Resident scientist: Joseph Mwangi
Teacher: Kathy Melious

Grade level: AP physics
Time allocation: 1.5 lessons
Learning objectives

- Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units (I don't see this in your lesson plan) In the calculation at the bottom of the page, the forces have been represented mathematically i.e. for example saying mg-T=Ma, the goal was for the students to be able to give such an expression, they had previously, in a different activity represented forces in diagrams.
- Predict the motion of an object subject to forces exerted by another object using an application of Newton's second law (I don't see this in your lesson plan)-After hanging the masses on the pulleys, the students are supposed to predict the direction of the resultant force (motion), this depends on the resultant
- Use data collected and mathematical representation to solve for the acceleration of an object.

Engaging the students - 10 minutes

Ask the students whether they have ever used a pulley or played See Saw with their friends. Also ask them whether they have lifted heavy items and how it compares with lifting heavy items using machines, ask them what kind of machines they used.
Based on their answers, build a discussion on how pulleys can be used to lift heavy items using less energy

Explore-30 minutes

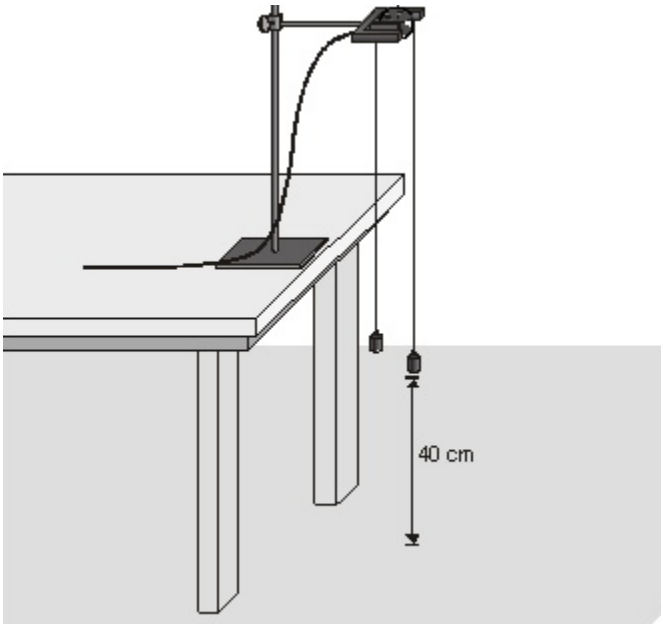
To explore the concepts and skills being developed through the lesson, give the students the machine parts, i.e. a pulley, a string, a system of masses, a complete (I've never heard this called a "complete stand")-here I meant to mean with the stand components already assembled stand, Motion detector and a Vernier software instrument. (I'm a little confused here Joseph – what movement are you measuring? Distance that masses are moved? And what exactly is the Vernier software instrument measuring?)-The motion detector is connected to the Vernier software instrument was to assist in collecting the data i.e. T, tension and acceleration, a which were used in the calculation below.

Ask the students to connect it in a way that it would enable them to operate it as a pulley.

Students will work in groups of four and be able to identify

- Independent variable- Force applied to the machine
- Dependent variable- Movement of mass on the machine
- Constant: The lab equipment

They should be able to connect up the machine and look close to this



Explain

Ask the students to explain how they connected the parts and how they plan to use it to collect the data.

Correct any mistakes or misunderstandings and let them collect the data.

Provide the following tables and ask them what data they need to collect

Part I: Total Mass Constant					
Trial	m_1 (g)	m_2 (g)	Acceleration (m/s^2)	Δm (g)	m_T (g)
1					
2					
3					
4					
5					

Part II: The Mass Difference Constant					
Trial	m_1 (g)	m_2 (g)	Acceleration (m/s^2)	Δm (g)	m_T (g)
1					
2					
3					
4					
5					

Elaborating on the concept- 30 minutes

Go through the data collected and use it to solve problems to calculate g i.e.

Write Newton's 2nd Law equations for both objects, taking care to note the positive y direction:

$m_1 g - T = m_1 a\ (1)$

$T - m_2 g = m_2 a (2)$

Next, combine the equations and eliminate T by solving for T in equation (2) and substituting in for T in equation (1).

$T - m_2 g = m_2 a (2)$

$T = m_2 g + m_2 a \qquad (2b)$

$m_1 g - m_2 g - m_2 a = m_1 a \quad (1+2b)$

Finally, solve for the acceleration of the system.

$m_1 g - m_2 g - m_2 a = m_1 a \quad (1+2b)$

$m_1 g - m_2 g = m_1 a + m_2 a$

$g(m_1 - m_2) = a(m_1 + m_2)$

$$a = g\frac{(m_1 - m_2)}{(m_1 + m_2)}$$

Evaluation: A homework given with problems related to the topic and follow up.

Can you include the homework assignment. Did you teach this lesson? If so, can reflect on the teaching and students' learning. Yes I can pull the homework, and I did teach the lesson.

Reflection on the teaching and students' learning

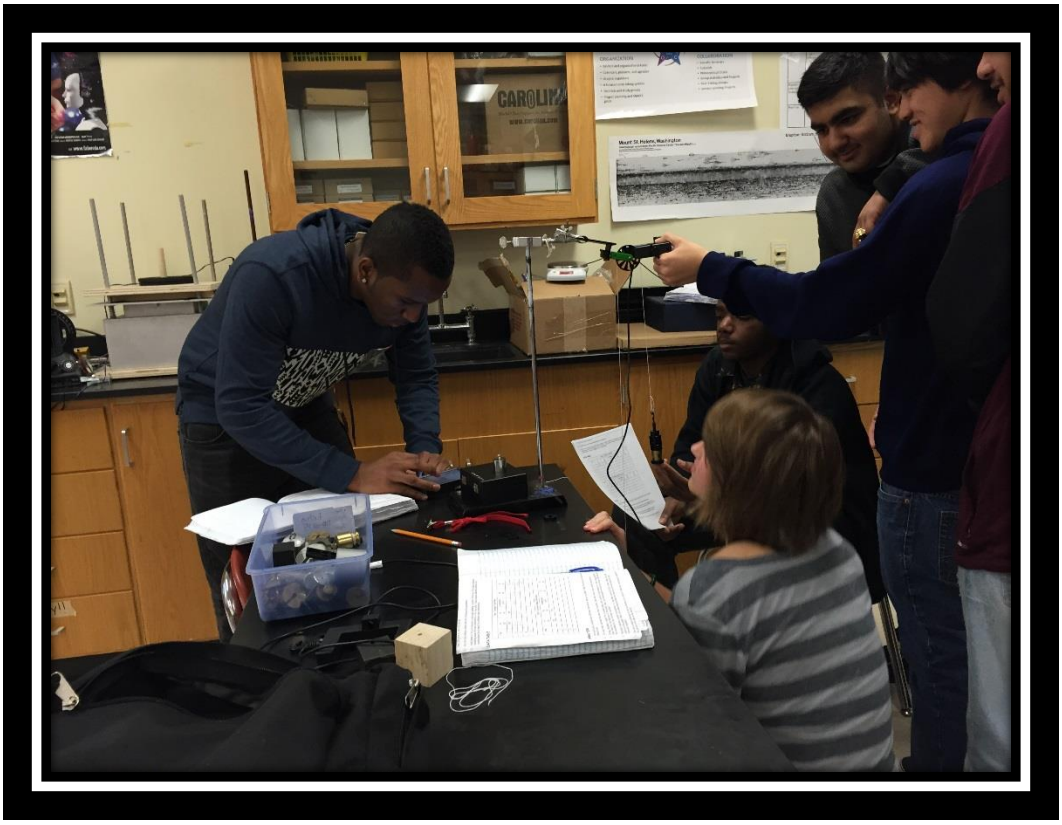
- The activity was supposed to be done in groups of four but since the class has only six students, all of them were in one group, it could have been better if it was a group of three, all students did not participate in equal measures due to this
- Positioning of the motion detector (meant to detect the motion of the string around the pulley) was an issue at the start but I helped the students position it accordingly
- Using the data from the software to calculate acceleration using the equations above was challenging but after going through with them, they seemed to understand it better

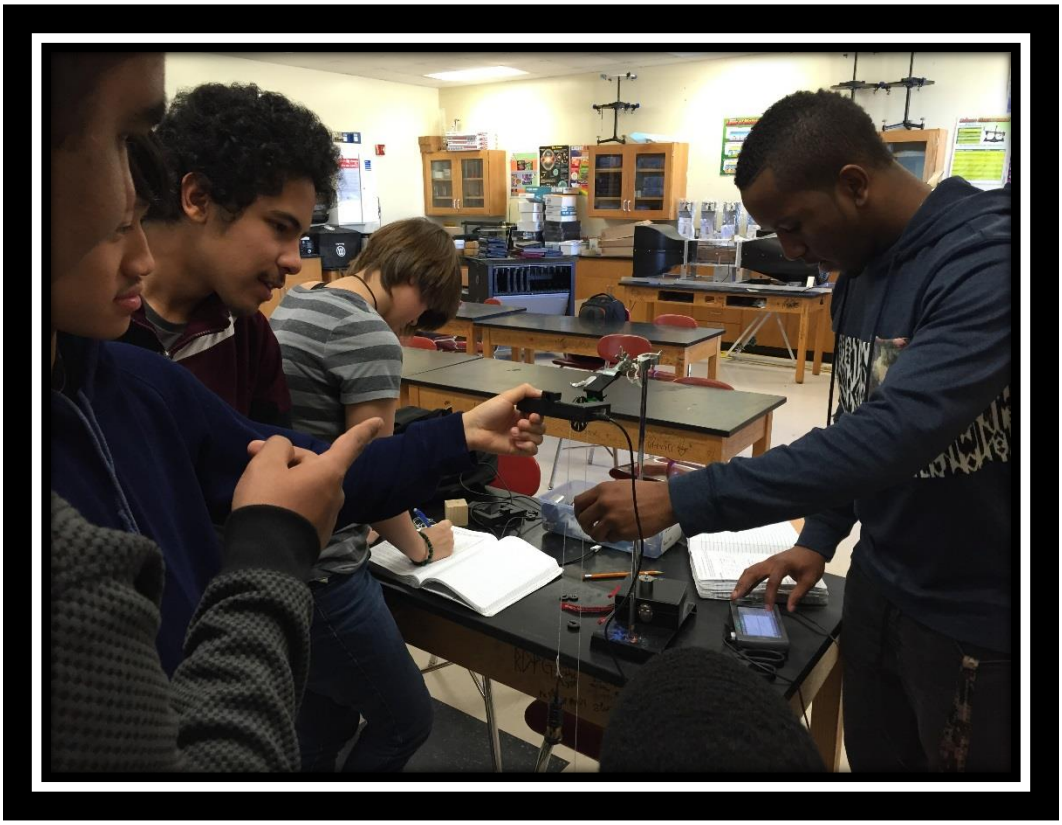
Pictures taken during the lesson

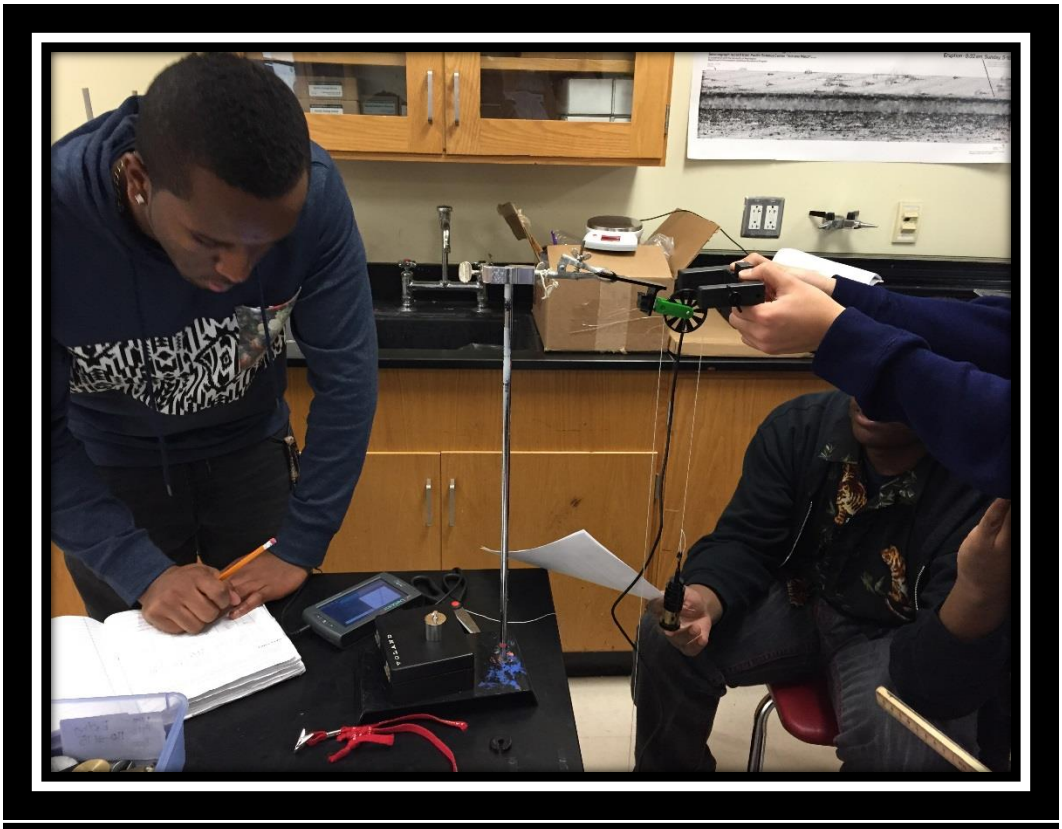
Do you need to cite any sources used to create this lesson?

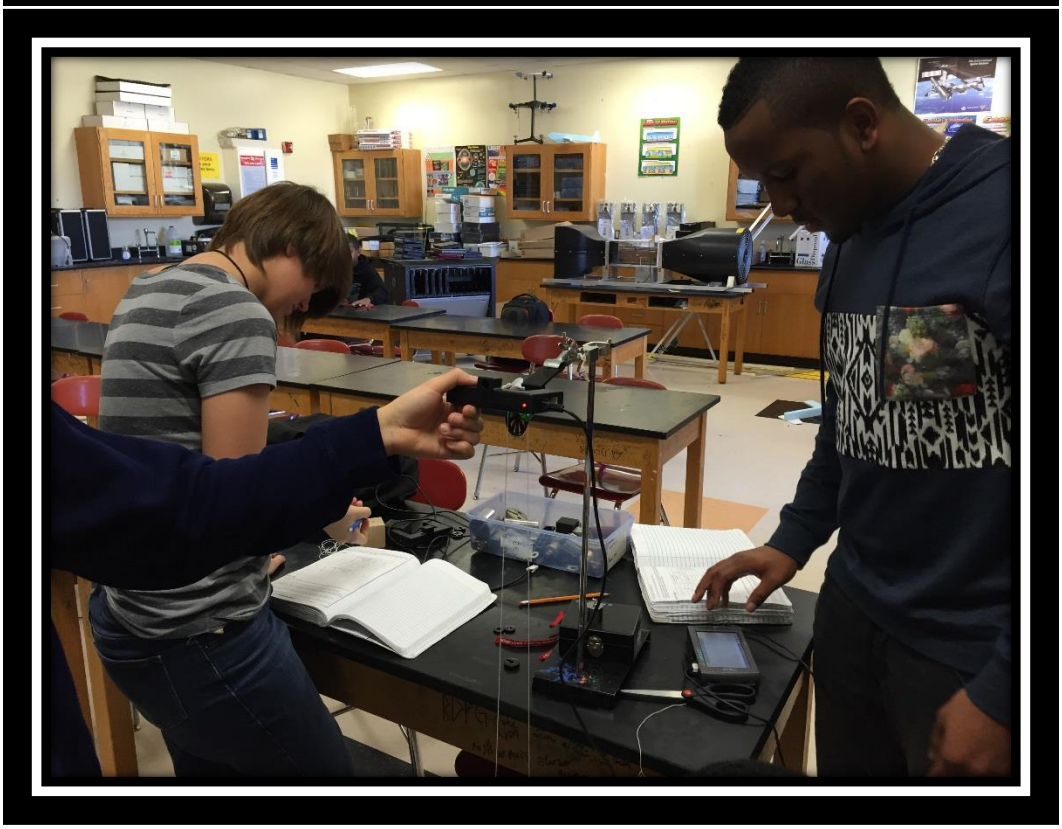
References

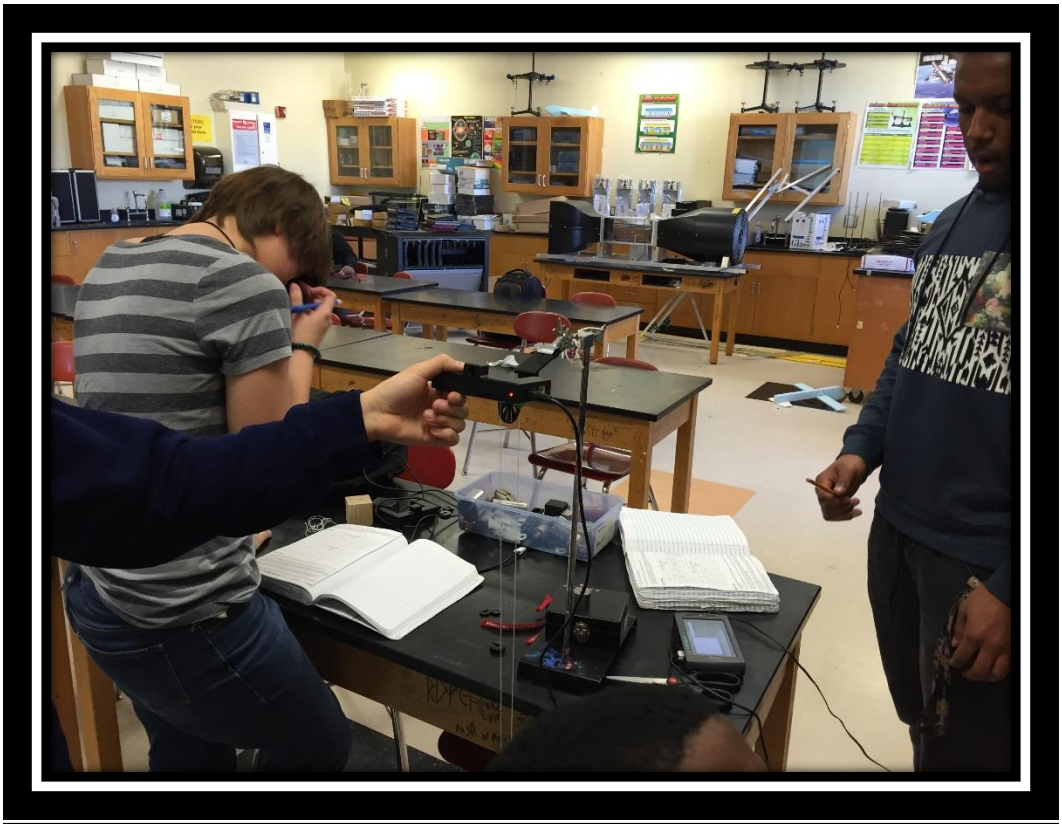
1. A plus physics http://www.aplusphysics.com/courses/honors/dynamics/Atwood.html
2. Using an Atwood Machine to Determine the Acceleration Due to Gravity, Lesson Plans from CMST Institute

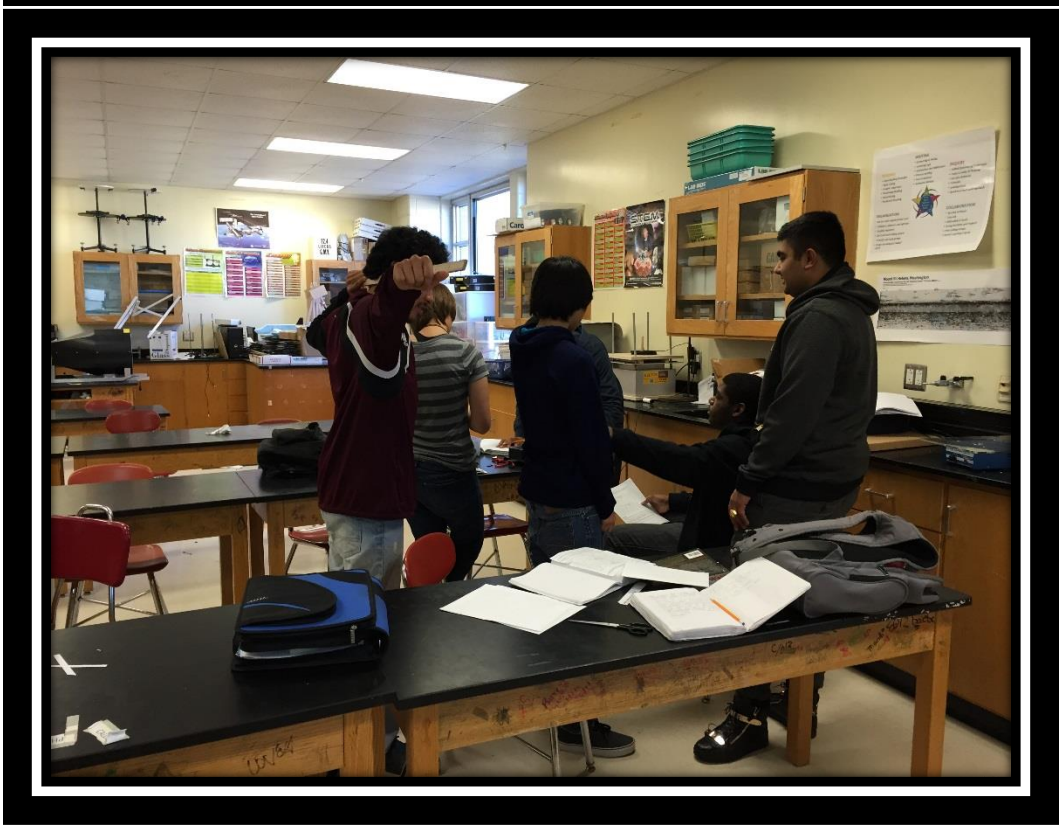


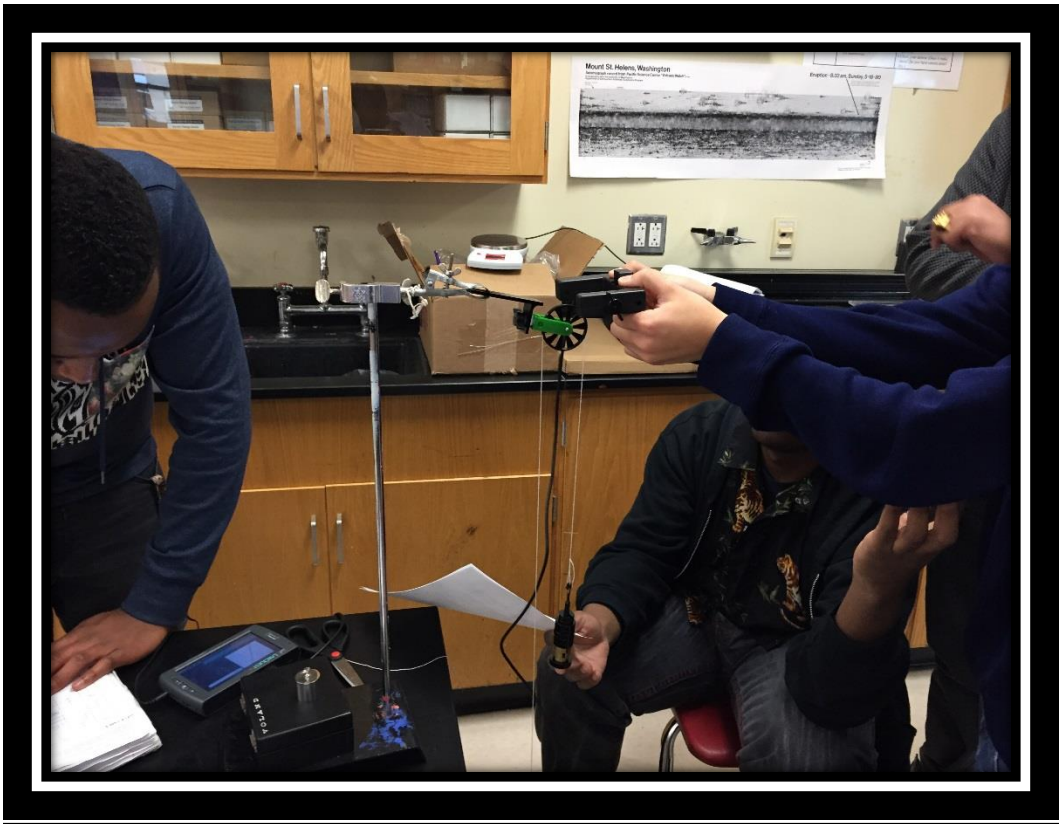








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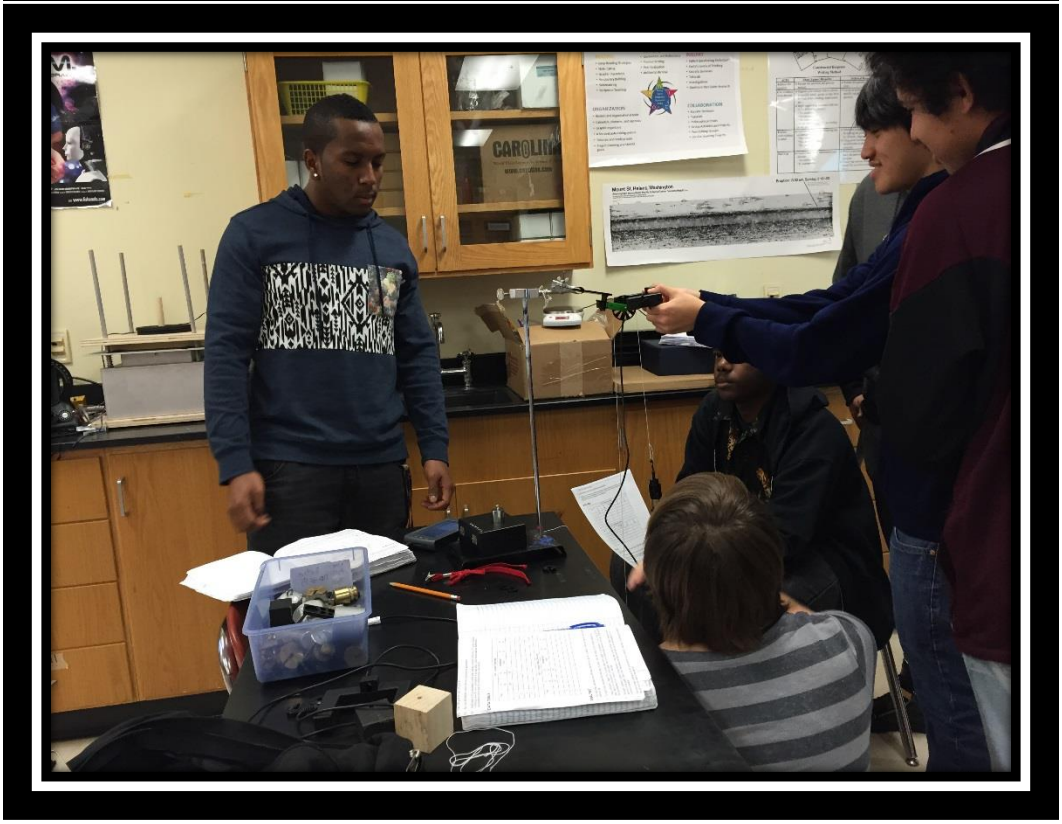
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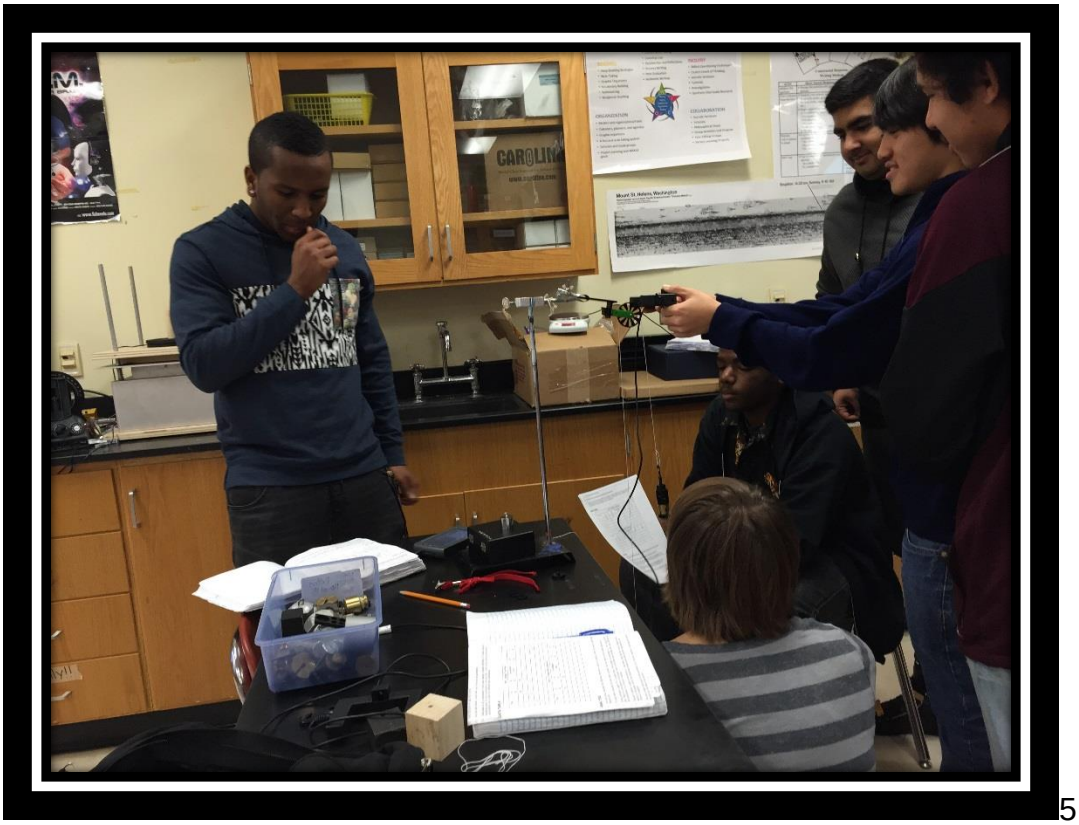

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