ESMIS physical science project

During June of 2000 I attended a physical science institute funded with Eisenhower Grant monies and administered by Michigan Technology University. We spent a week at the Ford Forestry center at Alberta, Michigan and on MTU’s campus. Throughout the course of the week we attended sessions related to physical science, went on field trips, and spent time sharing our teaching experiences with one another. Dr. Hindelang had an extensive library and computer lab with internet connectivity available for us to use. We all left the institute with a unit of study to implement in our classrooms in the fall. In examining our 3rd grade curriculum I decided to develop a unit on forces and simple machines.

Before I even started this unit I briefly indicated to the parents in the newsletter that I send home every Friday that we would be needing hammers, screwdrivers, 5 quart ice cream buckets, and non-working electrical appliances: ie. toasters, fans, can openers, VCRs, disk drives, etc.

I introduced the unit with three fictional picture books: Choo Choo by Virginia Lee Burton, Lazy Bear by Brian Wildsmith, and Mr Gumpy’s Motor Car by John Burningham. These books were on the chalk tray in the front of the room about a week before we started working on the unit. The first day of the unit we brainstormed different machines. As the children named machines I listed them on a piece of chart paper. After we had a sizable list, I asked what do they have in common. We made another list. I asked the children how these machines could be grouped. I then asked which were the simplest machines on the list. We then defined the six simple machines: wheel and axle, incline plane, pulley, lever, screw, and wedge. I divided the class into 6 groups. Each group was given a large piece of paper and the name of a simple machine. Over the course of the new few weeks they were to work on their simple machine poster whenever they had time.

Library books regarding simple machines were kept in a bin in the classroom for students to refer to during the study of this unit. This completed the first day's science lesson for simple machines.

The next day I divided the class into 6 random groups (different from the previous day's groups) of 4 each and had them design an incline plane with materials available in the classroom. Once their incline plane was assembled they were to test it with toy cars that were available to them. They were provided with a chart to record their observations on (see attachment 1). After they had run all the tests they were to graph the results. We also worked the inclined planes in reverse. The children pulled their cars up the plane with a spring scale and recorded the gram weight shown on the spring scale as they pulled the car up. Again they were required to redesign their inclined plane and record the amount of pull in grams for each test. After all groups had completed their tests of the inclined plane we discussed the results of various groups and talked about the various forces working on the car (pull, gravity, friction).

On the third day I brought in a skate board and another board similar in shape and size to a skate board. We put a person on each board and tried to move them. First on carpet and then on the tile. We then discussed our observations after this investigation. We talked about other applications of the wheel and axle.

On day four we explored the principle of the lever. I Divided the class into groups of no more then four children to a group. Each group was given a meter stick, two paper cups, a
bunch of washers, and a 6" by 4" piece of heavy tag board to be folded into a prism shaped fulcrum. One cup and ten washers were used as the load and secured to one end of the meter stick (90-100cm) with masking tape. The other cup was secured at the other end of the meter stick (0-10cm). This becomes the effort. The children recorded (see attachment 2) the position of the fulcrum and the number of washers needed for effort to lift the load. By repositioning the fulcrum and recording the number of washers needed for effort, the students determined the most effective position for the fulcrum. Their results were written up in paragraph form along with their conclusion and justification. As we discussed the results of our experimentation we also talked about push, pull, and the effect of gravity.

On the fifth day we worked with pulleys. Again the students were divided into groups of no more than four. Each group was given two pulleys, a spring scale, heavy twine, a five quart ice cream pail with wire handle, and 1 kilogram of sand. We went out on the playground and used some of the climbing equipment to hang our pulleys from. Using the diagrams from 203 Experiments, by Janice VanCleve, the students set up their pulleys, first as a single pulley system then as a two, or movable, pulley system. With each pulley system the students were to record the amount of pull, as determined by the spring scale, necessary to lift the load to a height of two feet. They were also expected to observe what was happening to the amount of twine needed to operate each pulley system. Once again they were expected to record their group's observations in their journal and explain which system they felt was more efficient and why. We then, as a class, discussed our observations, results, and conclusions.

For the sixth day I asked the students to bring in hammers and screwdrivers. I brought in some scrap pieces of 4X4s, nails, screws, and bar soap. The nails and screws were of the same length and diameter. Pilot holes were predrilled for the screws. Each child had a nail and screw to look at. We discussed the simple machine principles of the screw and nail. Each child hammered the nail and screwed the screw into the wood. If they were having trouble with the screw they were directed to rub the screw over the bar of soap. I also directed the children to remove the nail and feel the shank. After experiencing this activity we discussed why people use screws when nails are easier to drive into the wood and why did the soap make the screw go into the wood easier.

For the seventh day of this unit the children were asked to bring in a kitchen gadget (hand operated, not electric), hand tool, or toy. I brought in a collection of my own for those who didn't remember. Each child had at least one item. They had a few minutes to look over these items for applications of the simple machines that we worked with. Each child then stood up with their item and told us about the simple machine(s) used in its application.

A final class activity was to set up a simple machine museum. Anyone familiar with the Everyday Mathematics program knows of the museums suggested for the various grade levels: second grade creates a shape museum, Third grade does a large number museum. I decided to create a simple machine museum. I collected 6 medium size boxes and labeled them for the different simple machines: lever, wheel and axle, pulley, incline plane, screw, and wedge. This was the day we disassembled the appliances that we had been collecting over the last three weeks. I had some adult volunteers to come in and help with this activity. Each child had need access to screwdrivers, both flat head and Phillips head. As each child worked at disassembling an appliance he/she decided which simple machine box to put the parts into. They also labeled the part with the appliance it came from. We used masking tape for the labeling. As a safety precaution all electrical cords were cut off the appliances. I was able to come up with one appliance for each pair of students so that only two students were working on any one appliance. Some real
interesting discussions resulted in sorting these pieces.

During these two weeks I used the picture story books as read aloud. From the book Choo Choo I enlarged one of the pictures of the train engine and had the children label all the examples of simple machines in the picture. Lazy Bear is a story about a bear who likes to ride a wagon down an incline plane, but he doesn't like to pull it back up. He gets his friends to push him back up by telling him how much fun it is. This led to a discussion of go carts, toboggans, sleds, and ski hills.

There are a multitude of related activities for the picture story books in Teaching Physical Science through Children's Literature by Gertz, Portman, and Sarguis and Science Through Children's Literature by Bartow and Bartow.

I found some Rube Goldberg cartoons at www.rubegoldberg.com. We talked about the use of simple machines to make a simple job a very complicated process.

For assessing the children's learning after this unit I had them design a Rube Goldberg using explanations if necessary, the evaluation that is part of our school curriculum, and I had each child make a simple machine book. I had the school publishing house put 24 books together for me. We designed the cover and title page together. The students were instructed to use a double page (two facing pages) for each simple machine. On the left page they were to draw the simple machine and label its parts. On the right hand page they were to list or draw things that they encounter in their daily life that relate to that particular simple machine. They were given a list of words that should be illustrated or explained in their book. Each group displayed their simple machine poster and answered questions that the class had regarding the poster or simple machine.

Pre/Post test

Using the picture of a moving object, fill in the blanks using the words from the word bank

Word Bank Slowed down applied push
speed up applied pull
stopped gravity
friction

1. An ____________ ____________ started the ball moving.
2. At first, the force made the ball ____________ ____________.
3. The ball then rolled off the table and the force of ____________ pulled it to the floor.
4. The ball rolled on the floor and ____________ ____________ due to the force of ____________.
5. The ball rolled a short distance and then ____________.
6. The child picked up the ball using an ____________ ____________.

CHALLENGE: Place a star on the picture to show where the ball turns.

Use the Word Bank to tell what simple machines you would use to do the following (Examples may use more than one simple machine. Fill-in your own example for #11 and #12 and list what simple machines you would use):

Word Bank Inclined plane lever
pulley wheel and axle
screw wedge

1. Sharpening a pencil__________________________________________________
2. Opening a can of pop________________________________________________
3. Chopping wood____________________________________________________
4. Raising a flag_______________________________________________________
5. Raising a car to change a tire________________________________________
6. Driving to the top of a parking ramp__________________________________
7. Attaching a hose to an outdoor faucet__________________________________
8. Removing heavy furniture from a moving van____________________________
9. Making a peanut butter sandwich______________________________________
10. Shoveling snow______________________________________________________
11. _____________________ ____________________________________________
12. ____________________ _____________________________________________

Standards addressed in this unit from the Michigan Curriculum Frameworks.

Science Standards
I:1:2 Develop solutions to unfamiliar problems through reasoning
I:1:3 Manipulate simple mechanical devices and explain how they work
I:1:4 Use simple measurement devices to make metric measurements
I:1:5 Develop strategies and skills for information gathering and problem solving
I:1:6 Construct charts and graphs and prepare summaries of observations
II:1:2 Develop an awareness of the need for evidence in making decisions scientifically
IV:1:4 Identify forms of energy associated with common phenomenon
IV:2:3 Construct simple objects that fulfill a technological purpose
IV:3:1 Describe or compare motions of common objects in terms of speed and direction
IV:3:2 Describe how forces are needed to speed up, down, stop or change the direction of a moving object
IV:3:3 Use simple machines to make work easier

Math Standards
I:2:4 Use tables, charts, and hands-on-models to represent change
II:3:1 Select and use standard tools for measurement
II:3:6 Apply measurement to describe real world and solve problems
III:1:3 Present data using appropriate representations

English Language Arts Standards
Meaning and Communication
2:1 Write with developing fluency to produce a variety of texts
3:3 Listen and interact appropriately and represent creatively
Language
4:5 Use language appropriate for varied context and purposes.
Depth of understanding
9:2 Identify key ideas and concepts found in texts

Inquiry and research
11:2 Identify and use resources that are appropriate and available for investigating a particular question or topic

References