How to save time when helping students learn physics?

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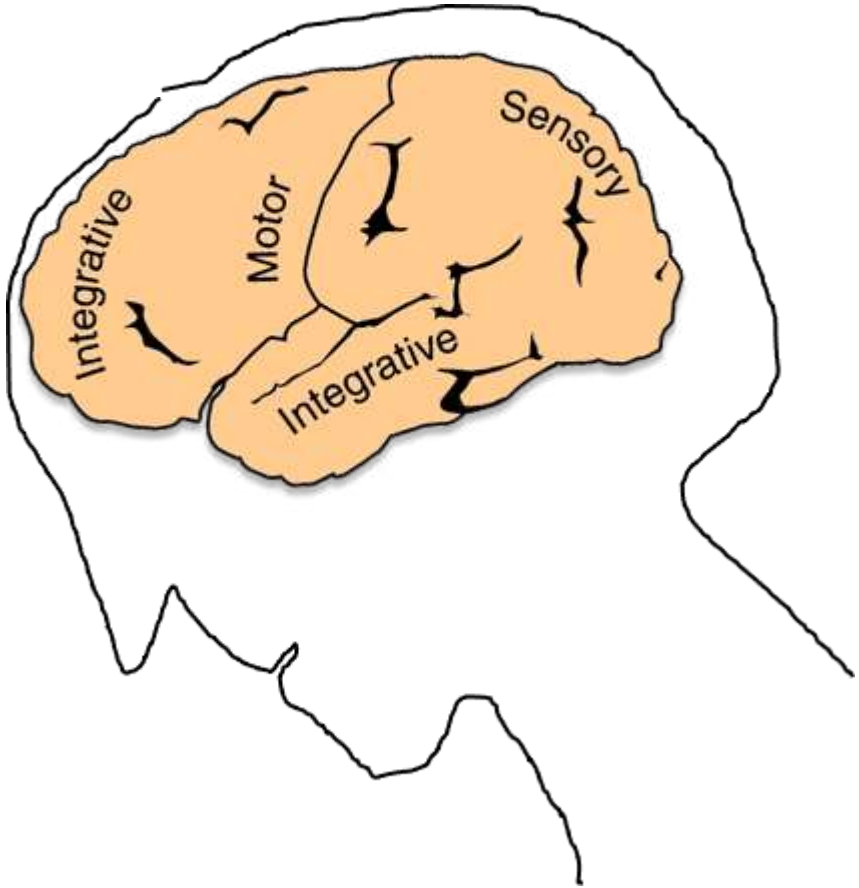
Link for ALG and OALG chapters in today's meeting

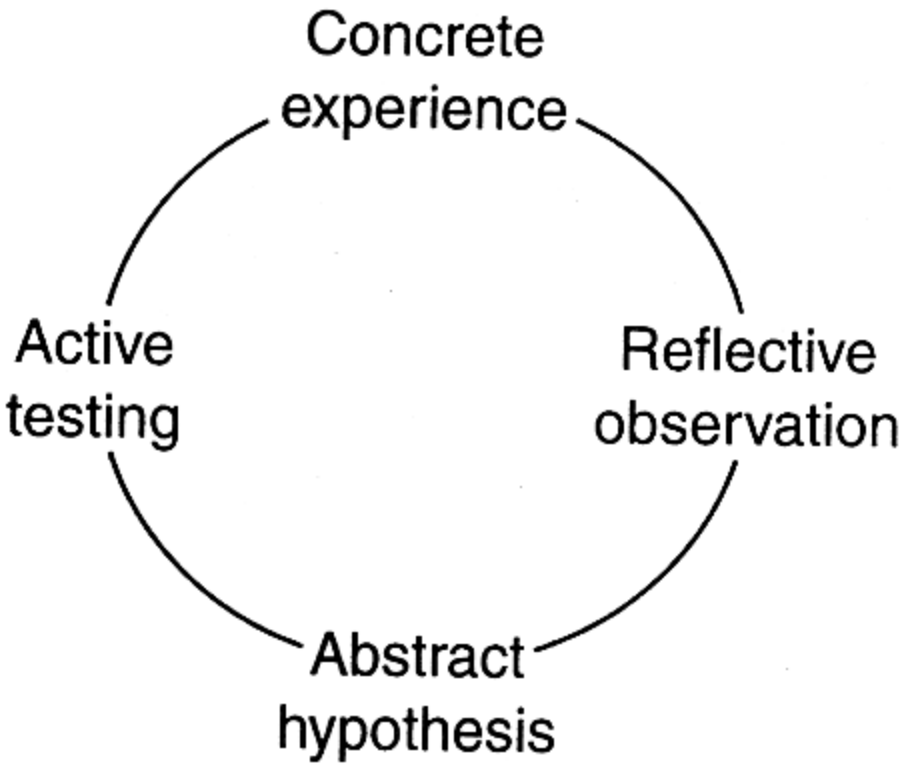
https://drive.google.com/drive/folders/1Li7W__C82pUN5FU8dRq77dhBBrXlJaa7?usp=sharing

First question: To “cover” or not to “cover”

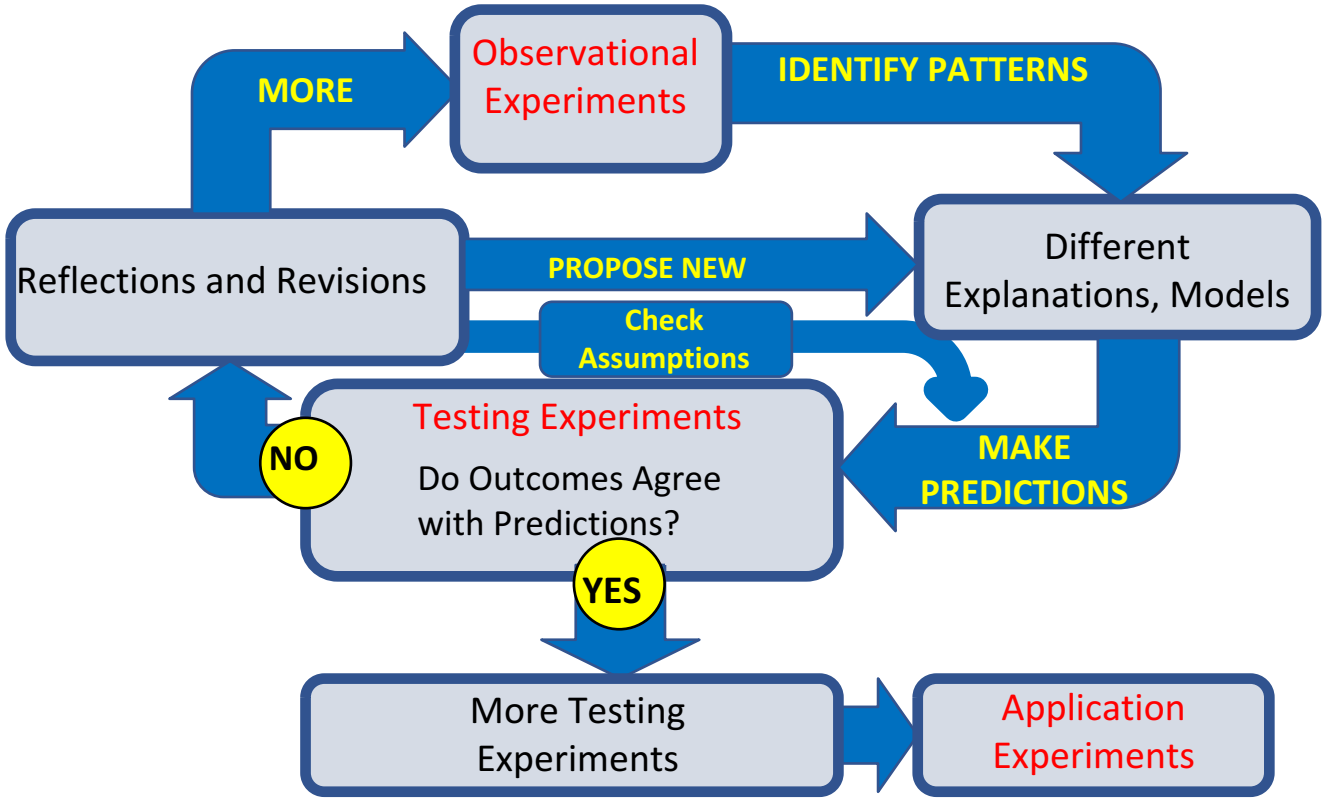
What happens when we learn?



Brain and learning cycle (J. Zull, 2002, The art of changing the brain)



The Investigative Science Learning Environment (ISLE) approach



Etkina and Van Heuvelen, 2001, 2007; Etkina, 2015, Implemented in College Physics: Explore and apply and all materials that support it.

Helping students learn, saving the spirit of inquiry and saving time

Experiments:

1. Students do the experiment, collect data and analyze data, find patterns.
2. Students watch the video of the experiment, collect data and analyze patterns.
3. Students do the experiment but do not collect data data, only analyze them and find patterns.
4. Students watch the video of the experiment, do not collect data. Analyze pretend data and find patterns.
5. Students learn about the setup of the experiment, analyze pretend data and find patterns.
6. Students learn about the setup of the experiment, the data are analyzed for them and they find patterns.

Example of 1 (ALG Chapter 2) Students do the experiment, collect data and analyze data, find patterns

2.6.2 Test your idea

***PIVOTAL* Lab:** *Equipment per group:* whiteboard and markers, metronome or any device to keep track of seconds, 2 battery-operated toy cars that move with *different* speeds, sugar packets (or any other marking device), meter stick or ideally a longer tape measure.

Work with your group members on the following assignments. Make sure that your group keeps detailed records of the experiments so that another group from your class can repeat the experiments and get the same results.

a. For car A, design an experiment to decide if the car moves with constant velocity. If it does, determine the magnitude of the velocity (the car's speed).

b. For car B, use the same equipment and method to decide if this car moves with constant velocity. If it does, determine the magnitude of the velocity (the car's speed).

c. Predict where the cars will meet if you simultaneously release them from 2.0 m apart moving straight toward each other. List all assumptions that you made about how the cars move. If the assumptions were not valid, how would your prediction change?

d. Decide how you will record the data. How will you represent the data? In your representation, mark the predicted value for the meeting location. Perform the experiment and collect data.

e. Did the outcome match your prediction? How many times do you need to conduct the experiment to be able to say for sure whether the outcome of the experiment matches the prediction or not? Write the result of the experiment (meeting location) accounting for the discrepancies in the meeting location in different repetitions of the experiment.

Example of 2 (OALG Chapter 2) Students watch the video of the experiment, collect data and analyze patterns.

OALG 2.6.2 Test your idea

Observe the video of a snail https://mediaplayer.pearsoncmg.com/assets/_frames.true/sci-OALG-2-6-2 . Use the arrow keys on the keyboard to advance the video frame by frame.

a. Decide if the snail moves with constant velocity. If it does, determine the magnitude of the velocity (the snail's speed). Record the data below in a table and plot a position-vs-time graph for the snail.

b. Predict where the snail would be in 26 minutes. What assumptions did you make?

c. Design an experiment to test whether or not you walk across a room in your house (apartment) at constant speed. Describe the experiment and the materials you will need to conduct it. If you do not have a meterstick or bean bags, use available materials to improvise. Record and analyze your data here.

d. If you determined that you walk at approximately constant speed, what is your speed? What assumption(s) did you use to make this estimate (Hint: think of what happens when you just start your motion.)

Example of 3 (OALG or ALG Chapter 2) Students do the experiment but do not collect data data, only analyze them and find patterns.

ALG 2.7.1 Analyze

Work with the data recorded in the table at the right for the up and down motion of the center of a ball thrown upward (the *y*-axis points up).
a. Sketch a motion diagram for the ball.

b. Draw a position-versus-time graph for the ball. Discuss whether the graph resembles a position-versus-time graph for an object moving at constant velocity.

c. Determine the scalar component of the average velocity for the ball for each time interval by completing the following table.

Clock reading *t* (s)	Position *y* (m)
0.000	0.00
0.133	0.44
0.267	0.71
0.400	0.80
0.533	0.71
0.667	0.42
0.800	- 0.04

Example of 4 (ALG Ch3) Students watch the video of the experiment, do not collect data. Analyze pretend data and find patterns.

3.5.1 Observe and find a pattern

PIVOTAL ***Class or lab:*** *Equipment per group:* whiteboard and markers, laptop computer.

Watch (video experiment 1, [https://mediaplayer.pearsoncmg.com/assets/_frames.true/sci-phys-egv2e-alg-3-5-1a]) and (video experiment 2, [https://mediaplayer.pearsoncmg.com/assets/_frames.true/sci-phys-egv2e-alg-3-5-1b])

a. On a whiteboard, draw a force diagram for the cart in Experiment 1 and another for the cart in Experiment 2.

b. Then use the data in the table at right to devise a relationship that shows how each cart's acceleration depends on the cart's mass and on the net force exerted on the cart by the string or fan, Earth, and the track. Note: When doing such an analysis, devise a relationship for each independent variable one at a time and for the dependent variable (for example, use some of the data to see how the acceleration depends on the net force exerted and then use other parts of the data to see how the acceleration depends on the mass of the cart). Then combine these relationships to get a final relationship.

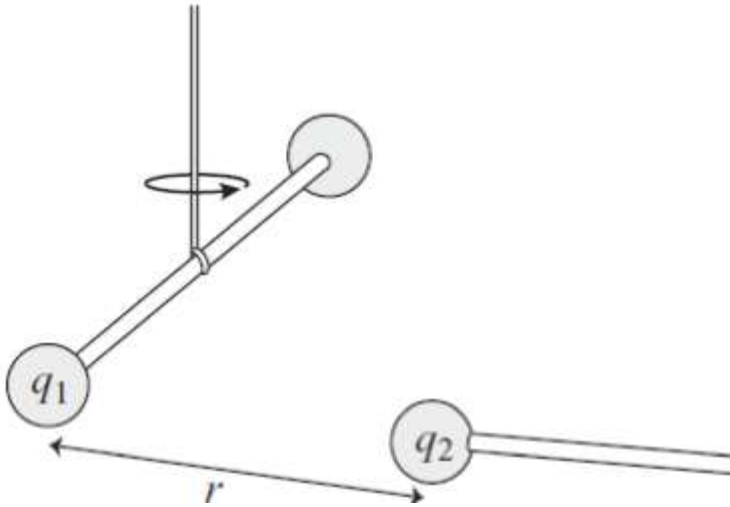
Analysis of video experiment 1	
Acceleration (m/s^2)	Net force (N)
0.38	0.2
0.74	0.3
1.67	0.5
2.8	0.75
4.3	1.2
Analysis of video experiment 2	
Acceleration (m/s^2)	Mass (kg)
0.27	0.56
0.20	0.76
0.15	0.96
0.13	1.16
0.10	1.36

Example of 5 Students learn about the setup of the experiment, analyze pretend data and find patterns.

17.4.1 Find a pattern

***PIVOTAL* Class:** *Equipment per group:* whiteboard and markers.

Charles Coulomb used a torsion balance (see the figure at right) to measure the force that one charged ball exerts on another charged ball to find out how the force between two electrically charged objects depends on the magnitudes of the charges and on their separation. Coulomb could not measure the absolute magnitude of the electric charge on the metal balls. However, he could divide charges in half by touching a charged metal ball with an identical uncharged ball. The table that follows provides data that resemble what Coulomb might have collected. Represent the data graphically collaborating with your group members on a whiteboard. Discuss with your group: which are the independent variables and what is the dependent variable in Coulomb's experiment? Then analyze the changes in the dependent variable as you change only *one* independent variable at a time. Use this analysis technique (controlling variables) to find patterns in the data and devise a mathematical relationship based on these observations. Put your final equation on a whiteboard and share it with another group.



Continue with 5

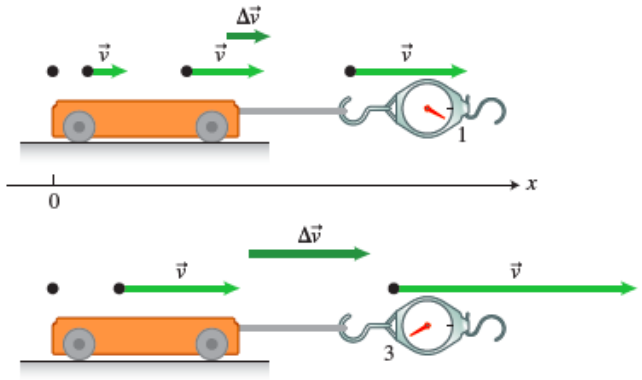
Charges (q_1, q_2)	Distance	Force
1, 1 (unit)	1 (unit)	1 (unit)
1/2, 1	1	1/2
1/4, 1	1	1/4
1, 1/2	1	1/2
1, 1/4	1	1/4
1/2, 1/2	1	1/4
1/4, 1/4	1	1/16
1, 1	2	1/4
1, 1	3	1/9
1, 1	4	1/16

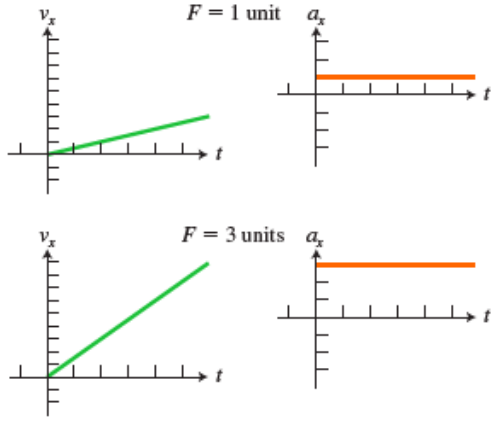
Example of 6 Students learn about the setup of the experiment, the data are analyzed for them and they find patterns.

OBSERVATIONAL EXPERIMENT TABLE 3.4 Forces and resulting acceleration

VIDEO OET 3.4

Observational experiment	Analysis
Experiment 1. A cart starts at rest on a smooth horizontal track. A spring scale continuously exerts one unit of force in the positive direction. The experiment is repeated four more times. Each time, the force probe exerts one additional unit of force on the cart (up to three units). We record the value of the force, and use a motion detector on the track to record the cart's speed and acceleration.	Using this information, we create velocity-versus-time and acceleration-versus-time graphs for two of the five different magnitudes of force. Note that the greater the force, the greater the acceleration.





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Using the textbook for help

Reading interrogation strategy - open OALG Chapter 1, proceed to activities 1.1.5 and 1.6.1.

Using problem solving strategy for help

Open Textbook Chapter 3 and go to Page 67 PSS 3.1

More ideas on how to “cut the time”