:
Peer support: Students working in groups for most activities so they can combine their strengths
Scaffolded group roles/responsibilities: Students self-select a role in the group that allows them to engage in the activities and showcase their abilities
Choices in tools/materials used
Activities encourage active participation of all group members
Wide range of what is considered acceptable performance

Continuity/Repetition: Same lab sheet used for lessons 3-7 so students have practice thinking about each question in a new context. Link to lab worksheet https://docs.google.com/document/d/1w9wUYwrgB3ip6-ZUwV8E6Oa2wkE9DAXJ3WVdOo5_Cs4/edit?usp=sharing

Differentiated Instruction (DI):

Flexible range of "acceptable" engagement in activities depending on individual student goals

Use of non-verbal communication to check-in with certain students

Be ready to diffuse tension with humour with certain students

Upload lab/worksheets to google docs for students that require tech to write (Re: IEP)

Overview of Lessons:

Important links:
-Link to lab worksheet for Lesson 3-7 https://docs.google.com/document/d/1w9wUYwrgB3ip6-ZUwV8E6Oa2wkE9DAXJ3WVdOo5_Cs4/edit?usp=sharing
- Lesson 8: Copy of Maker Day Editable Template - Google Docs
- Lesson 1: Jeopardy questions and slides
https://docs.google.com/presentation/d/1FwcPRTy1np1hh97gKHP1yQMW2DZYh1iJbjBwirGxoyI/edit?usp=sharing
-Lessons 1-8 slides: https://docs.google.com/presentation/d/1-ZwV51UxmNH06xyJ51TXfl9-JL1fWRUFFP8y8PHq9kA/edit?usp=sharing

Lesson 1

Name &Time (Minutes Allotted):	What do you know? 45 minutes
Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts **Processing and analyzing data and information**

	• Identify First Peoples perspectives and knowledge as sources of information *- Examples of Indigenous uses of certain simple machines will be presented* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to work together in small groups to answer questions related to the unit. Students will be able to demonstrate their pre-exisiting knowledge of forces and simple machines. Students will be able to generate examples of simple machines and connect their knowledge to contextualized experiences.
Assessment:	Jeopardy: Groups scores tallied on the board, any group with a correct answer will get a point (no rush to be first to answer, gives students time to process information). Points are just for fun and to motivate students. Assessment "for" learning: Teacher candidate will make note of areas students are proficient or needing more information
Teaching Strategies:	Setting the stage for the unit Accessing prior knowledge and misconceptions in the first lesson of the unit
Materials:	Mini-white boards and markers for students to record/show their answer Tech to show Jeopardy slides
Lesson Activities:	
Introduction/Hook:	Show/demonstrate a simple machine students will be making Introduce unit to students, brief overview of the 8 lessons
Body:	Jeopardy questions! https://docs.google.com/presentation/d/1FwcPRTy1np1hh97gKHP1yQMW2DZYh1iJbjBwirGxoyI/edit?usp=sharing Concepts to include in questioning: Variable questions (what are variables? identify some, what is a constant) Questions to get students to generate a real-life example of a simple machine (draw it) Questions about: forces, simple machines, identifying real-world connections, "machines are devices that transfer force and energy", review law of energy conservation, review different types of energy (kinetic, static).
Closure:	Discussion about tomorrow's lesson and introduction to the worksheet they will be completing. Talk about how centers and labs will be assessed for the unit (lessons 2-7).

Lesson 2

Name &Time (Minutes Allotted):	Forces Activity Centers 1 hour
Learning Standards: Curricular Competencies	**Questioning and predicting**

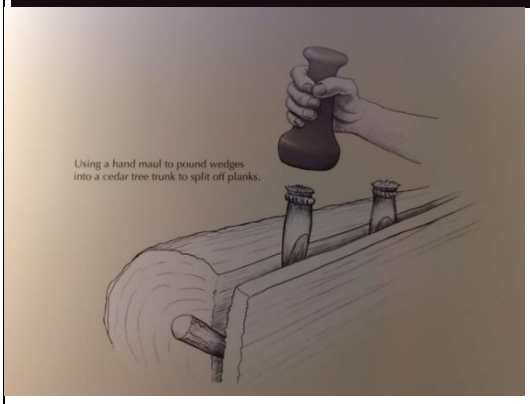
	• Make observations in familiar or unfamiliar contexts **Planning and conducting** • Use equipment and materials safely, identifying potential risks - *Safety will be discussed before each activity* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to demonstrate prior understanding of physical forces that they will need to know for the following lessons on simple machines.
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment** Students complete "Forces Centers Lab Report" to be assessed with proficiency scale for completion/detail. Completion of each activity center (Y/N) Level of detail assessed with proficiency scale (E/D/P/E)
Teaching Strategies:	Centers were briefly explained the previous lesson to speed up the introduction/explanation of each center. Teachers will be circulating the classroom to keep students on track Practice transition cues before starting
Materials:	Materials for EACH center Copies of centers worksheet (1 per student)
Lesson Activities:	
Introduction/Hook:	Explain centers and the worksheet that students complete as they go around the centers. • Explain centers, complete the 5 centers (5-7 minutes at each station) • 25 students divided into groups of 5 (if 26 students one group of 6) • As students move through the centers, they have a worksheet that they fill out Worksheet/checklist includes: 1. What forces are present

	2. Are the forces present contact/non-contact forces 3. An example of where in the real world have, they seen this force in action 4. Definition/explanation of the force in students' own words 5. When is the force in balance, when is it unbalanced?
Body:	Rotating through the centers and completing their checklist as they go • Centers are comprised of: Friction: Sandpaper and hot wheels cars Gravity: Feather and rock Magnetism: Magnets and various metal items Pushing: Springs Pulling: Elastic bands
Closure:	Discussion about what students noticed, anything they missed on their list or needed clarification. Prepare students for next few lessons which are lab-based. Introduce Simple Machines Lab worksheet that will be used in lessons 3-7

Lesson 4* switched for timing reasoning with class schedule

Name &Time (Minutes Allotted):	**All about Wedges** **30 minutes**
Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry *- Students will be encouraged to change variables one at a time and record their findings in their lab reports* • Make predictions about the findings of their inquiry *- Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Decide which variable should be changed and measured for a fair test *- Students will be told to change one variable at a time* • Choose appropriate data to collect to answer their questions *- Students will need to decide what information is important and relevant to each variable chance* • Observe, measure, and record data, using appropriate tools, including digital technologies *- Students will fill out a lab report for each activity* • Use equipment and materials safely, identifying potential risks *- Safety will be discussed before each activity* **Processing and analyzing data and information** • Identify First Peoples perspectives and knowledge as sources of information

	- Examples of Indigenous uses of certain simple machines will be presented • Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data *- Students will show how changes in a variable affect the outcome* • Identify patterns and connections in data *- Students will identify relationships and patterns between variables and affects* • Compare data with predictions and develop explanations for results *- Students will make a hypothesis, change a variable, and then define a connection and explanation for a result within the lab report* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways - Lab f*indings will be reported through written and illustrative means* *- The final project will be a sketch and explanation*
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to create a functional simple machine and explore its properties. Students will be able to change one variable at a time, record the data and explain the changes they observed. Students will be able to communicate their findings using diagrams and/or text.
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment** Students complete “Simple Machines Lab Report” to be assessed with proficiency scale for completion/detail. Link to lab worksheet: **https://docs.google.com/document/d/1w9wUYwrgB3ip6-ZUwV8E6Oa2wkE9DAXJ3WVdOo5_Cs4/edit?usp=sharing**

Teaching Strategies:	Circulate and monitor students but also try not to interfere with student inquiry.
Materials:	-Playdough, plastic knife, popsicle sticks, assortment of "tools" to cut playdough (cookie cutters) -Potato base (cut in half so it sits flat on the table), golf tees/nails other wedge-like object, hammers/something blunt to hit golf tee with, big rocks? https://inventorsoftomorrow.com/2016/10/12/wedges-2/
Lesson Activities:	
Introduction/Hook:	Hook: Show an example of a wedge, see if students can identify or guess what the simple machine is. • Show first section of this video: Rock cutting, using only hammer - YouTube • Connection to Indigenous ways of knowing here as wedges are present in many old technologies such as arrowheads and antler wedges. Antler wedge:   Indigenous Simple Machines - Learning Portal (royalbcmuseum.bc.ca)
Body:	Students in their groups exploring different materials and how wedges are helpful for manipulating materials. Students completing lab worksheet as a group. Choices: Potato (cut in half): golf tees, rocks, popsicle sticks Playdough: cookie cutters, plastic knife, popsicle stick, elastic bands
Closure:	Discussion What "tool" worked the best? Why? What do these efficient tools have in common? -Where else do we find wedges? Students generate examples of wedges in real-life context.

	Blades (axe, scissors) Doorstop (friction) Shim (spacer, adjust heights, often tapered) - What happens when the angle of the wedge changes? (Thick vs thin)

Lesson 3*

Name &Time (Minutes Allotted):	Lever Launchers 45 minutes
Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry *- Students will be encouraged to change variables one at a time and record their findings in their lab reports* • Make predictions about the findings of their inquiry *- Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Decide which variable should be changed and measured for a fair test *- Students will be told to change one variable at a time* • Choose appropriate data to collect to answer their questions *- Students will need to decide what information is important and relevant to each variable change* • Observe, measure, and record data, using appropriate tools, including digital technologies *- Students will fill out a lab report for each activity* • Use equipment and materials safely, identifying potential risks *- Safety will be discussed before each activity* **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 *- Students will show how changes in a variable affect the outcome on the lab worksheet* • Identify patterns and connections in data *- Students will identify relationships and patterns between variables and affects* • Compare data with predictions and develop explanations for results *- Students will make a hypothesis, change a variable, and then define a connection and explanation for a result within the lab report* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways *- Lab findings will be reported through written and illustrative means*
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature

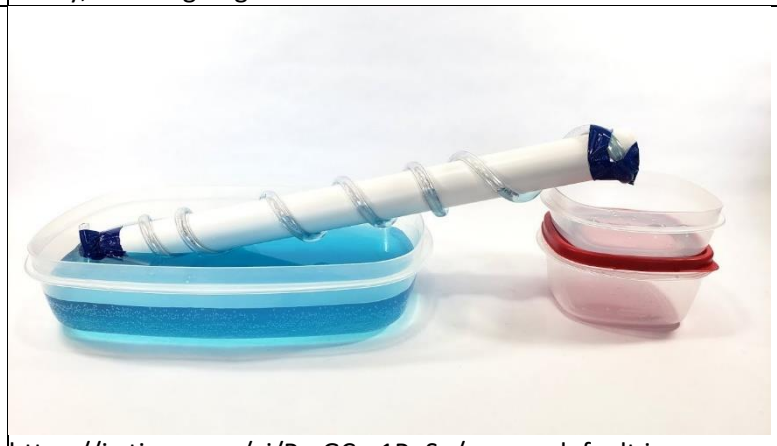
	Grade 6 • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to create a functional simple machine and explore its properties. Students will be able to change one variable at a time, record the data and explain the changes they observed. Students will be able to communicate their findings using diagrams and/or text.
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment:** Students complete "Simple Machines Lab Report" to be assessed with proficiency scale for completion/detail.
Teaching Strategies:	Structuring and explaining worksheet in great detail because it's the first day students are using it. Circulating during work time but still giving students space to try, explore and experiment. Challenge students to launch the various projectiles high/far, into cups prompt thought about angle and amount of pressure applied? What do they notice?
Materials:	Tongue depressors Plastic spoons Elastic bands Plastic cups Mini marshmallows Cheerios Pom poms  https://www.google.com/imgres?imgurl=https%3A%2F%2Fi0.wp.com%2Fandreaknightteacherauthor.com%2Fwp-content%2Fuploads%2F2021%2F09%2Fprojects-for-simple-machines.jpg%3Fssl%3D1&imgrefurl=https%3A%2F%2Fandreaknightteacherauthor.com%2F2015%2F12%2Fsuper-science-simple-machines.html&tbnid=6wOgey9w4EyFRM&vet=12ahUKEwjMw6DK7IX3AhXcGTQIHRs6AEYQMygMegUIARC8AQ..i&docid=S1-eBriOF3x7qM&w=3264&h=2448&q=lever%20launcher%20materials&ved=2ahUKEwjMw6DK7IX3AhXcGTQIHRs6AEYQMygMegUIARC8AQ
Lesson Activities:	

Introduction/Hook: 5 minutes	Get ready to fly today! Today we are going to make mini-rocket launchers! Introduce levers: Ask students if they have any ideas on how to multiply the amount of force they can apply to an object without any complex machinery? Can they identify any real-world examples of levers being used? Ie. a seesaw, garlic press, claw end of a hammer.
Body:	Challenge: Launch your marshmallows/cheerios over the wall (a stack of books or a binder standing up) or into a cup. Students will measure and record the height of the wall, the distance from the wall to the launcher, and the success of the flight (ie. did the projectile make it over the wall). OR the distance from the launcher to the cup. Bonus challenge: Target practice, create and try to hit a target Questions to consider: What adjustments can you make to your lever launcher to get your projectiles over the wall? How consistent is the flight path of your projectile?
Closure:	Class discussion: What factors made the winning launcher win the target practice? What forces were in play? When was the system in balance? When was is unbalanced?

Lesson 5

Name &Time (Minutes Allotted):	Archimedes Screw (screw and incline plane)
Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry *- Students will be encouraged to change variables one at a time and record their findings in their lab reports* • Make predictions about the findings of their inquiry *- Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Decide which variable should be changed and measured for a fair test *- Students will be told to change one variable at a time* • Choose appropriate data to collect to answer their questions *- Students will need to decide what information is important and relevant to each variable chance* • Observe, measure, and record data, using appropriate tools, including digital technologies *- Students will fill out a lab report for each activity* • Use equipment and materials safely, identifying potential risks *- Safety will be discussed before each activity* **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

	- *Students will show how changes in a variable affect the outcome* • Identify patterns and connections in data - *Students will identify relationships and patterns between variables and affects* • Compare data with predictions and develop explanations for results - *Students will make a hypothesis, change a variable, and then define a connection and explanation for a result within the lab report* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways - Lab f*indings will be reported through written and illustrative means* *- Students will communicate thoughts and ideas through class and group discussions*
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to: - Build an Archimedes Screw! - Make a hypothesis about what will be the most efficient system - Manipulate variables one at a time on the screw to determine the most efficient system - See the connection between simple machines and compound machines - Demonstrate mechanical advantage through using the screw
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment** Students complete "Simple Machines Lab Report" to be assessed with proficiency scale for completion/detail.
Teaching Strategies:	- The teacher will have slides prepared and in order of progression with the lesson including a day plan at the beginning of the slides - The teacher will use rhythmic clapping to get the class's attention - The teacher will walk around the room to assist each group throughout the lesson if necessary

Materials:	- Slides including instructions for activity https://docs.google.com/presentation/d/1-ZwV51UxmNH06xyJ51TXfl9-JL1fWRUFFP8y8PHq9kA/edit?usp=sharing these slides include lessons 5 - 8 - 6 short and wide plastic tubes for body - 6 or more long plastic tubes for wrap around - Scissors - Tape (something that remains sticky when wet) - 12 containers - Books for stacking container B to increase the incline plane - Lab reports
Lesson Activities:	
Introduction/Hook:	Prompting question: If you were a farmer and needed to get water from the river up the hill to your land, how would you do that? (Imagine electricity and motors do not exist yet, remember water is very heavy). Think, Pair, Share with your elbow partner a possible solution. Picture of a modern day Archimedes Screw:  The Archimedes screw uses a combination of two types of simple machines: 1) screw 2) incline plane What are incline planes used for? - to move a load vertically with more ease. The Archimedes screw uses both of these machines to transport liquid uphill. Today, we are going to build our own!
Body:	 https://i.ytimg.com/vi/PszGCm1PqSo/maxresdefault.jpg

	In this version of the Archimedes Screw, students will build and manipulate the incline of the body of the screw and the length and number of wrap arounds of the tube wrapping the screw to find out which set up is the most efficient in transporting the water from container A to container B.
Closure:	Class discussion: What worked and what didn't? Students will also be asked what forces were evident in this activity and when was the system in balance and when was it unbalanced.

Lesson 6

Name &Time (Minutes Allotted):	Rubber Band Racer
Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry - *Students will be encouraged to change variables one at a time and record their findings in their lab reports* • Make predictions about the findings of their inquiry - *Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Choose appropriate data to collect to answer their questions - *Students will need to decide what information is important and relevant to each variable chance* • Observe, measure, and record data, using appropriate tools, including digital technologies - *Students will fill out a lab report for each activity* • Use equipment and materials safely, identifying potential risks - *Safety will be discussed before each activity* **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 - *Students will show how changes in a variable affect the outcome* • Identify patterns and connections in data - *Students will identify relationships and patterns between variables and affects* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways - Lab f*indings will be reported through written and illustrative means* *- Students will communicate thoughts and ideas through class and group discussions*
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature

	Grade 6 • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to: - Build a rubber band racer! - Understand how a wheel and axle system works - Demonstrate mechanical advantage with their racers - Identify real world examples of wheel and axle systems - Identify what types of variables increase the efficiency of the system
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment** Students complete "Simple Machines Lab Report" to be assessed with proficiency scale for completion/detail.
Teaching Strategies:	- The teacher will have slides prepared and in order of progression with the lesson including a day plan at the beginning of the slides - The teacher will use rhythmic clapping to get the class's attention - The teacher will walk around the room to assist each group throughout the lesson if necessary
Materials:	- Slides to guide lesson - Instructions projected onto a screen - 24 or more bottle caps with small holes drilled in them - 14 or more straws - 12 or more rubber bands - 4 or more hot glue guns - 14 or more popsicle sticks - 6 scissors - 12 or more toothpicks - Lab reports
Lesson Activities:	
Introduction/Hook:	 This is a pile of rocks. Each rock is at least 10 pounds and there are at least 80 rocks. That's 800 pounds! That's almost 1 ton! If I wanted to move this pile of rocks in one go, what is a way that I could do that. Think, Pair, Share with your neighbour a way that you could do that. The answer we are looking for is with a wheelbarrow!

	
Body:	Can anyone name the type of simple machine that makes up the main part of a wheelbarrow? The answer we are looking for is a wheel and axle! Where in the real world can we find the simple machine wheel and axle? - List answers up on the whiteboard. Discussion about the forces that affect the wheel and axle system and mechanical advantage. Activity: Rubber Band Racer! Each group will build a rubber band racer while filling out the lab report. At the end of the activity, students will have a competition to see whose racer goes the farthest.  Image from: https://i.pinimg.com/originals/40/66/0e/40660e8d9ed703ee421b3ebd4647c190.jpg The video we will use: How To Make a Rubber Band Car (SIMPLE CAR TOY) - YouTube
Closure:	Class discussion to bring it all together. Guiding questions: What factors made the winning racer go the farthest? What forces were involved? When is the car in balance? When is it unbalanced?

Lesson 7

Name &Time (Minutes Allotted):	Pulley on my Heart Strings

Learning Standards: Curricular Competencies	**Questioning and predicting** • Make observations in familiar or unfamiliar contexts • Identify questions to answer or problems to solve through scientific inquiry *- Students will be choosing the materials that they use to create the system and test it. If materials don't work, they can switch up one variable at a time and test different solutions* • Make predictions about the findings of their inquiry *- Students will make a hypothesis about each variable they change and then test their hypothesis to find the answer* **Planning and conducting** • Decide which variable should be changed and measured for a fair test *- Students will be told to change one variable at a time* • Choose appropriate data to collect to answer their questions *- Students will need to decide what information is important and relevant to each variable chance* • Observe, measure, and record data, using appropriate tools, including digital technologies *- Students will fill out a lab report for each activity* • Use equipment and materials safely, identifying potential risks *- Safety will be discussed before each activity* **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 *- Students will show how changes in a variable affect the outcome* • Identify patterns and connections in data *- Students will identify relationships and patterns between variables and affects* • Compare data with predictions and develop explanations for results *- Students will make a hypothesis, change a variable, and then define a connection and explanation for a result within the lab report* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways - Lab f*indings will be reported through written and illustrative means* *- Students will communicate thoughts and ideas through class and group discussions*
Learning Standards: Content	**Grade 5**

	Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to: - Create a flagpole with a pulley system using materials of their choosing - Identify when the system is in balanced and when it is unbalanced - Identify the forces involved with their pulley system - Identify other real-life examples of pulley systems
Assessment:	**Formative assessment:** The student teachers will be walking around during each activity to give immediate feedback on the lab reports and the building activity itself. **Summative Assessment** Students complete "Simple Machines Lab Report" to be assessed with proficiency scale for completion/detail.
Teaching Strategies:	- The teacher will have slides prepared and in order of progression with the lesson including a day plan at the beginning of the slides - The teacher will use rhythmic clapping to get the class's attention - The teacher will walk around the room to assist each group throughout the lesson activity if necessary
Materials:	- Slides with instructions for activity on them - Small pieces of cardstock for flags - Pencil crayons to colour flags - Plenty of string - Scissors - Glue guns Potential pole materials: sticks, straws, popsicle sticks, pencils, etc. Potential pulley materials: buttons, paper clips, binder clips, rubber bands, etc. Potential adhesive materials: sticky tack, hot glue, tape, etc.
Lesson Activities:	
Introduction/Hook:	Pose the following riddle to the class: "How does one get water out of a deep well without ever going into it?" Get students to discuss possible answers with their elbow partners for 2 minutes. After the 2 minutes, see if anyone came up with a pulley as their solution.
Body:	"You have recently become the leader of a new land! Name your land and create a flag for your new country. Then build a flagpole equip with a pulley system!"

	To create this flagpole, students must choose their own materials from the table of mixed materials and determine how to assemble their pulley system to make it functional.  Image from: https://inventorsoftomorrow.com/2016/09/26/pulleys-2/#activities
Closure:	Class discussion: What worked? What didn't work? What forces were involved? When was the system in balance? When was it unbalanced?

Lesson 8

Name &Time (Minutes Allotted):	Complex Design Machine
Learning Standards: Curricular Competencies	**Applying and innovating** • Co-operatively design projects *- Students will each design their own complex machine, but can communicate with their peers in the brainstorming phase* • Transfer and apply learning to new situations *- Students will apply the learning that they have done in the previous lessons to design a complex machine made up of simple machines* • Generate and introduce new or refined ideas when problem solving *- The machines that the students build will be purposed around solving a problem* **Communicating** • Communicate ideas, explanations, and processes in a variety of ways *- The final project will be a design sketch of a complex machine and an explanation of its purpose*

	- Students will communicate thoughts and ideas through class and group discussions
Learning Standards: Content	**Grade 5** Machines • Properties of simple machines and their force effects • Machines: constructed and found in nature **Grade 6** • Effects of balanced and unbalanced forces in daily physical activities • Force of gravity
Instructional Objectives	Students will be able to: - Use at least two simple machines to design a compound/complex machine - Design a machine that addresses a problem - Explain how their design would work - Understand that simple machines provide the building blocks of complex machines - Identify the forces that would affect their machine
Assessment:	Students will mark their own complex machine designs based on a checklist rubric. The teacher will then assess the self-assessment and the project.
Teaching Strategies:	- The teacher will have slides prepared and in order of progression with the lesson including a day plan at the beginning of the slides - The teacher will use rhythmic clapping to get the class's attention - The teacher will walk around the room to assist each group throughout the lesson if necessary
Materials:	- Slides with instructions for the activity on them - Blank and graph paper as options for drafting their complex machine - Rulers, pencils, pencil crayons, compasses, and erasers
Lesson Activities:	
Introduction/Hook:	Students will be given a list of question prompts to ask their partners while filling out the Maker Day template including: - What kind of problems do you run into at home or at school that a machine could solve? - What is a task that you dislike doing? - What are some chores that you do at home? - Is there a machine that you use frequently that could be improved? Students will then interview their desk partners and begin to fill out the Maker Day template: Copy of Maker Day Editable Template - Google Docs While filling out the template, they will be told that their designs MUST incorporate two or more types of simple machines.
Body:	Once students are done filling out their Maker Day templates, they will pick one idea to design in more detail. They will then draw out their design

	on paper and write a description of what their machine is designed to do and why, highlighting where the simple machines are incorporated.
Closure:	If students would like to share, they can tape their designs on the wall and the class will do a gallery walk around the classroom and observe each project.

Resources:

Resources for information/content:
Overview on forces: Types of Forces (physicsclassroom.com)
PBS video on simple machines: Our World: Simple Machines - Here and In Space | PBS LearningMedia
Flagpole pulley system activity: https://inventorsoftomorrow.com/2016/09/26/pulleys-2/#activities
Overview of balanced/unbalanced forces: https://examples.yourdictionary.com/balanced-unbalanced-forces-world-around-you
Indigenous wedge tool: Indigenous Simple Machines - Learning Portal (royalbcmuseum.bc.ca)

Resources we created to use in this unit plan:

- **Lab Report for lessons 3 - 6:** https://docs.google.com/document/d/1w9wUYwrgB3ip6-ZUwV8E6Oa2wkE9DAXJ3WVdOo5_Cs4/edit?usp=sharing
- **Slides for classes 5 – 8:** https://docs.google.com/presentation/d/1-ZwV51UxmNH06xyJ51TXfl9-JL1fWRUFFP8y8PHq9kA/edit?usp=sharing
- **Compound machine grading rubric for lesson 8:** https://docs.google.com/document/d/1Jz9gBFWd0S4mBvM9W45PwLQ4jgOEJIfkWWMM8MviyLA/edit?usp=sharing
- **Instructions for lessons 5 – 6 and worksheet for lesson 7 (pulleys)** https://docs.google.com/document/d/1YevzUB4uuc83Co6QxQ8fYeF2SG8tCeMtURA62A9zdDw/edit?usp=sharing

Extensions to Unit:

Students could be given more time to develop their complex machine design before the gallery walk. During the walk, there would be a feedback piece of paper beside each project so students could leave comments about what they liked and how the design could be further developed. After the walk, the class could nominate three of their favourite machines. The three machines with the greatest number of nominations would then go into a final round where each student votes on the machine that they would like to build. Once a machine is decided, the project would go into a more detailed design phase where materials would be discussed. There could be multiple iterations of design with this machine. Finally, the class would build and test the machine together.

Reflections and Revisions