Nathan Belcher: Lesson 2

Topic: Let's Get Moving (Newton's Laws of Motion)
Date: 12 February 2010
Subject: Physical Science
Grade level: 8
NSES Standards:

Teaching Standard B: Teachers of science guide and facilitate learning. In doing this, teachers:

- Focus and support inquiries while interacting with students;
- Challenge students to accept and share responsibility for their own learning;
- Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

Teaching Standard D: Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers:

- Structure the time available so that students are able to engage in extended investigations;
- Create a setting for student work that is flexible and supportive of science inquiry;
- Ensure a safe working environment.

Assessment Standard A: Assessments must be consistent with the decisions they are designed to inform:

- Assessments are deliberately designed;
- Assessments have explicitly stated purposes;

Assessment Standard D: Assessment practices must be fair:

- Assessment tasks must be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, or limited English proficiency;
- Assessment tasks must be set in a variety of contexts, be engaging to students with different interests and experiences, and must not assume the perspective or experience of a particular gender, racial, or ethnic group.

Grades 5-8 Content Standard A: As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry;
- Understandings about scientific inquiry.

Grades 5-8 Content Standard B: As a result of their activities in grades 5-8, all students should develop an understanding of:

- Motions and forces;
- Transfer of energy.

SOL: PS.10

The student will investigate and understand scientific principles and technological applications of work, force, and motion. Key concepts include:
b) Newton's Laws of motion.

Intended Learning Outcomes:
- Student will (SW) recall Newton's three Laws of motion in their own words.
- SW use the formula F = ma to compare and contrast differences in acceleration for differences in mass and force.
- SW describe an example for each of Newton's three Laws.

Daily Question: What are Newton's three laws of motion?

The flow of this lesson is as follows: K-W discussion, Explore for Newton's First Law, Explain for Newton's First Law, Explore for Newton's Second Law, Explain for Newton's Second Law, Explore for Newton's Third Law, Explain for Newton's Third Law, L part of strategy using 3-2-1 chart.

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time
Engagement: To engage the students, I will use the K (what do you Know?) and W (what do you Want to know?) sections of the K-W-L strategy to discuss their prior knowledge of Newton's Laws.	What do you know about Newton's Laws? What do you want to know about Newton's Laws?	Presentation software	Student participation	5 minutes
Exploration: For Newton's First Law, I will take the students into the hall and have them stand behind/beside/behind the catcher of the golf ball to see that it rolls in a straight line over varying distances (10 meters, 20 meters, 30 meters). Before leaving the classroom, remember to remind students the importance of keeping conversation to a minimum so that they do not disturb other teachers.	In what path does the ball move down the hallway?	Golf ball Thrower Catcher	Observation	5 minutes
Explanation: Have the students write down the formal definition of Newton's First Law from the presentation. Ask for examples of saying it in their own words.	What does Newton's First Law say?	Presentation software	Notes	5 minutes

Exploration: For Newton's Second Law, show both videos: one of a man pulling six trucks, and the other of the man pulling the car. Discuss how much effort would be needed to pull each of those, and relate that to the second Law. Have a volunteer (or Vicki or Jim) sit in a rolling chair and push the chair, to discuss how difficult or easy it is to make something move.	How much effort does it take to move each vehicle? How much force does it take to move each vehicle? How much force does it take to move a light person? How much force does it take to move a heavy person?	Videos Rolling chairs Volunteers	Observation	10 minutes
Explanation: Have the students write down the formal definition of Newton's Second Law from the presentation. Ask for examples of saying it in their own words. Show the formula F = ma and discuss the relationship between the three variables and implications that arise from their relationship.	What does Newton's Second Law say?	Presentation software	Notes	10 minutes
Exploration: For Newton's Third Law, sit in a rolling chair and try to move (without feet touching the ground). Ask the students if this is possible, and discuss why or why not. Have a volunteer sit in another rolling chair, and push the back of their chair while sitting in your chair. Comment on how both people went opposite directions, and discuss why.	Can I move without touching the floor? Which direction do the people in the chairs move when pushed?	Rolling chairs Volunteers	Observation	10 minutes
Explanation: Have the students write down the formal definition of Newton's Third Law from the presentation. Ask for examples of saying it in their own words.	What does Newton's Third Law say?	Presentation software	Notes	5 minutes

Extension: 3-2-1 chart (3 things you found out, 2 interesting things, 1 question you still have) as the L part of the K-W-L strategy. Each student will complete a chart individually, and after if there is time solicit answers and write them in the presentation. To help the students move Newton's Laws to their more permanent memories, they will write the Laws in their own words for homework based off the definitions they received in class.	What are three things you found out? What are two interesting things? What question do you still have?	Paper/pencil Presentation software	3-2-1 chart Student writing	5 minutes + homework

Notes:

Vocabulary: Newton's three Laws of motion

Safety:
- When rolling the golf ball to a student or teacher, do not roll the ball to quickly.
- When pushing the rolling chair, make sure the person sitting is holding tightly. Push with a 'smooth' force on the lower back of the chair, instead of a 'hitting' force on the top or middle of the back of the chair.

Differentiation:
- Multiple modalities: demonstrations, video, writing, hearing.
- Notes for those with IEPs so that they may have a copy if they are not able to read the ones they have written.

Technology
- Presentation using computer and projector.
- Video of man pulling 6 trucks that are attached, each weighing 10 tons (http://www.youtube.com/watch?v=eHHT896dwEY&feature=fvw).
- Video of a man pulling a car by his hair (http://www.youtube.com/watch?v=9J3BUy0Jz1M).
- Presentation software to record students' answers on K and W parts of K-W-L.

Reflection from watching the video:
- The students were much quieter when they arrived in the classroom for whatever reason, and this was good.

- I went over the homework for the first 20 minutes or so, and this actually was a good thing because this lesson took less time than I had anticipated. I ended up finishing right on time, so the long homework check was okay. In the future, though, I would not like to spend that much time reviewing the homework, so I need to find/figure out some better ways to review and check homework.
- I am trying to get the students used to raising their hands instead of calling out, and I forgot for the first five minutes as we were reviewing the homework. I eventually remembered, and instituted the policy again.
- I am also trying to get more students involved during the questioning times of the lesson, and it will be easier as I learn their names. I will implement some random chance name strategies in addition to seeing who is either paying attention or not and calling on them, so those will be good to try eventually.
- This lesson used a K-W-L chart to give a little structure and provide an opportunity for students to see what they said on the screen, and I went into the slide and typed what they said on the slide during the presentation. It took them a little while to get into it, but when they did the students were able to provide some good questions and things they knew about motion.
- The first demonstration took about four minutes, so this was close to the time. I then had the students give observations, again as a way to introduce the nature of science subtly. This also gives them an opportunity to work on their observation skills, which will be important as we perform activities and labs.
- I made sure to clarify the terms directly and indirectly proportional, because I did not know if the students knew what they were. It turns out that they did not know what they were, so going over the terms was very useful.
- The students liked being included in the demonstrations and eagerly raised their hands to be involved. I will try to keep a record of who I have called on and who I have not, so that I don't play favorites and always have the same people involved.
- During the time of putting the definitions in their own words, one student tried to simply make a joke out of the process. I would have none of it, and made sure that he could do it before moving onwards.
- Again, I need to call on people in a more systematic way. I made a giant mistake by calling on a very shy girl during the lesson, and she immediately shut down and did not speak. I gave her about five seconds and she didn't respond, so I gave an example of my own. I did apologize to her as I was giving out her their homework, and she drew a little smiley-face on the paper that she turned in for the 3-2-1 exit slip.
- The exit slip idea went well, and I also took them home with me and tried to give a reasonable answer to every question that I could. I gave them back to the students on the next class period, and it was interesting and instructive to see what they had come up with for questions. This will probably become a favorite of mine as a formative assessment, because it doesn't take too much time and is a good indicator of the level of the students.