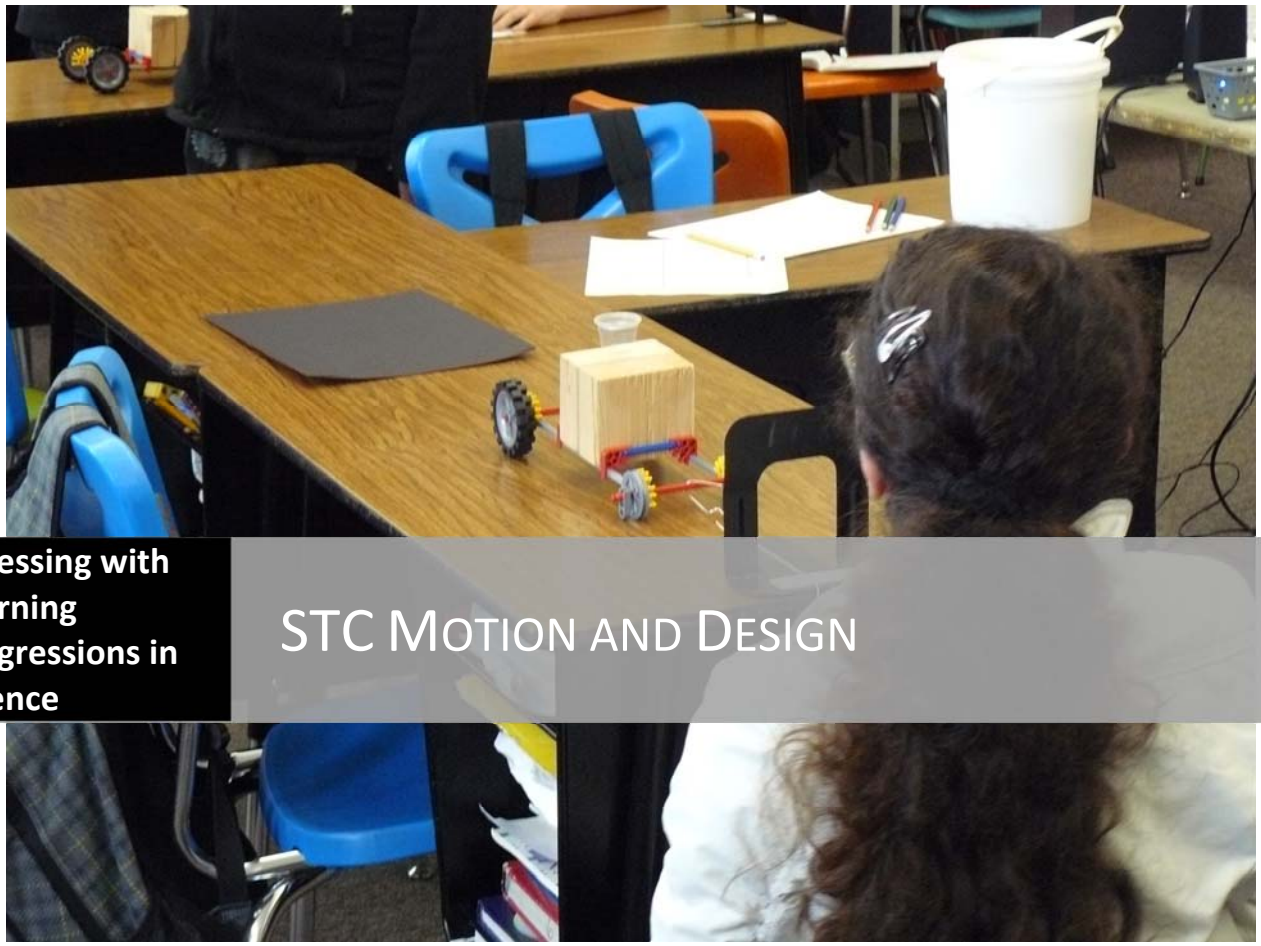
8/1/2012



Assessing with Learning Progressions in Science

STC MOTION AND DESIGN

Photo by Joanne Johnson

Content Professional Development Tools| **Contributor: Ben Fackler-Adams**

Northwest Educational Service District 189
Together We Can

Skagit Valley College
Where Learning Comes to Life

Funding information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B

Learning Progression

FOSS Force & Motion

Prerequisite skills:
- Working effectively in groups.
- Communicating scientific concepts effectively.

Learning Target:

Motion is changing position and depends on direction & speed of change.

Success Criteria:
I can… describe the motion of objects & read speed v. time graphs.

Formative Assessment:
- **Discussion** of Summarizing Questions S1 thru S6, p.2-22 & 2-22 of packet.

Learning Target:

A force is push or a pull & can cause a change in motion.

Success Criteria:
I can… describe the effect of various forces on the motion of an object, & determine where on a speed v. time graph forces were acting on an object.

- **Discussion** of Summarizing Questions S1 thru S4, p.2-44 & 2-45 of packet.

Learning Target:

Motion of an object will not change if the net (summed) forces on it are balanced.

Success Criteria:
I can… identify the balanced forces on immobile objects and on objects moving at constant speed.

I can… determine if an object is experiencing balanced forces based on its motion.

- **Whiteboard Discussion** balanced forces prompt.

Learning Target:

Motion of an object will change if the net forces on it are unbalanced.

Success Criteria:
I can… predict the motion of an object w/ unbalanced forces acting on it.

I can… determine the net force on an object w/ changing motion.

- **Discussion** of Summarizing Questions S1 thru S4, p.2-60 thru 2-63 of packet.

Learning Target:

The change in motion of an object to unbalanced forces is inversely proportional to its mass.

Success Criteria:
I can… predict the effect of a force on objects of different masses.

I can… determine the effect of different strength forces on an object.

- **Discussion** of Summarizing Questions S1 thru S5, p.2-110 thru 2-114 of packet.

Big Idea:

The change in motion (speed and/or direction) of an object is proportional to the net force and inversely proportional to the objects mass.

Later Big Ideas that build on this big idea include:

Whenever one object exerts a *force* on another object, a *force* of equal magnitude is exerted on the first object in the opposite direction. (Newton's Third Law of Motion)

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NW ALPS Force & Motion PD **Fackler-Adams**

AGENDA Winter 2012

- Content Pre-test (~30 minutes)
- Initial Ideas: Record your thoughts (~10 minutes)

What is a force?

How can forces affect the motion of an object?

What questions do you have about force and motion?

- Whiteboard (review protocols): *Share your thinking with your group and develop a white board to share that represents your consensus ideas to the INITIAL IDEAS questions.* (~25 minutes)
- Form Groups & Develop Group Norms (~5 minutes)
- Intro. & Overview of ***Physics For Everyday Thinking: Ch. 2 Interactions & Forces*** Packet (~5 minutes)
- Act. 1: Complete p. 2-3 thru 2-22 of packet (~30 minutes)
- Formative Assessment: **Discussion** of Summarizing Questions S1 thru S6, p.2-22 & 2-23 of packet. (~30 minutes)
- Act. 2: Complete p. 2-23 thru 2-49 of packet (~45 minutes)
- Formative Assessment: **Discussion** of Summarizing Questions S1 thru S4, p.2-44 & 2-45 of packet. (~30 minutes)

LUNCH BREAK

- Act. 3: Complete p. 2-51 thru 2-52 of packet (~25 minutes)
- Formative Assessment: **Whiteboard Discussion** of INITIAL IDEAS Prompt p. 2-52 of packet (~25 minutes)
- Act. 4: Complete p. 2-52 thru 2-63 of packet (~25 minutes)
- Formative Assessment: **Discussion** of Summarizing Questions S1 thru S4, p.2-60 thru 2-63 of packet. (~30 minutes)
- Act. 5: Complete p. 2-99 thru 2-114 of packet (~25 minutes)
- Formative Assessment: **Discussion** of Summarizing Questions S1 thru S5, p.2-110 thru 2-114 of packet. (~30 minutes)
- Instructor Comments and Q &A: Scientist's Ideas about forces and motion. (~15 min.)
- Reflection: *Review your Initial Ideas & List of Questions from the INITIAL IDEAS. Record your reflections on how your thinking about forces and their relationship to motion of objects has changed, and describe which specific activities had the biggest effect on modifying your understanding and why.* (~15 minutes)
- Whole Group Discussion: Classroom Applications (~25 minutes)
- Content Post-test (~30 minutes)

RESOURCES USED:

- ***Physics For Everyday Thinking: Ch. 2 Interactions & Forces***, http://petproject.sdsu.edu/

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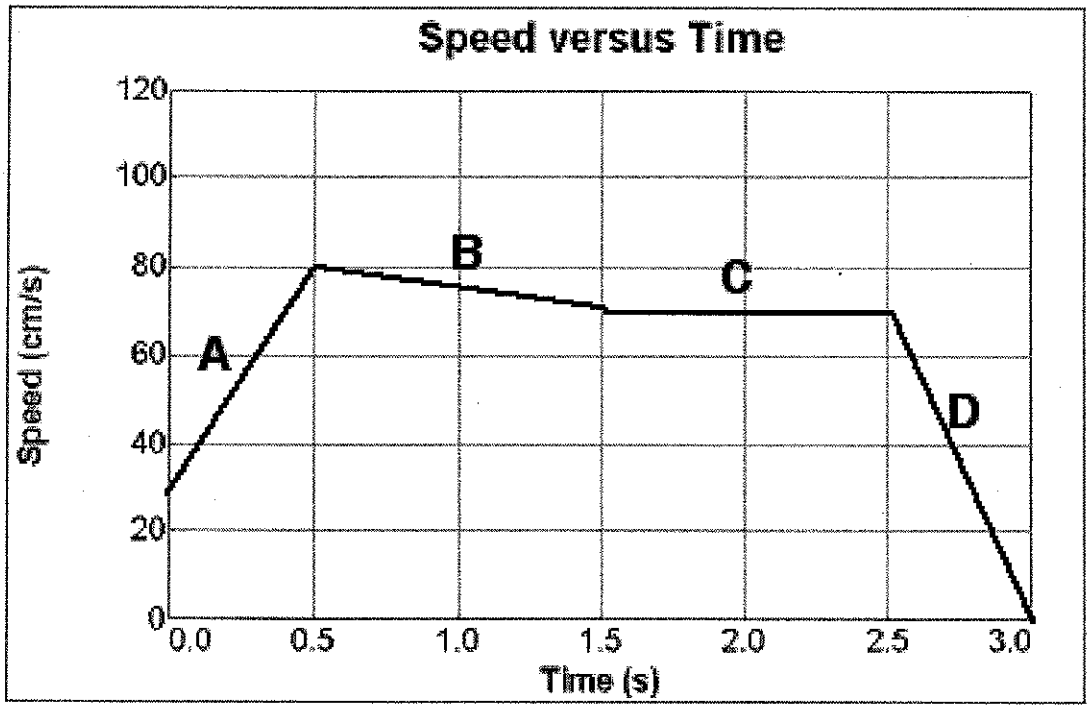
Physics 111 - Cycle 2 Test

Fall 2010 **Name** _____

1. Shown below is a speed-time graph for a cart moving in front of the motion sensor. For convenience it has been divided into four sections (A,B,C,D).



During each of the four separate periods shown on the graph (A, B, C, D), was an **unbalanced** force acting on the cart? YES or NO. If not, how can you tell from the graph? If yes, did the unbalanced force act in the same direction as the cart's motion, or against it? Briefly explain <u>how you can tell this from the graph</u>.

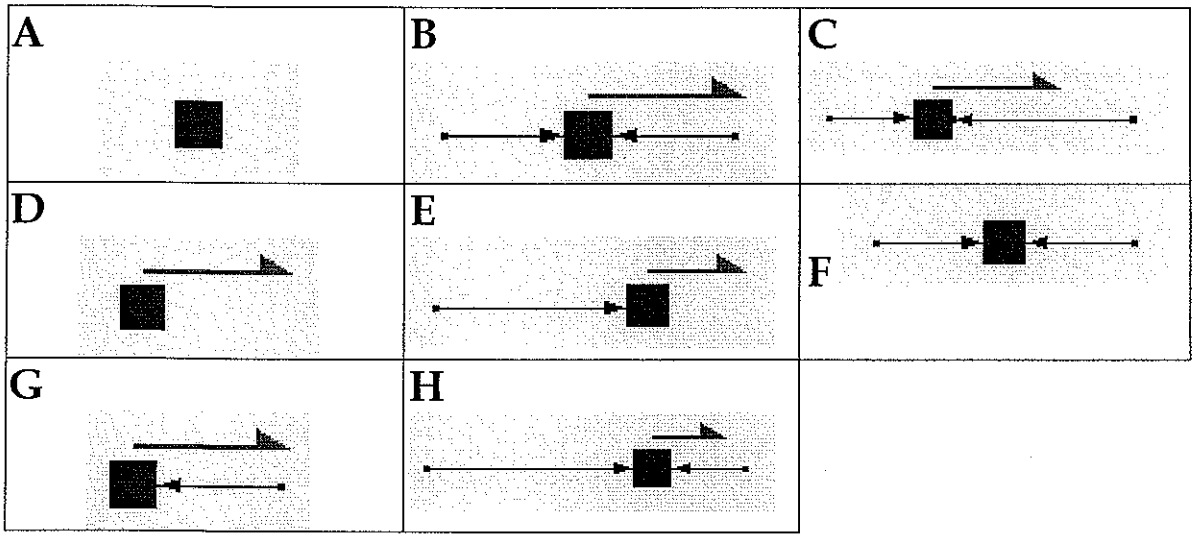
A

B

C

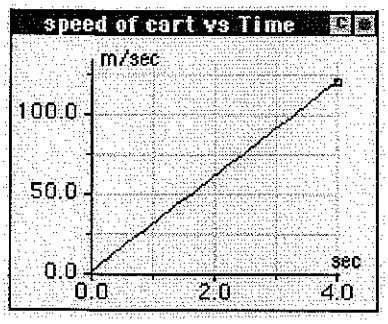
D

2. Shown below are eight different force diagrams (labeled A to H), taken from simulator set-ups of a cart on a track.

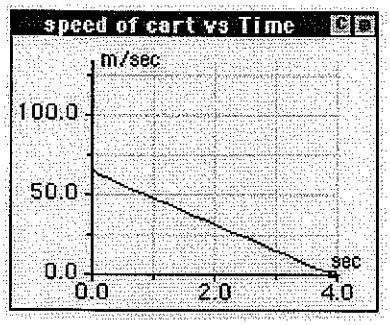


Which situations, represented by these force diagrams, would lead to speed-time graphs for the motion of the cart like those shown below. In each case you may choose as few, or as many, force diagrams as you think appropriate. You should also briefly explain your reasoning in each case.

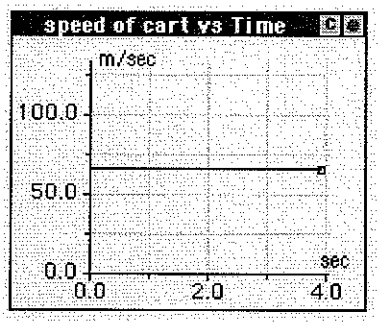
a)



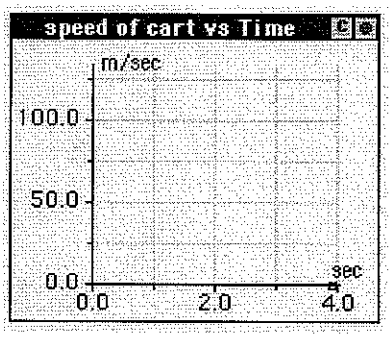
b)



c)

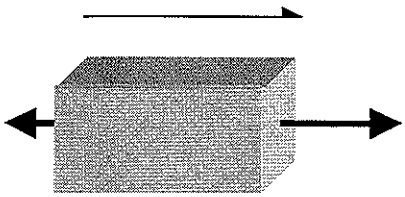
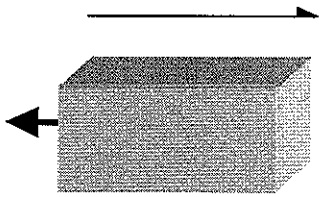
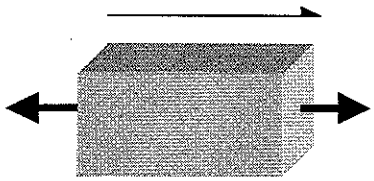
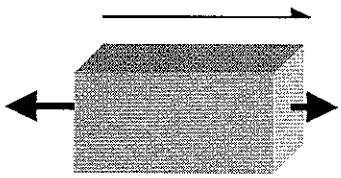


d)



3. A man wants to move a large box across a level floor by pulling on a rope attached to the box. The floor is **not** perfectly smooth so friction acts between the floor and the box.

Below are force diagrams representing four *possible* arrangements of forces that could be acting on the block **after** it has already started moving to the right. The situations are also described briefly in words.

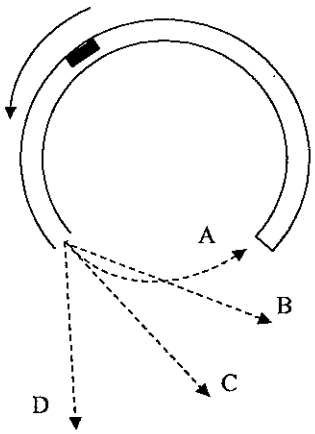
A. The man's pull to the right is stronger than the force of friction opposing the motion. 	B. The man does not pull at all. Friction opposes the motion. 
C. The man pulls to the right with a force strength that is exactly the same as that of the frictional force. 	D. The man's pull to the right is weaker than the force of friction opposing the motion. 

a) Indicate **all** the situations shown above (if any) that you think would result in the block **moving to the right at a constant speed** (after it has already been started moving.) Briefly explain the reasoning behind your choices.

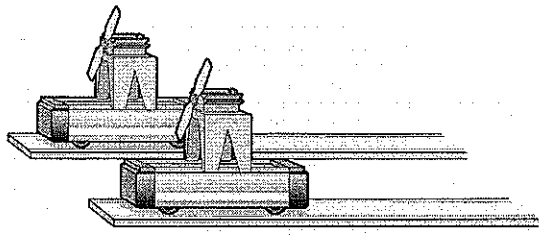
b) For those situations that you did not select in part a), what do you think the motion of the cart would be like? Again, explain your reasoning.

4. A child's toy car moves at a constant speed round a flat circular track. (A top view is shown to the right.) A section of the track is missing, as shown, and the car leaves the track and runs across the floor.

Which line in the diagram best represents the path the car will follow when it leaves the track? Briefly explain the reasoning behind your choice.



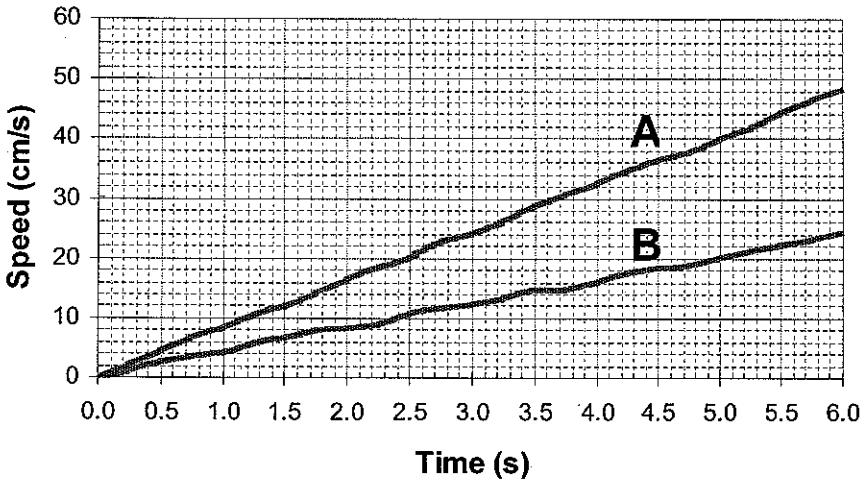
5. A group of students arrange two level tracks side-by-side so they can have a race between two carts. They mount identical fan units (each with two real batteries) on two identical carts.



When the two carts, with fans turned on, are released simultaneously from the end of the tracks they speed up at the same rate, traveling side-by-side, and so the race ends in a tie (Experiment 1).

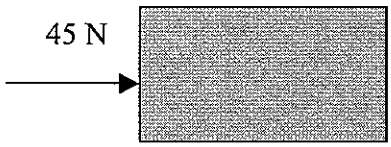
The students then add extra mass to one of the carts and repeat the experiment (using the same fan units), and record speed-time data for both carts (Experiment 2).

a) The next week, when they look at the speed-time data they graphed (shown below), there are two lines (labeled A and B), and they are not sure which is which. Can you help by identifying which line represents the motion of the cart with the <u>added</u> mass? **Justify your choice.**

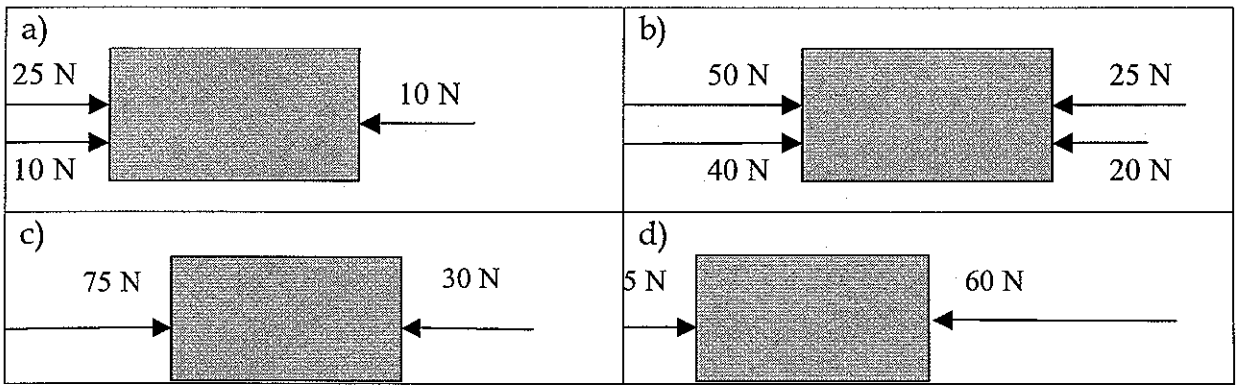


b) However, one of the students remembers that they also attempted to break the tie in Experiment 1 by adding a additional battery to one of the fan units without adding extra mass to either cart (Experiment 3). Could the speed-time data shown in the graph be from Experiment 3? Yes or No. **Justify your answer (use back sheet if necessary).**

6. Five identical crates are initially at rest, side-by-side. One is acted on by a single force of 45 N, as shown.



Which of the other crates, shown below, would move side-by-side with the crate described above? (Choose as many as you think appropriate.)



Briefly explain your choice(s).

The following copyrighted curricular materials were used for the Force & Motion PD:

Physics For Everyday Thinking

Information about the content of this curriculum is available at:

http://petproject.sdsu.edu/content/content.html

Information about the copyright of this curriculum is available at:

http://its-about-time.com/htmls/pet/pet.html

For the PD we used …

Chapter 2: Interactions and Forces introduces students to an alternative framework (that of forces) within which they can explain interactions they first see in Chapter 1 that involve objects pushing or pulling on one another.

Formative Assessments are built into the structure of the curriculum and access with the students in real time via discussion and questioning in the classroom.

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