What do particles have to do with our everyday lives?

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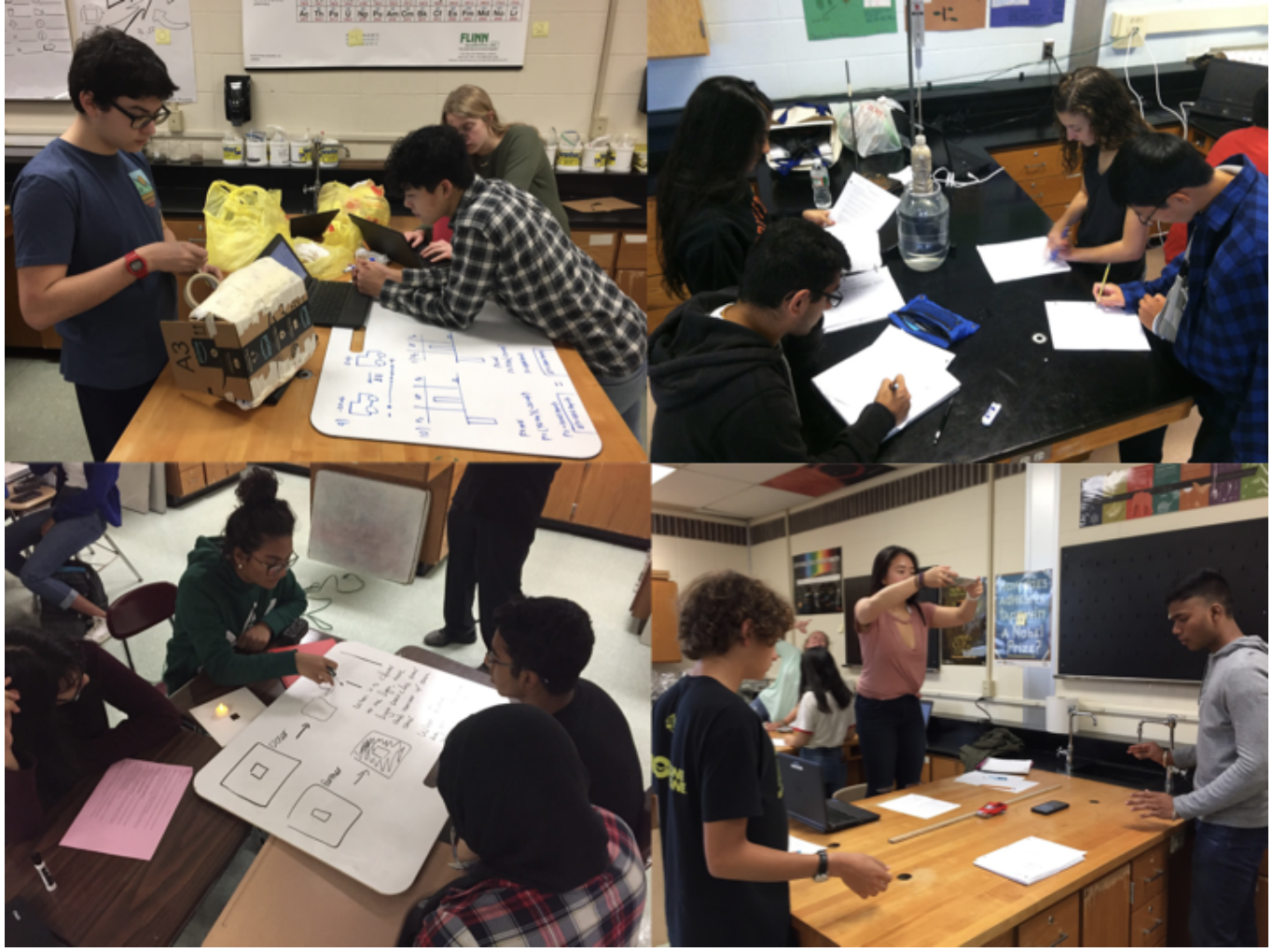
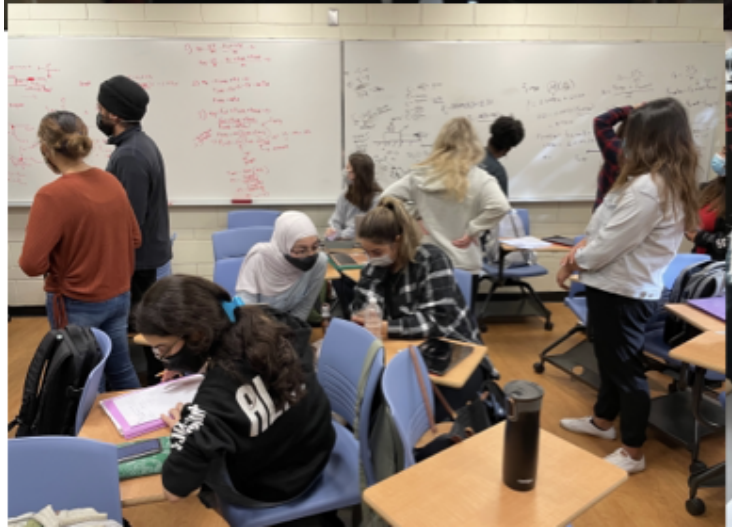
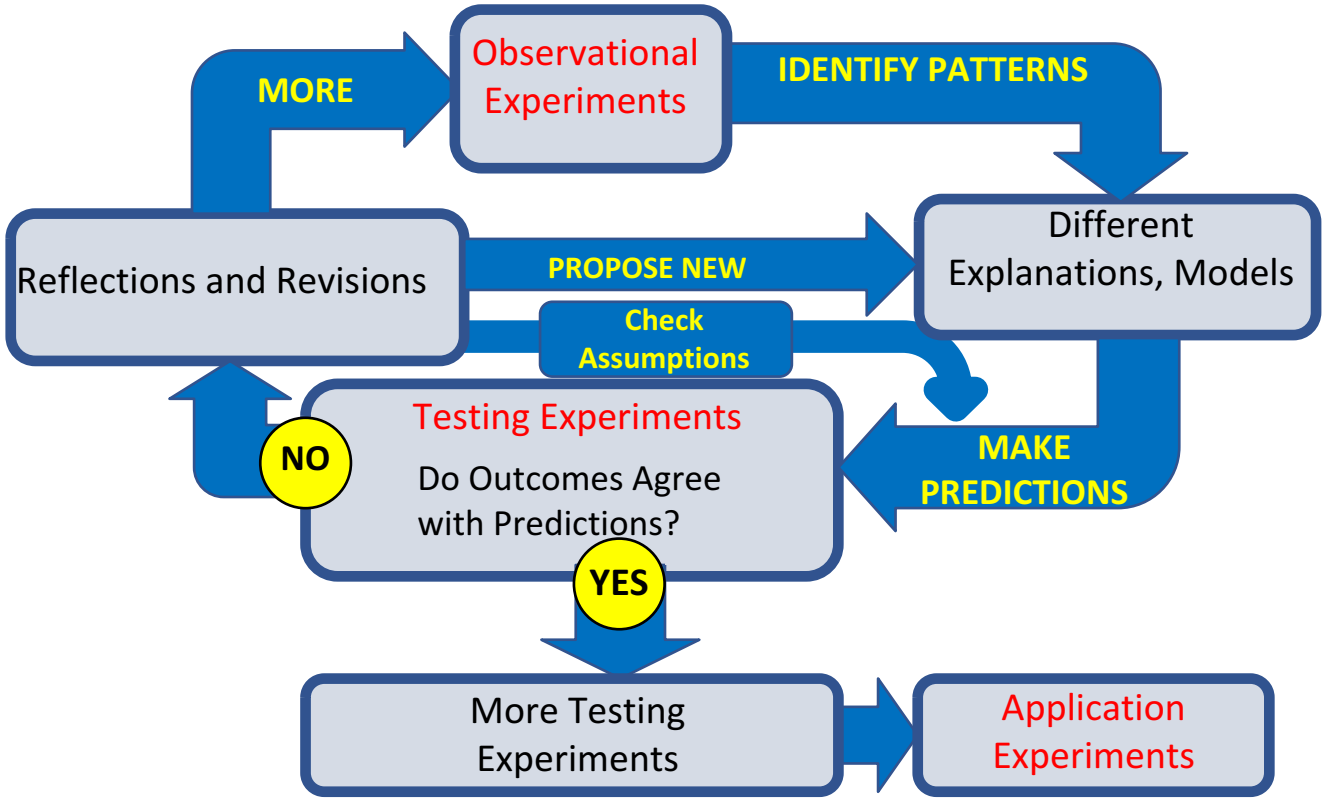




What was the idea that we constructed during our first workshop and how did we do it?

The Investigative Science Learning Environment (ISLE) approach



Etkina and Van Heuvelen, 2001, 2007; Etkina, 2015

Extending our understanding of particles

Go to http://islevideos.net/experimentindex.php?topicid=7&cycleid=14

Observational Experiments: Click on the first video (mixing in cold water), watch carefully. Record the time needed for the dye to mix with water.

Then click on the second experiment. Watch and notice the time.

Development of an explanation: What could be reasons for the difference in time?

Testing experiment: Use your explanation to predict what will happen if we take two tea bags and put one in cold water and one in hot water.

Then watch the third experiment and compare the outcome to the prediction.

What is the new idea that we just constructed?

Here is another idea that we will need

Observational Experiment

Take a glass (or a transparent plastic cup) and pour ice cold water into it.

a. Carefully observe the glass for a few minutes. Describe what you observe in simple words. Take a photo of the glass to share with the class. If you do not have access to the materials, use the link https://mediaplayer.pearsoncmg.com/assets/_frames.true/sci-OALG-1-1-2a.

b. Think of different explanations (wild ideas) for the observed patterns. Try to devise as many explanations as possible.

Possible explanations

From inside of the glass, water came through glassF

From outside (air)

There are water-particles in the glass, that appear

Water is built when air and the cold glass come together

The water molecules in the air are attracted by the cold glass

Students' proposed explanations

1. Water goes out from the surface and settles outside the glass.
2. Water seeps through the glass material.
3. There is water in the material of the glass and the glass material "sweats" and the water comes out.
4. Water comes from outside air.
5. Water is made when air touches the cold glass

What do we do with all those explanations?

What do we do with all those explanations?

c. How can you find out which explanation is correct? In science we conduct testing experiments. A testing experiment is an experiment whose outcome you predict before conducting it using the explanation under test. You do not need to agree with the explanation, but the prediction of the outcome must be based on it. After you design the experiment and make predictions based on all explanations that you devised, you conduct the experiment and compare the outcome to the prediction. Think about what testing experiments you can run to test the proposed explanations. Try to propose as many as you can by writing each one with a brief description.

d. For *each* testing experiment, make a prediction for its outcome based on *each* explanation that you proposed in b. Indicate any of your additional assumptions when making the predictions. (Note: The best testing experiments are those that give different predictions for different explanations).

Team 1 Testing experiments and predictions based on each explanation

Experiment:	Prediction based on Explanation 1,3	Prediction based on Explanation 2	Prediction based on Explanation 4	Prediction based on Explanation 5
Vacuum bell	Water on glass	Water on glass	No water on glass	No water on glass
Measuring cylinder	Same volume??	Less water in the glass (volume)	Same volume	Same volume
Scale - and	Same mass	Reduced	Same mass??	Same mass??

Team 2 Testing experiments and predictions based on each explanation

Experiment:	Prediction based on Explanation 1	Prediction based on Explanation 2	Prediction based on Explanation 3	Prediction based on Explanation 4
We use cold alcohol instead of the water and observe what happens	We should have alcohol drops on the glass surface	We should have alcohol drops on the glass surface	We should have normal water drops, no alcohol	We should have normal water drops, no alcohol
We use cold coloured water and observe	Water drops should have colour	Water droops should have colour	We should have normal water drops,	We should have normal water drops,


KIRKLAND
Signature
ORGANIC
STRAWBERRY SPREAD
Whole
Milk
KIRKLAND
Trader Joe's Organic Preserves are

One last final testing experiment

One of the testing experiments suggested by other students is as follows: you take a glass, put it on a scale, pour ice cold water into it and record the mass. What do the remaining explanations predict what will happen to the mass as the glass sits on the scale?

Now, watch the experiment and compare the predictions to the outcome:

https://mediaplayer.pearsoncmg.com/assets/_frames.true/sci-OALG-1-1-2b

Let us summarize what the students should know by now

Real world phenomena that your students should be able explain now; let's try to explain as many as we can

How do wet things dry?

How do we smell things?

Why do we smell hot soup not cold?

Why do we feel cold when our skin is wet?

Why do dogs stick out their tongues in the summer?

Why does sugar dissolve in hot tea faster than in the cold tea?

Why do our lips dry in the winter or in the mountains?

Why do our glasses get fogged up when we come from cold air into a house?

Team 1 Choose as many phenomena from the list above as you can and try to explain them

Why do we feel cold when our skin is wet?

The faster particles leave first, the water is getting colder, the skin is getting colder.

How do we smell things?

All particles are in movement, it’s the tea-experiment in the air, the particles (of the fragrances) are moving to our nose.

Team 2 Choose as many phenomena from the list above as you can and try to explain them

Why do dogs stick out their tongues in the summer?

The faster molecules from the tongue leave and the cooler water particles stay and that cools the dog.

We do the same thing with our skin. Dogs need the water from outside and drink a lot.

Why do our lips dry in the winter or in the mountains?

The water is on the cold surfaces and is not in the air any more. The water particles from the skin “just walk out.”

And two more ideas for questions:

Why do we feel hotter in summer when the humidity is high? And why to we use ventilators to cool down?

Humid air already contains a lot of water molecules and cannot accept extra water molecules from our skin. When we use ventilator, it

Which phenomena would you choose your students to work on? Think of what testing experiments they could design to test their explanations?

What did you learn today?

Use only words that the students created

Use no other word than particals

Say, how many time the groups have to work

Don´t answer questions that the students didn´t ask

How to do the group work - 3 person groups for creativity

Its difficult to design simple experiments, that help

Everything consists of particles. Particles move. Particles move faster if the substance is warm. There is water in the air.

1. The particles oft he water move faster, when the water is hot.

2. In hotter materials particles move faster (tea bags).

The faster particles leave first, the colder ones stay in the water, so the water becomes

There is water in the air