Force Unit Introduction

By Carl J. Wenning

Title: Newton's Laws of Motion

Overview: This 20-minute unit introduction is designed to get students started working in the area of dynamics. It is assumed that the students have a working knowledge of the following:

- kinematics
- *Graphical Analysis*
- graphical methods
- dimensional analysis

Performance Objectives: Students will:

- state and provide an everyday example for each of Newton's three laws of motion
- provide a rationale for studying force and Newton's three laws
- respond to questions designed to elicit preconceptions about force (see below)

Anticipatory Set: This lesson will be linked to motion by conducting a quick review of what students know and then asking what role force places in constant velocity and accelerated motion. I'll also attempt to elicit known preconceptions relating force to motion (see below).

Process: Once the students are engaged in the project through the activities of the anticipatory set, I'll pursue the following steps:

1. ask students to state Newton's three laws of motion
2. elicit definition of force, inertia, mass, etc.
3. engage students in a tug-of-war demonstration
4. ask what happens under conditions of "winning" and "stasis" to elicit preconceptions
5. ask students how, if $F_1 = -F_2$, a horse cart can ever move forward
6. ask students to explain what forces are on a book resting on a desktop
7. ask students to represent forces with vector diagrams (force diagrams)
8. have students design an experiment using a cart and weight set to find relationship between mass and acceleration.

Closure: Draw unit introduction to a close by charging the students to actually carry out the experiment they have designed for relating distance to time.

Assessment: This will only be informal and will consist of a constant flow of questions to the students to get them to think about dynamical phenomena and make their thinking transparent.

Preconceptions: I'll attempt to elicit the following alternative conceptions during the anticipatory set:

- Force is required to keep an object in a constant state of motion under any circumstance.
- If an object is at rest, no forces are acting upon it.
- Forces are only imparted via direct contact between two objects.
- Force always results in perceptible motion.

Materials: rope for tug-of-war; book for desktop; small items for dropping, throwing, etc.