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| **Title**  | The Newton Challenge |
| **Introduction**  | Manufacturing Plants like Ply Gem make wise decisions to harvest the most energy possible using the least amount energy. Lean manufacturing process like this are vitally important for improvement of environmental issues. Isaac Newton’s Law are fundamental to life. Newton realized that objects fall to the ground on Earth, once in motion they stay in motion, and forces have opposite and equal reactions. Using lean manufacturing ideas, the science of Newton, the Engineering Design Process, and much needed “soft skills”; like communication and teamwork, will help students achieve success.  |
| **Curriculum** **Alignment**  | **NC Essential Standards**  Content Area: Science Grade Level: 7  **NC Standard Course of Study**: 7.P.2.4 Content Area: Math Grade Level: 6, 7  **Common Core**: 6.RP.3, 7. RP. 1, 7. G.5 Content Area: Engineering Grade Level: Middle School (6-8) **Next Generation Standard**: MS. Engineering Design |
| **Learning** **Outcomes**  | *Students will gain a working definition of the six types of Simple Machines* *Students will be able to identify Simple Machines as small parts of Complex Machines in a real-world situations.* *Students will gain a working knowledge of Newton’s Laws.* *Students will use the Engineering Design Process to compete.* *Students will complete a Lab Report that is focused and supported, including both hands-on resources, virtual resources, and people as resources.* *Students will express their ideas on Simple and Compound Machines, as well as Newton’s Laws clearly both verbally and in writing.*  |
| **Time** **Required and** **Location** | Location: Science Lab with tables for each group of 3-4 Time: 8 - 60 minute Periods |
| **Materials** **Needed** | *Teacher List* * *Lesson Plan*
* *Simple Machine Station Guide*
* *Key Note/Power Point on Newton Challenge*
* *The Newton Challenge Handout (teacher version)*
* *The Make and Race a Balloon-Powered Car Worksheet*
* *EDP Rubric to use for Cars*

*Student List* * *Simple Machine Lab Report*
* *The Newton Challenge Hand Out (student copy)*
* *The Make and Race a Balloon-Powered Car Worksheet*
* *1 computer for every group*
* *Various recycled, “building” supplies contributed by students*
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| **Safety** | Students must have satisfactorily completed the *Lab Safety Assignment.* Students must have a signed *Student Safety Contract* on file. ( see attachment 1) My students and parents read and sign this during the first week of school.  |
| **Student Prior** **Knowledge**  | These activities are designed to be part of a unit on force and motion. Students should be familiar with the concept of energies in various forms, potential, kinetic, and how they become mechanical. Students must also understand the basic concepts of work, effort, force, and motion. |
| **Teacher** **Preparations**  | * Become familiar with various types of Simple Machines, and how they from Compound Machines.
* Become familiar with various energies (kinetic, potential, and mechanical), as well as Newton’s Laws.
* Become familiar with Lean Manufacturing Techniques
* If necessary, reserve computers, or print copies of assignments and lab reports for this lesson.
* Assign Students Lab Partners, or put into groups of 3-4.
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| **Activities** | Day 1: 60 minutes***Engage:*** Direct students to begin class with warm-up exercise, an eight question survey (google form) addressing preconceived idea on Machines, Newton, and Recycling. see newton\_preassessment [10 minutes] Open class discussion by asking the students to define the word “machine.” [5 minutes] Toss a soft ball into the class and have students share their thinking after they have caught the ball. Write down their responses on a surface that the whole class can see. [5 minutes] Read the Simple Machine Reading and answer the questions see introduction\_to\_machines\_reading (25minutes) Class Wrap-up/dismissal (5 minutes) Day 2: 60 minutes ***Explore:*** Students will begin class with a warm up. Add the following definitions to your notebook. (5 minutes) Simple Machine Lever Wheel and Axel PulleyIn prearranged groups of 3-4. Students will explore simple machine stations [35 minutes] see simple\_machine\_station\_guide\_demo2Students will return to tables in groups to complete the “Simple Machine Lab Report” which is found at the end of the above document (15 minutes] Class Wrap-up/dismissal (5 minutes) Day 3: 60 minutes ***Explain:*** Students will begin class with a warm up. Add the following definitions to your notebook: (5 minutes) Wedge Ramp ScrewStudents will share lab findings from worksheet. As a class we will discuss the definition and function of each simple machine. (20 minutes) Answer the following questions as a class: * What type of simple machines did you see in your lab?
* What type of simple machines do you use daily? - Were you surprised at any of the “machines” - How does a wedge work?
* How does a screw work, and how is it different from a nail?

Students will chose a partner for a school exploration trip. (20 minutes) Each pair will take a clip board with the **Chase Middle Simple Machine Scavenger Hunt** (I designed this for my school, but it could easily work for others) Class wrap up discussion/ dismissal (15 minutes) Ask the following: * What type of simple machines did you see today?
* Tell me at least one new thing that you learned today. - Is this the first time that you noticed these machines?

Day 4: 60 minutes ***Explain:*** Students will begin class with a warm up. Add the following definitions to your notebook: (5 minutes) Force Friction Mass Momentum Students will research Isaac Newton. After a brief introduction, students, in groups of 2, will be given the entire class period to develop a presentation on Newton. (55 minutes) See attachment for newton\_presentation\_class\_project2. Day 5: 60 minutes Presentation day! No warm up today, we will need all class time to present. Students will present their Newton Presentation: Each group will have around 5 minutes to share their presentation with the class. Day 6: 60 minutes Introduce the Challenge see the Newton Challenge Handout see newton\_challange\_handout Ask, Plan, and Design phases Day 7: 60 minutes Build, Test, and Improve phases Day 8: 60 minutes Final RACE DAY!  |
| **Assessment** | *Knowledge of machines and its application to standards will be assessed by formative assessments (listening to group talk, write to learn exercises, etc.).* *Some assessments are as follows:* 1. *Lab report for simple machines*
2. *Newton Challenge Worksheet*
3. *Rubric for engineering design process*
4. *Rubric for presentation*

*As always class participation will be evaluated* |
| **Critical** **Vocabulary**  | Compound Machine -machine that is a combination of two or more simple machines. Inclined Plane - simple machine that consists of a sloping surface, such as a ramp, that reduces the amount of force needed to lift something by increasing the distance over which the force is applied. Lever - simple machine consisting of a bar free to pivot about a fixed point called the fulcrumPulley -simple machine that consists of a grooved wheel with a rope, chain, or cable running along the groove; can be either fixed or movable. Screw- simple machine that consists of an inclined plane wrapped in a spiral around a cylindrical post. Simple Machine - machine that does work with only one movement—lever, pulley, wheel and axle, inclined plane, screw, and wedge *.* Wedge - simple machine that is an inclined plane with one or two sloping sides. Wheel and Axle - simple machine that consists of a shaft or axle attached to the center of a larger wheel, so that the shaft and the wheel rotate together.  Mass - A lighter mass will speed up more quickly than a heavier mass if the same force is applied. A lighter rocket will speed up more quickly and will also be easier to launch because it will have less gravity acting on it. A good example of the effect of mass is to think of a light person and a heavy person sitting on two swings. If each person is given the same size push, the lighter person will speed up more quickly. A light balloon car will speed up more quickly. Force -A larger force will cause an object to speed up more. For a balloon car, it is good to use a fresh balloon each time and blow it up well. To maximize the forward force, friction from the wheels (and perhaps from air resistance) also needs to be minimized. Momentum - Once the car is moving, it will keep moving because of its momentum, even though the balloon is deflated. Momentum is equal to mass multiplied by velocity. Newton’s first law states that an object at rest will tend to remain at rest and that an object that is moving will tend to keep moving at a constant speed in a straight line until an external force acts on it.Friction -The car will slow down and stop due to the opposing force of friction. There are two kinds of friction: air resistance and the friction as the surfaces of the axle, body of the car, wheels and ground move past each other. Ideas of streamlining and designing good axles and wheels are intended to reduce friction. In this challenge, minimizing friction caused by surfaces rubbing together is more important than streamlining.  |
| **Community** **Engagement** | * Presentations to business, economic development, education community groups
* Display students “Simple Machines”
* Parent - Guest Speaker
* Virtual Tour of Ply Gem
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| **Extension** **Activities**  | **Science Journal Entries:** Students will explore their homes, their own personal space outside of school. Create a science journal entry about at least 3 simple and/or compound machines in your space. Your Journal Entry should have: 1. List of machines
2. Drawing of Machines 3- In your own words describe why one of these machines makes life easier!

**Simple Machine Games:** If students have successfully creates required assignments they will be allowed to explore simple machines through the games at the following link: [http://www.edheads.org/activities/simple%2Dmachines](http://www.edheads.org/activities/simple-machines) |
| **Modifications**  | * Mac books will read aloud for ESL students
* Extra time will be provided when need to meet modifications
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| **Alternative** **Assessments**  | * I will work with EC Teacher to meet all needs.
* Extra time will be given for project as needed.
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