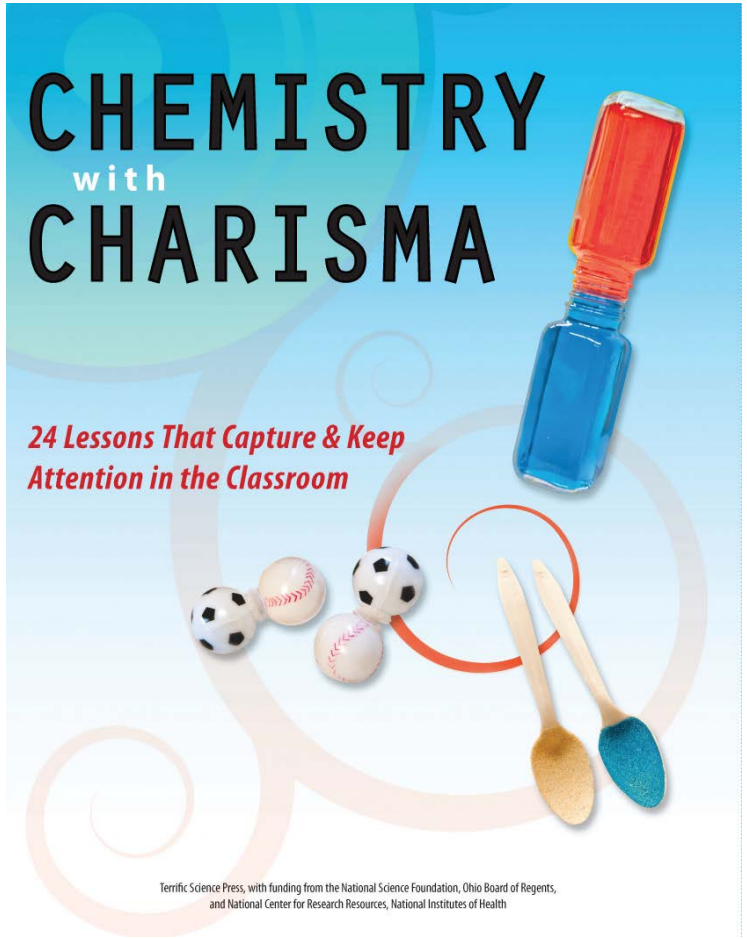
Lowering Student Activation Energy to Learn Chemistry—Using Toys Creatively

Lynn Hogue, Lynn@TerrificScience.org

www.terrificscience.org

In addition to things we do with you
check out our resources at
www.TerrificScience.org/freebies/


CHEMISTRY
with
CHARISMA
24 Lessons That Capture & Keep
Attention in the Classroom
Terrific Science Press, with funding from the National Science Foundation, Ohio Board of Regents,
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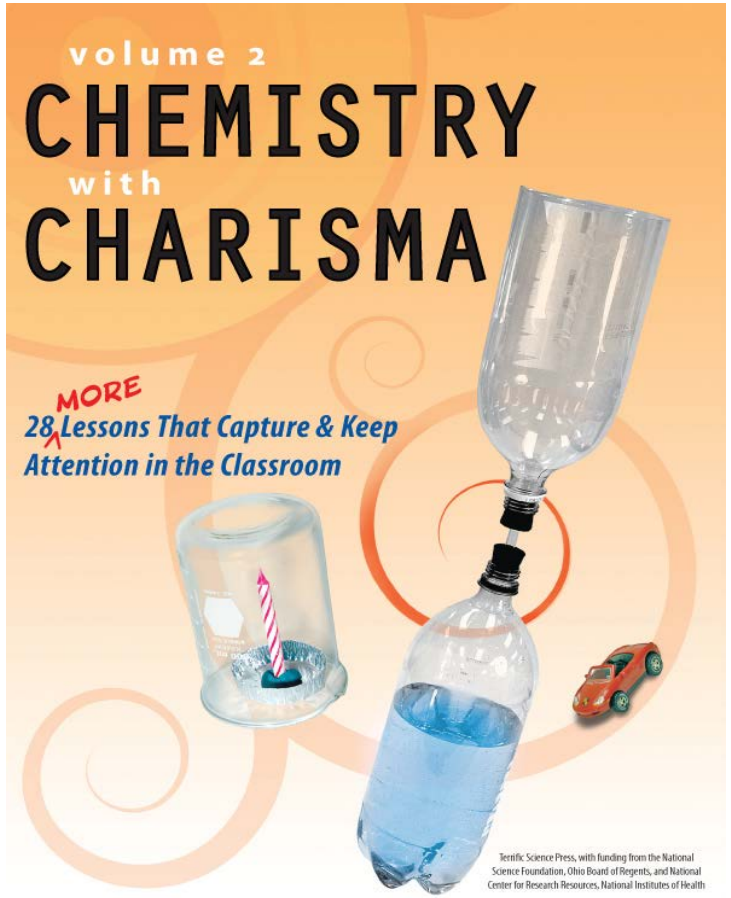
volume 2
CHEMISTRY
with
CHARISMA
MORE
28 Lessons That Capture & Keep
Attention in the Classroom
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Add to water...

...or directly under your tongue.

111 O2 SPA BAR ALL NATURAL LIQUID OXYGEN™ DROPS

Drink It Up! Helps with jetlag, fatigue, boosting your immune system, hangovers, fresher-looking skin and purifies drinking water. Just add it to water or juice or directly under your tongue, to revitalize while you're flying. Bottle provides 2-month supply. Family friendly. Safe and healthy for everyone, everyday...

$22

9540

Waiwera Infinity Water

The company website states:

"By shrinking the water molecules, the minimized clusters can move through your body faster than other water and can penetrate your cell membranes faster."

Reported in

Chemical & Engineering News, 3/06/06

We Brew Our Own Premium Beers

- *FRESH*
- *NATURAL*
- *NO CHEMICALS*

Pilsner

A light crisp and traditionally hoppy beer with a soft palate and flowery bouquet. Light both in color and taste, it is The "Classic" Old World Beer that will be most familiar to the individual who prefers domestic beers.

Red Stallion

A malty, aromatic and hoppy mixture. Copper colored, this beer is medium strong and full of flavor. Vienna style.

Black Forest

A full-bodied dark mahogany beer, with a rich malty texture. It is strong and sparsely hopped, in the traditional Munich style.

Weiss Beer

Golden unfiltered "wheat" beer. Smooth quality with hints of bananna and cloves and a spicy finish.

Special Brew

Please ask about our Special Brew that the Brewmaster is featuring this month.

How keen are your powers of observation?

The old shell game.

“Super Slurper” (Sodium Polyacrylate):
From Entertainment to…

SCIENCE

Argument-based inquiry

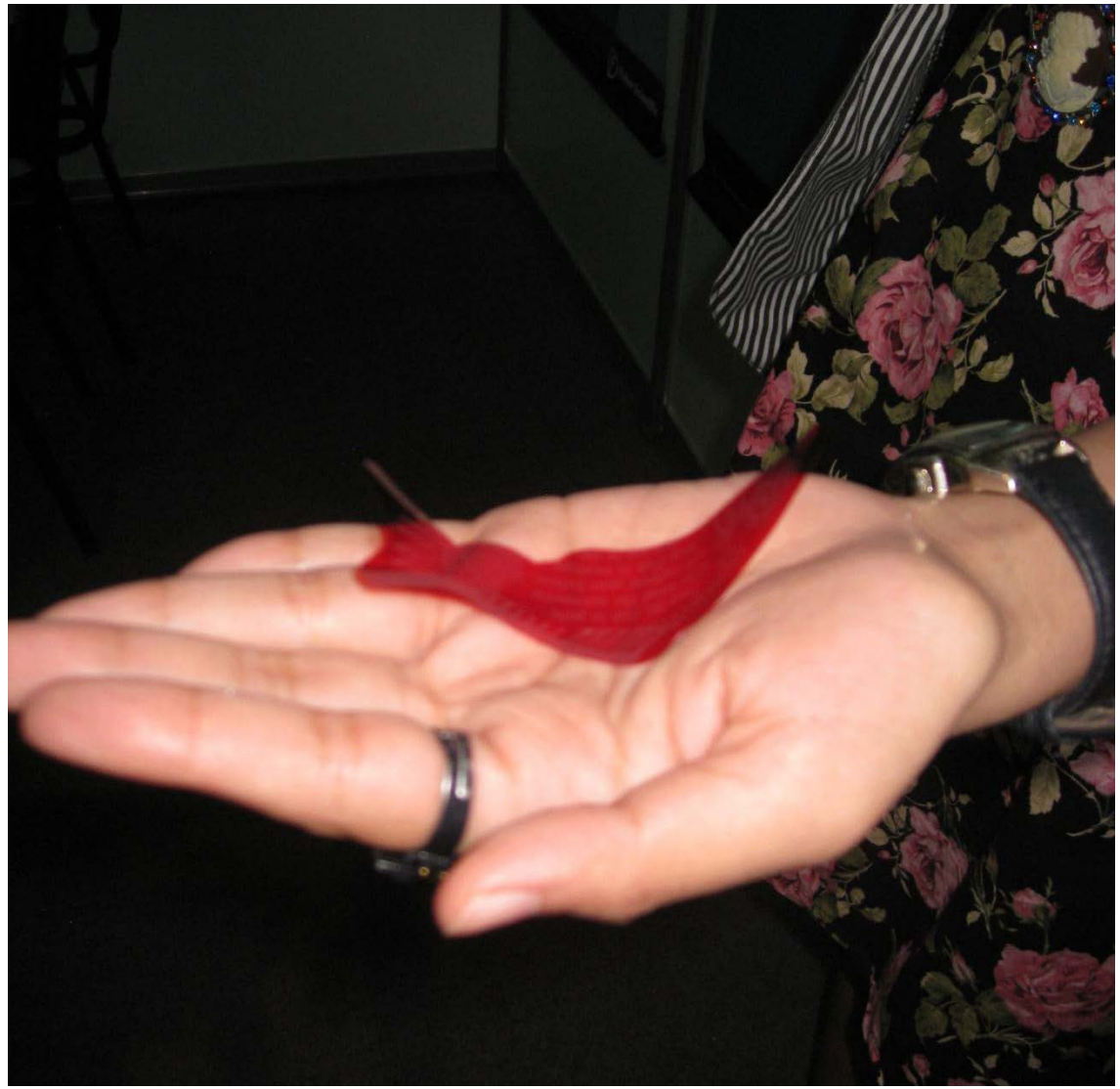
- Testable Questions
- Design appropriate investigations
- Data collection and analysis
- Make a claim
- Evidence

Construction and Critique (practices of science)

Align science instruction with what scientists do

What do scientists do?

Fortune Telling Fish




FORTUNE TELL
MIRACLE FISH


Fisher Scientific
Isotemp®
350
125
700
60
1100
Stir
Fisher Scientific
off
1200 rpm

Hot Stuff:
Investigating Reusable Heat Packs

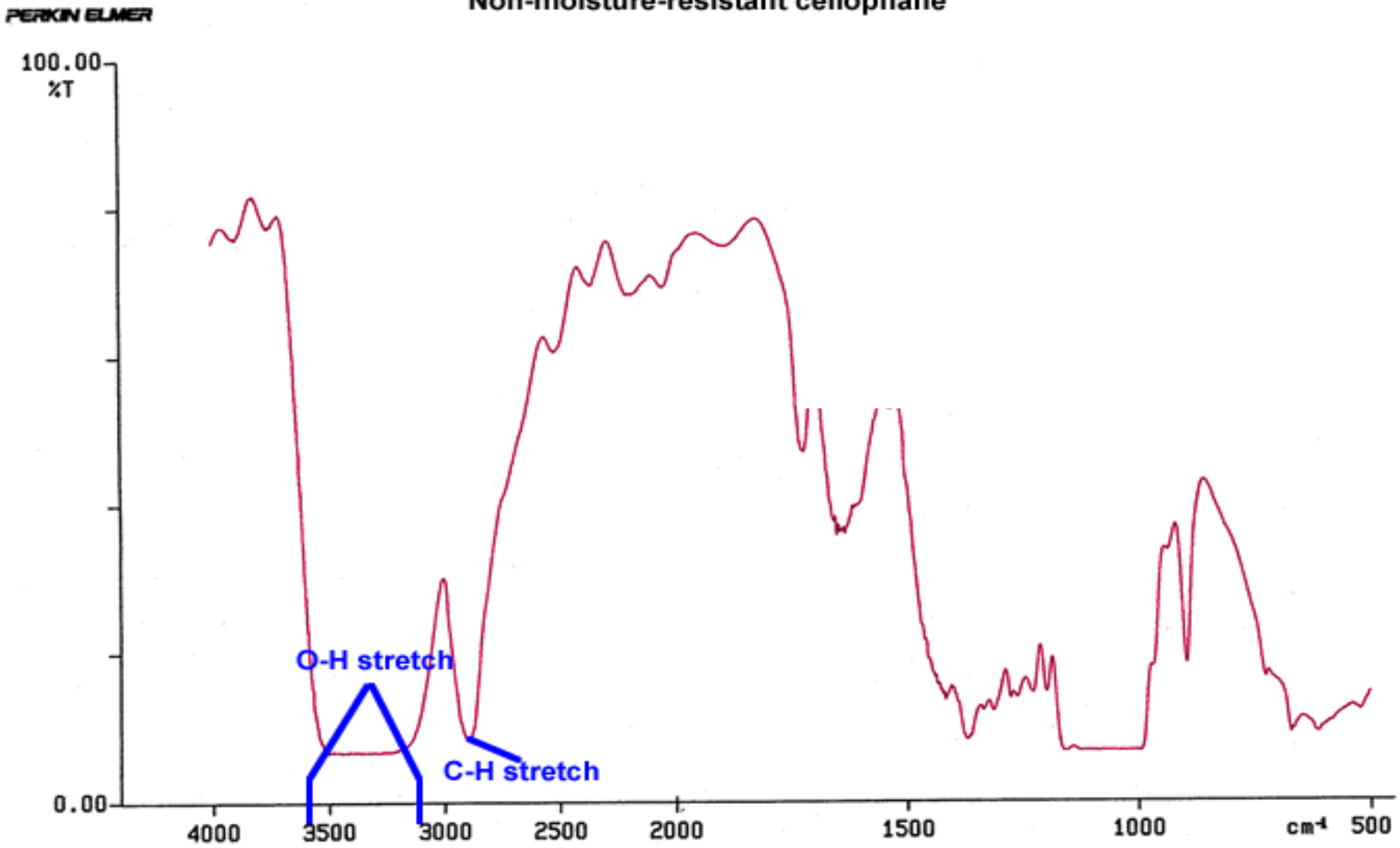
supersaturated sodium acetate solution

Crystallizing the Supersaturated Solution

- How much of the sodium acetate remains in solution after this crystallization process?
- Design an experiment to determine the amount of heat required to recrystallize this solid.

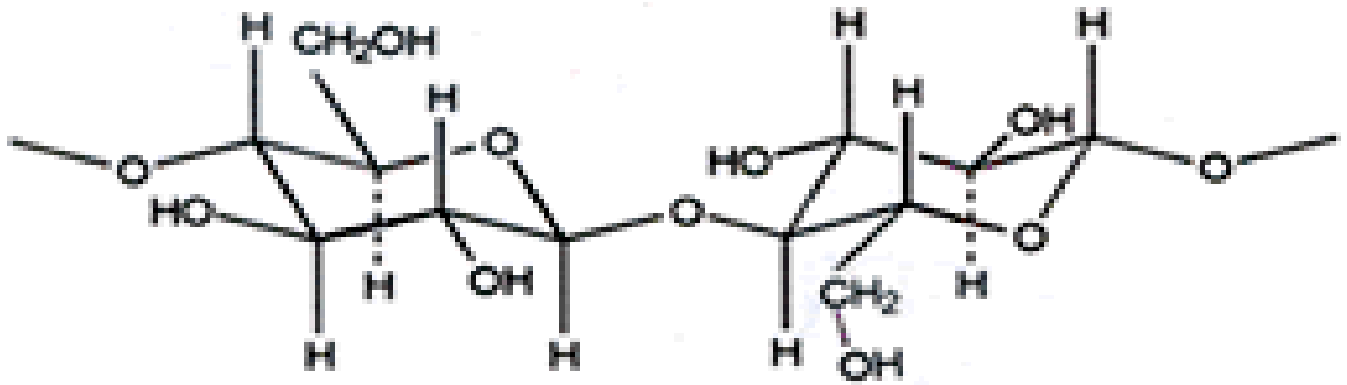
Additional research & literature reveals

Fortune Telling Fish
Non-moisture-resistant cellophane



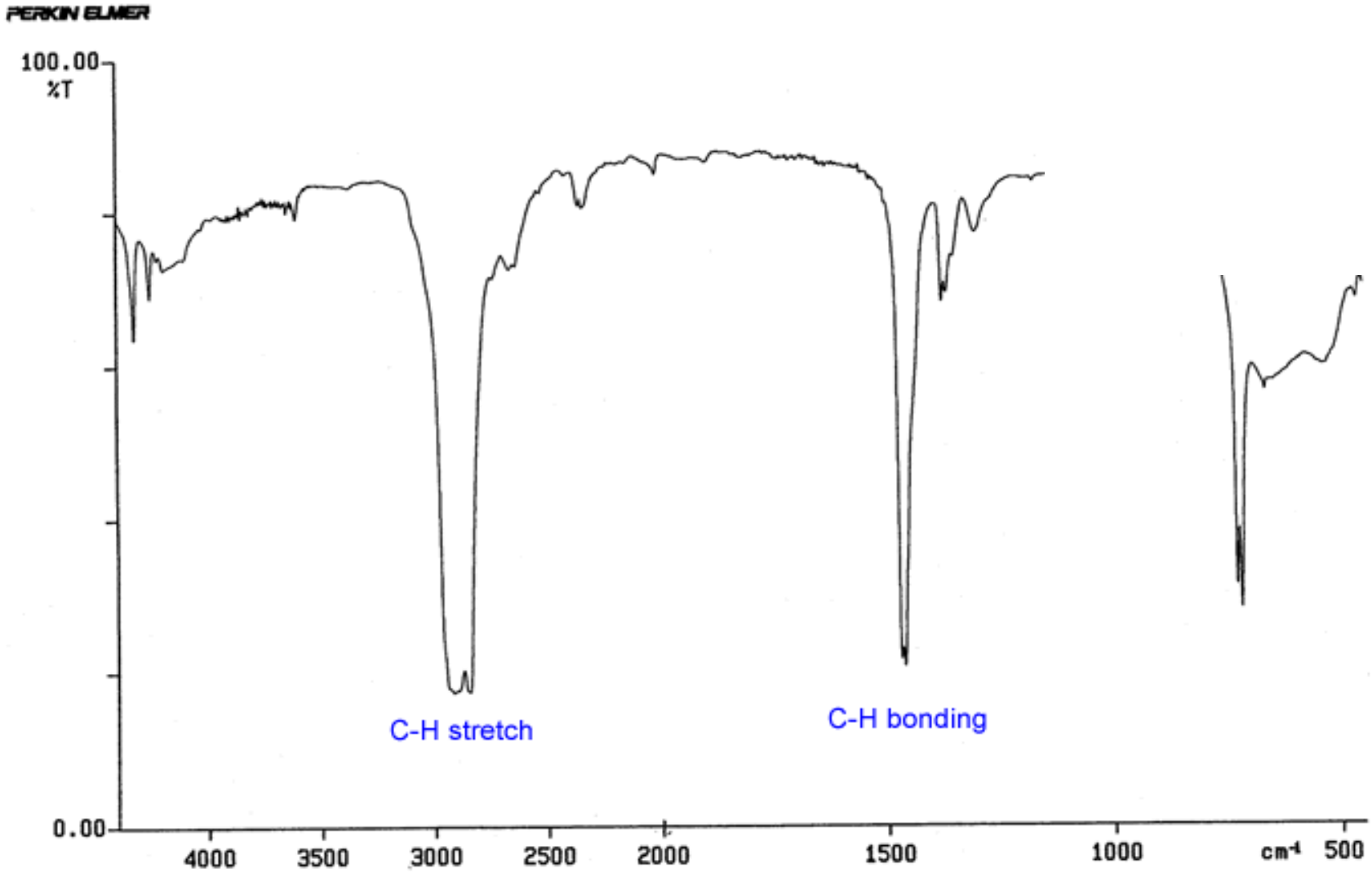
06/03/03 08:40 SCANecified
X: 4 scans, 4.0cm-1, apod weak
Fourier Transform Infra Red Spectrometer (FTIR)

the fish is made of



Cellulose

Wrapper for Fortune Telling Fish



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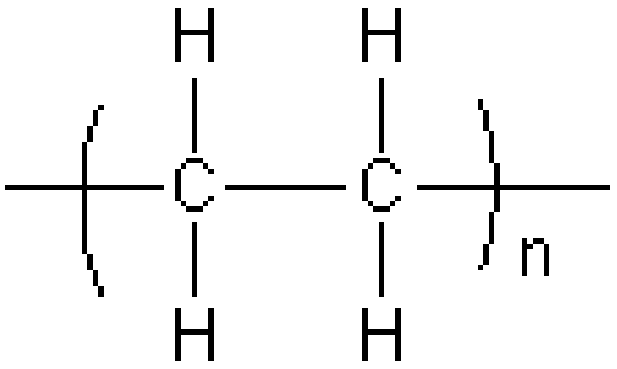
Fourier Transform Infra Red Spectrometer (FTIR)

the wrapper is made of



Polyethylene

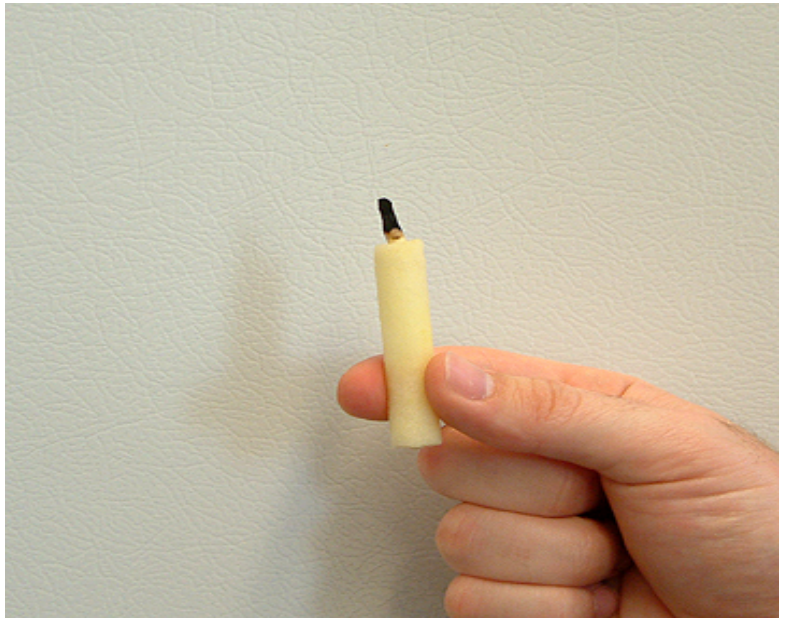
SCIENCE

Argument-based inquiry

- Testable Questions
- Design appropriate investigations
- Data collection and analysis
- Make a claim
- Evidence

Construction and Critique (practices of science)

What types of observations?



Qualitative Observations

Quantitative Observations

What do whoopee cushions, potato guns, and exploding straws have in common?

Straws: Science Tools

Work in pairs.
One partner hold a straw.
The other prepare to flick.
Then

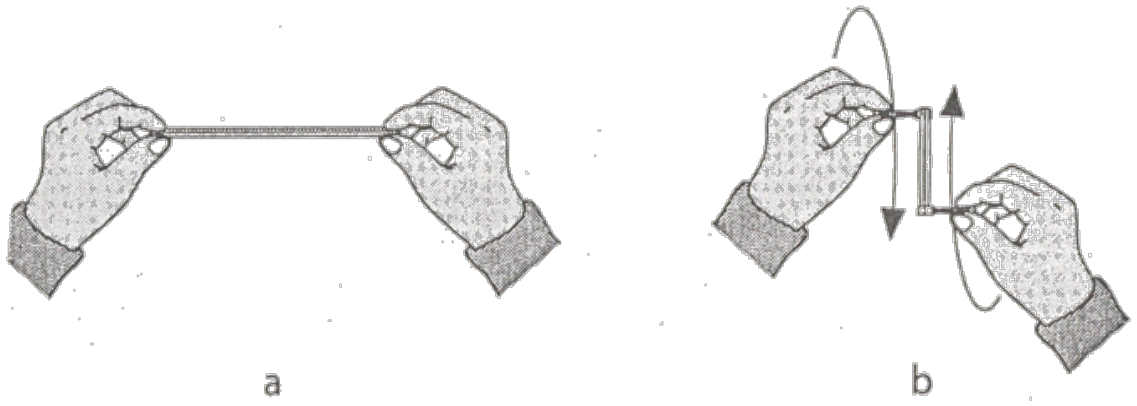


Figure 3: After (a) grasping the straw with both hands, (b) twist one hand over another until about two inches of unrolled straw are left in the middle.

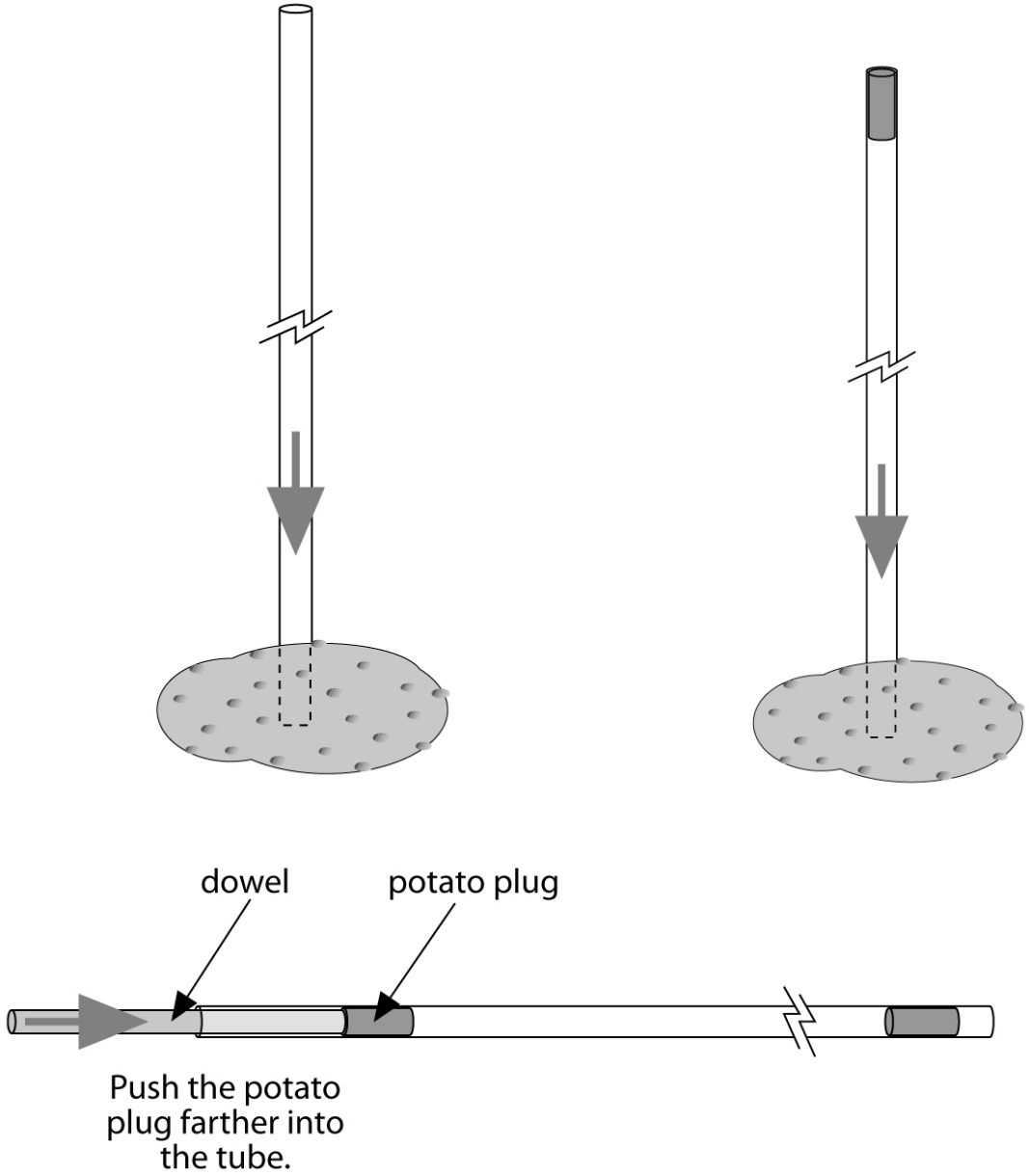
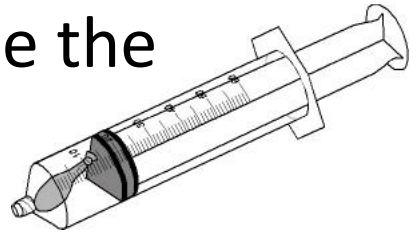


Figure 4: Push the plug 5–6 cm (about 2 inches) into the tube with the dowel.

From phenomena to student generated models…

- Trap air inside a syringe. Observe as you increase and decrease the pressure.

- Put a small, tied-off balloon into the syringe. Close the system. What happens if you decrease the pressure in the syringe?



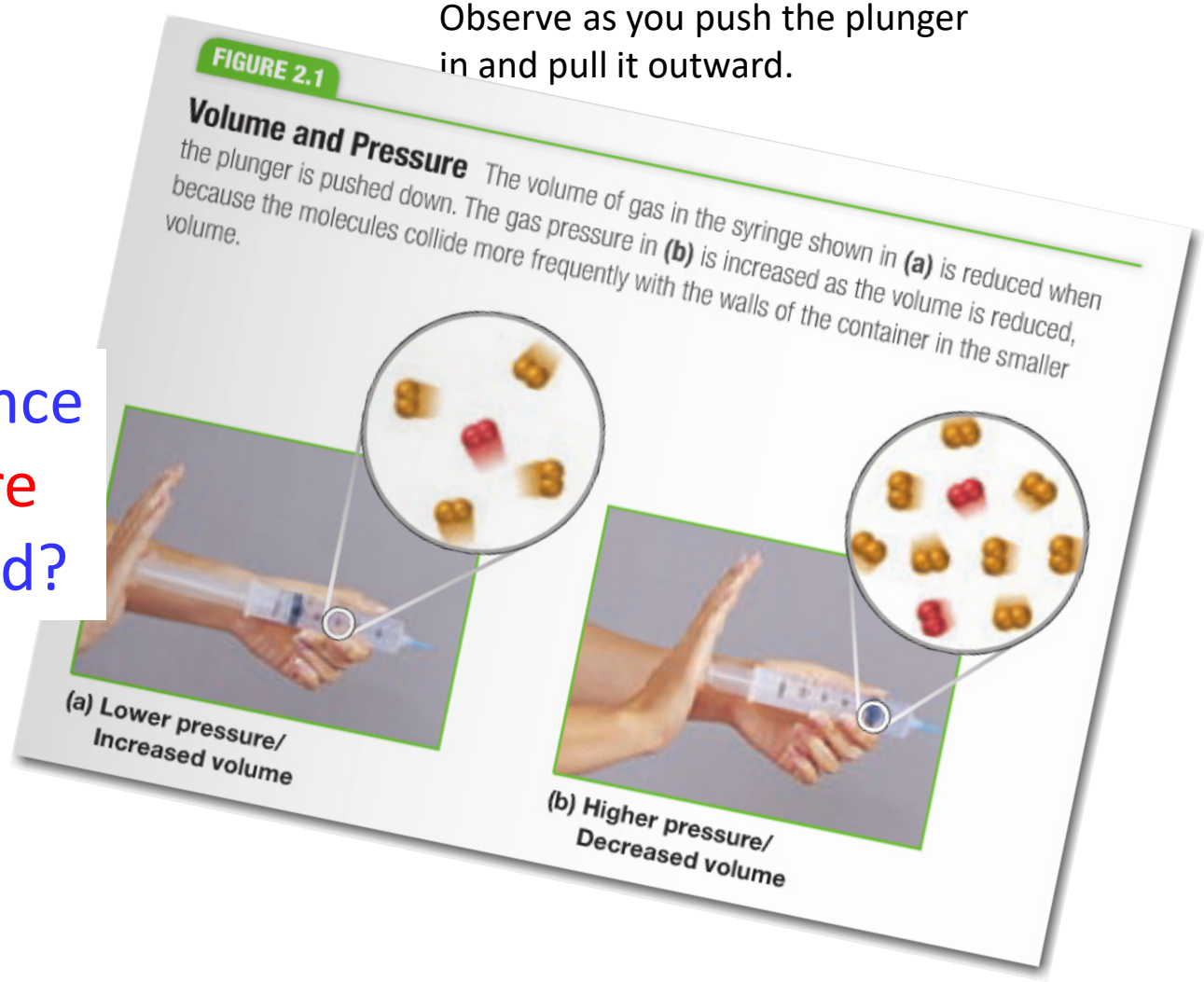
- Repeat the experiment with a marshmallow. What happens?

Thank you Robert William Boyle (1627-1691)

Trap air inside a syringe.

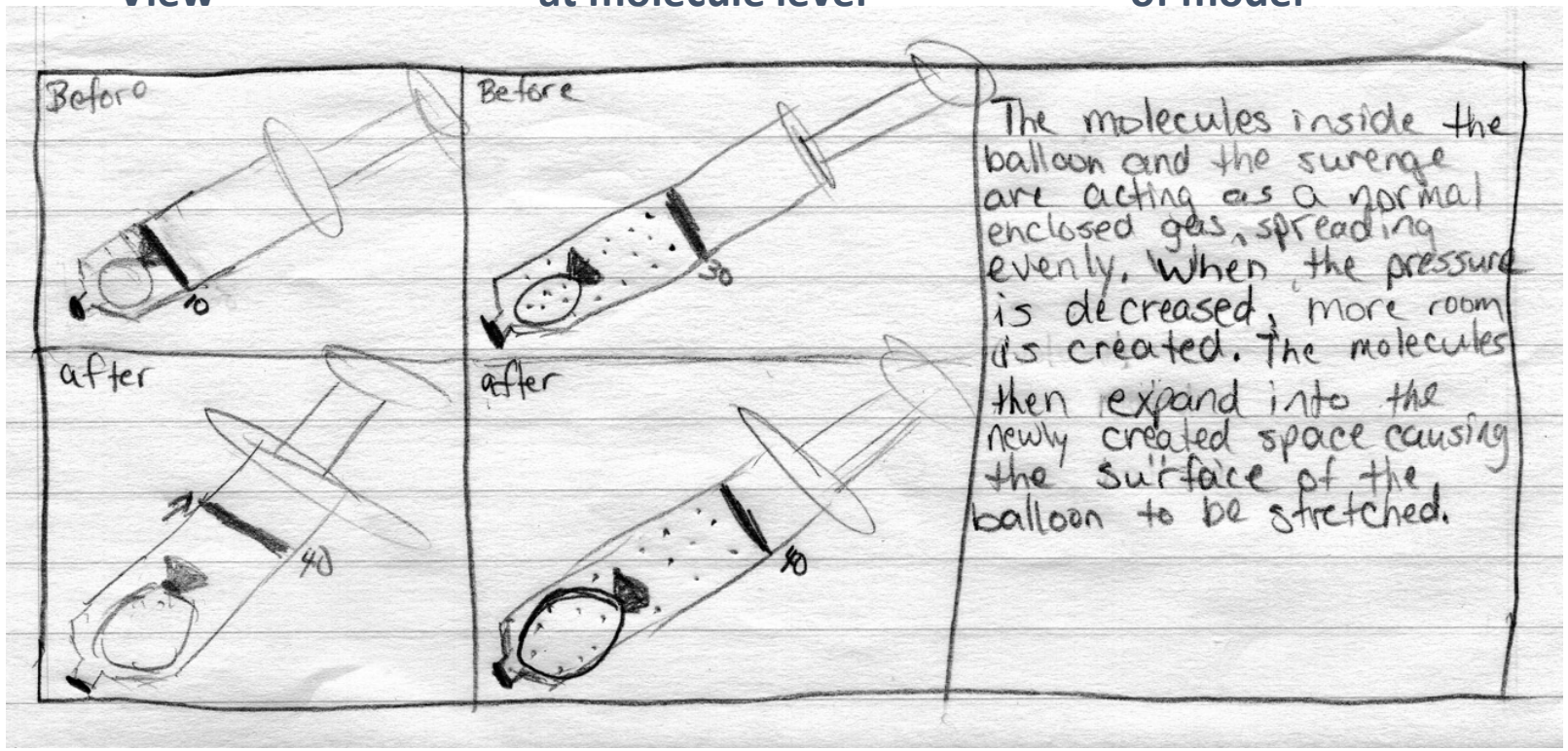
Observe as you push the plunger in and pull it outward.

What's the evidence that the pressure inside is increased?



HS Student's Visualization & Storyboarding

Macroscopic View | **Visualization at molecule level** | **Explanation of model**



Charles Law meets the bubble film

Simple… yet surprising
&
they are doing it!

Placement in your curriculum

- gas laws ($V \alpha T$)

Useful, engaging, & fun chemistry tools!

Hand boiler (love meter)

Challenge students to figure out

- the engineering/design of the toy
- the science of the system

Placement in your curriculum

- how gases make pressure
- gas laws ($P \propto T$)
- what is boiling & what isn't

carefully invert …

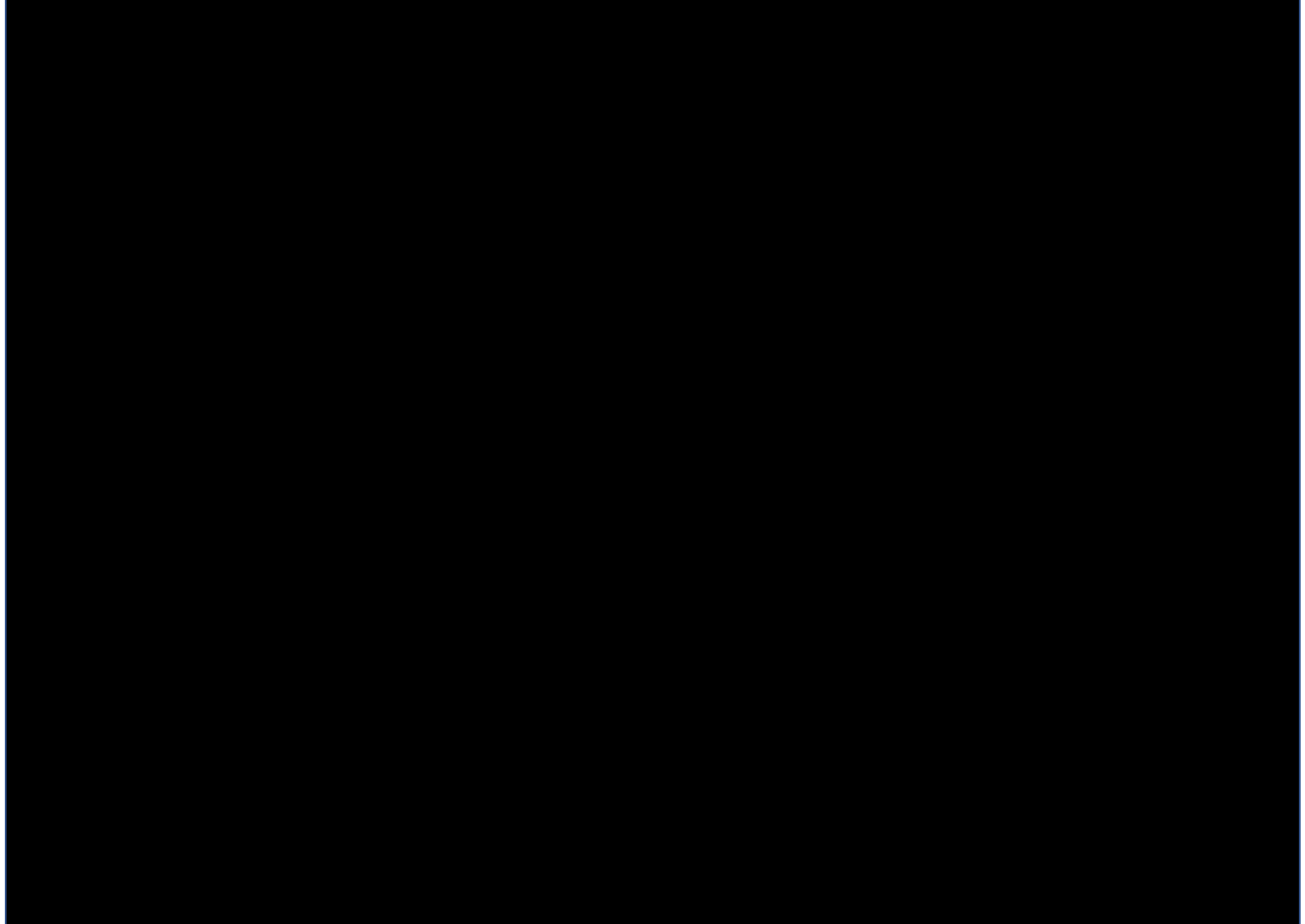
keeping ALL of the colored liquid in

the base chamber..

What does the top chamber feel like?

Ice-salt bath

Fluorescence & Phosphorescence



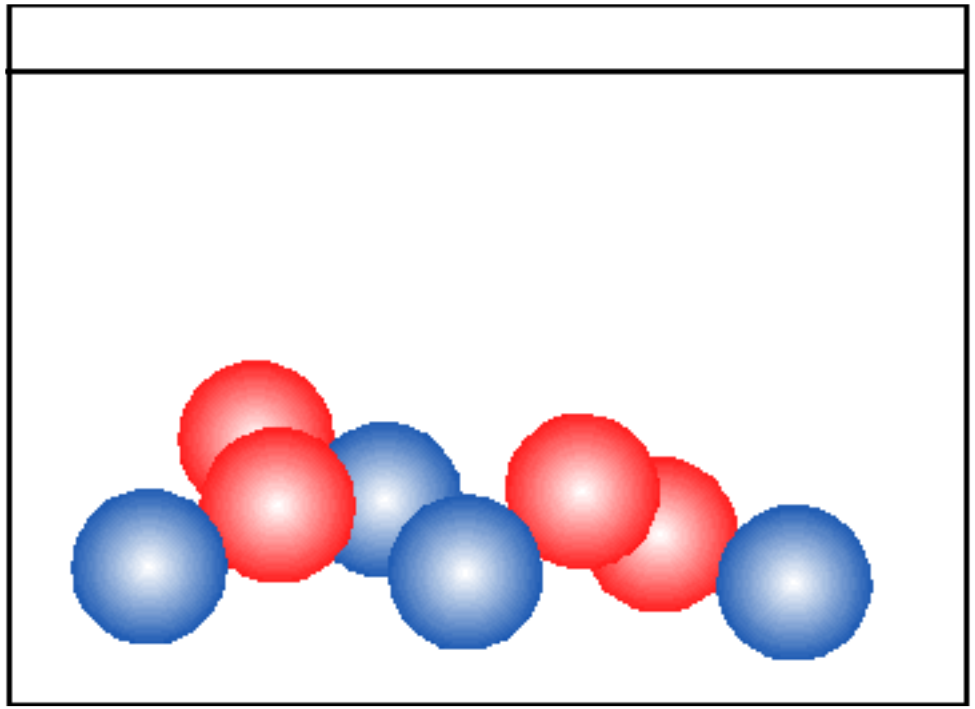
phosphorescent vinyl
yet another use

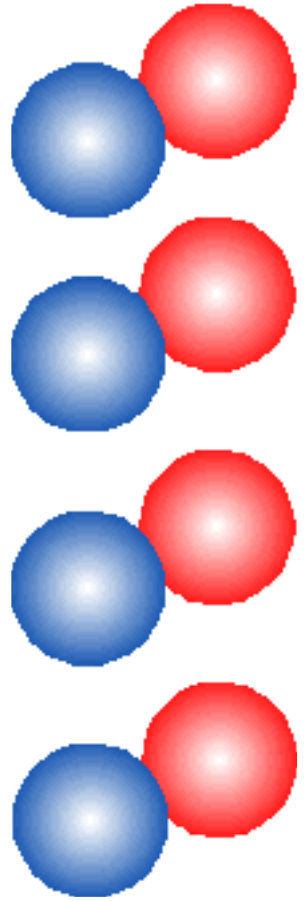
ZnS doped with Cu:
emission occurs at 520 nm

Wavelengths of the LED light:

- **RED** λ = 630 nm
- **GREEN** λ = 525 nm
- **BLUE** λ = 470 nm

Mixture or Pure Substance?





Pop beads As a Science Tool

?? Element, Compound, or Mixture ??

pure substance

compound

X-Y

Sample B

mixture
of two different elements

Y [monoatomic element]
(X-X) [diatomic molecule]

Sample B

mixture
of two different elements

Y [monoatomic element]
(X-X) [diatomic molecule]

REMEMBER the hand boiler?
Distillation

Before

dye in solution

empty

After

← solid dye

colorless liquid

Separating a mixture

shake

Volume estimate


WATER
10% EPSOM SALT SOLUTION
UNIVERSAL INDICATOR SOLUTION

Pencil assembly

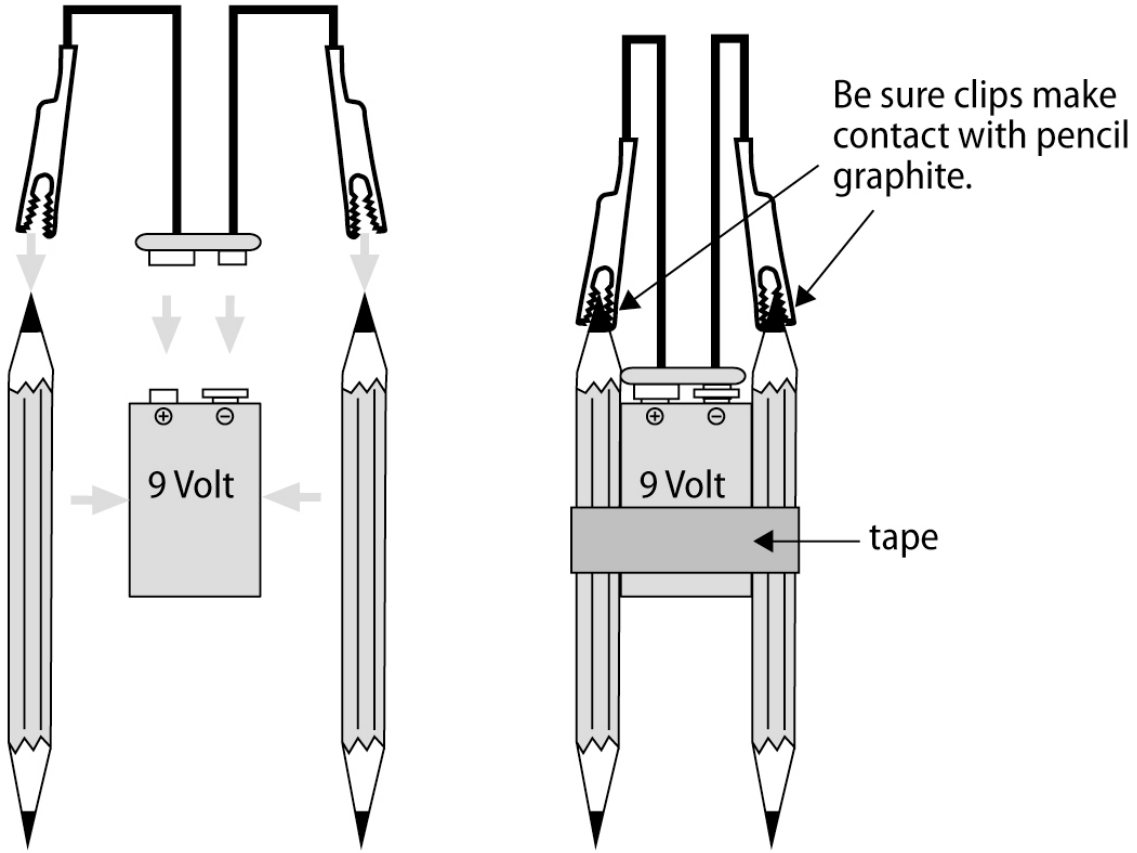
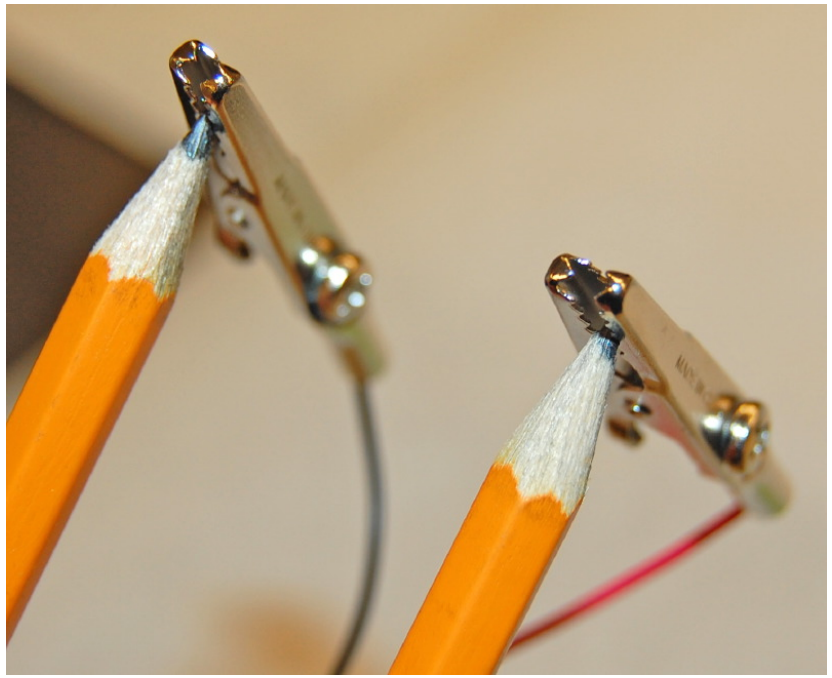
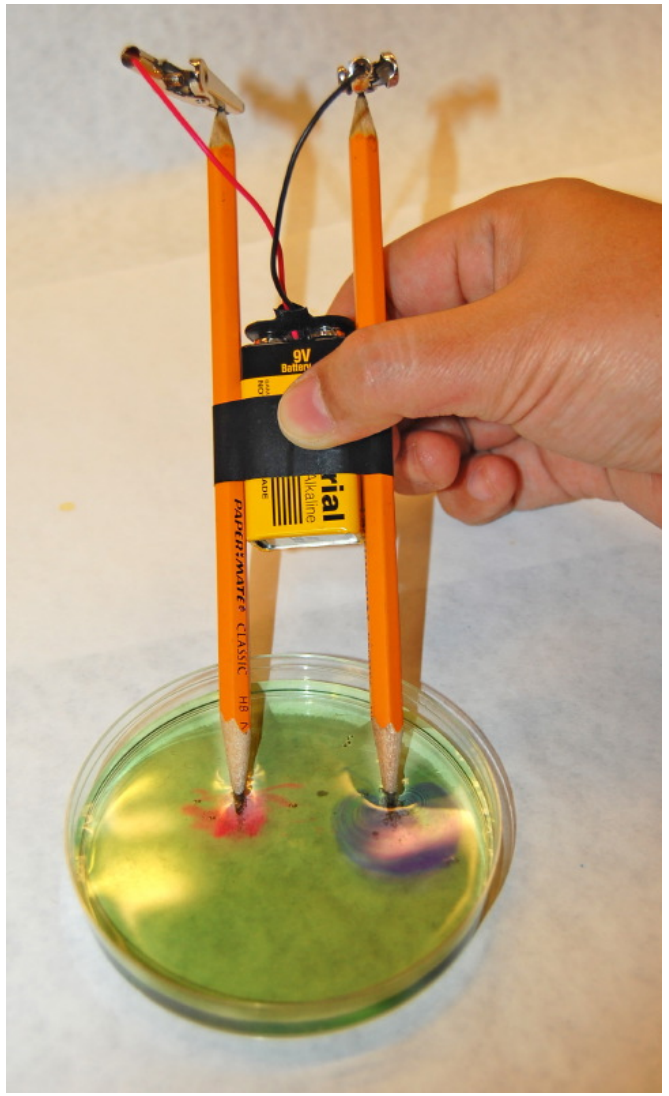
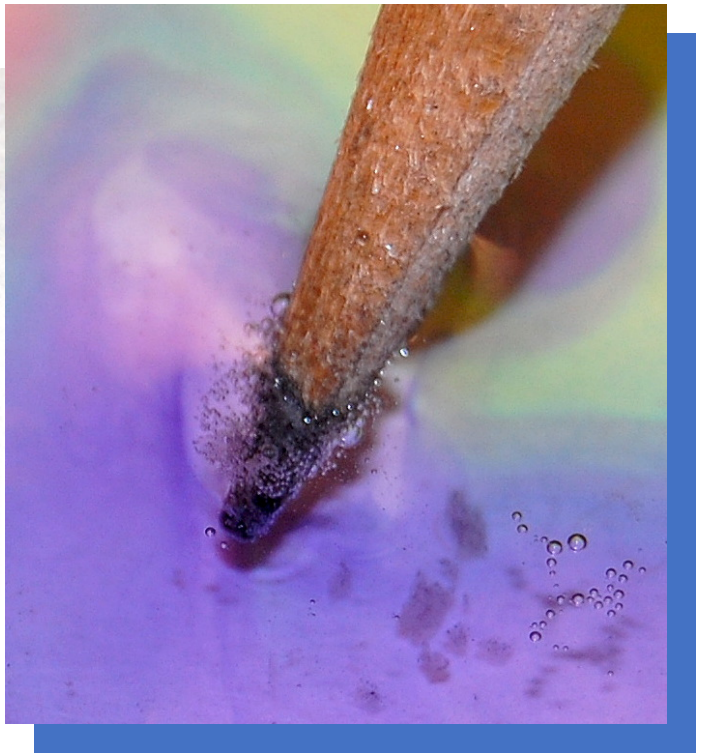


Figure 1: Assemble the pencil electrolysis apparatus.




9V
Paper Mate
CLASSIC


CLASSIC
HB



$$4H_2O(l) + 4e^- \rightarrow 2H_2(g) + 4OH^-(aq)$$

$$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$$

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g) + 4H_2O(l)$$

Magic sand


100ml
KIMAX
60
40
20

WATER

- The “universal non-solvent”
- Hydrophobic effect

Magic Sand: Modeling the Hydrophobic Effect and Reversed-Phase Liquid Chromatography

Ed Vitz, Kutztown University

Journal of Chemical Education

Volume 67, Number 6, June 1990

A scientist is someone whose curiosity survives education's assault on it.

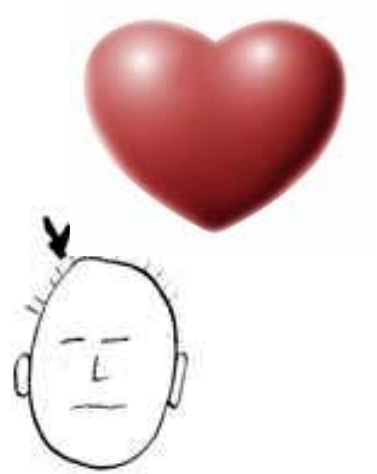
– *Sir Herman Bondi*

But we believe:

A scientist is someone whose curiosity is nurtured by education's impact on it.

Someone once said…

- A good teacher is…
  - 1/3 heart
  - 1/3 head
  - 1/3 ham



Thank You

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