# Lyniece McKim

## Biology Instructor

## Star Valley High

## Afton, WY

lmckm@lcsd2.org


# TEACHER SHARE-A-THON
# NABT 2010

## Biology: Chemistry of Life

- **Lab: Testing Mystery Substances**
  - Inquiry activity
  - Using indicators; i.e. red cabbage juice
  - Testing common acids & bases
  - Recognizing pH of human cells/homeostasis
- **National Science Standards**
  - NS.9-12.1 Science as Inquiry
  - NS.12.2 Physical Science
  - NS.9-12.3 Life Science

# Lab Groups of Three

- Classroom organized in groups of three.
- Lab groups are the same.
- Assigned roles in class and lab.

# Equal Participation

- All students must be involved/responsible.
- Roles for each student:
  - Student #1: Cabbage paper
  - Student #2: Cabbage gel
  - Student #3: Cabbage juice

# Using Litmus Paper

- Pre-lab discussion & activity
- Ammonia & vinegar drops
- Red, blue, wide-range litmus
- Discover color change
- Role of indicators

# Three Testing Indicators:

## Red Cabbage juice, gel, paper

- **Safety Precautions:**
  - Gloves, aprons, glasses
  - Clear dropper bottle tips between uses if needed
- **Materials List:**
  - 12 dropper bottles (3 sets); marked #1-12
  - 12 common acids & bases
  - Red cabbage juice in gallon containers
  - Small measuring pitcher per group
  - 10 ml graduated cylinder per group
  - Test tubes & rack per group
  - Paper towels & scissors
  - Cabbage gel & plastic knives
  - Paper plates & markers

# Why Red Cabbage?

- Red Cabbage juice's purple color is due to pigments of anthocyanins.
- Slight molecular change takes place when mixed with acids and bases.
- Causes change in absorbing and reflecting light.
- Changes the colors we see when mixed with various acids or bases.
- Lasts many days when refrigerated.
- Dispose of down the drain.
- Safe; non-staining.
- Inexpensive

# Teacher Preparation

- **Juice**:
  - Boil one medium-sized, sliced red cabbage in 2 gallons water, 30 min.
  - Remove cabbage/Collect juice/Refrigerate.
- **Gel**:
  - Add 1 Knox gelatin envelope to 1 C. cooled juice (x4).
  - Stir and heat to dissolve.
  - Pour 1/4” deep into shallow containers/ Refrigerate 2 hrs.

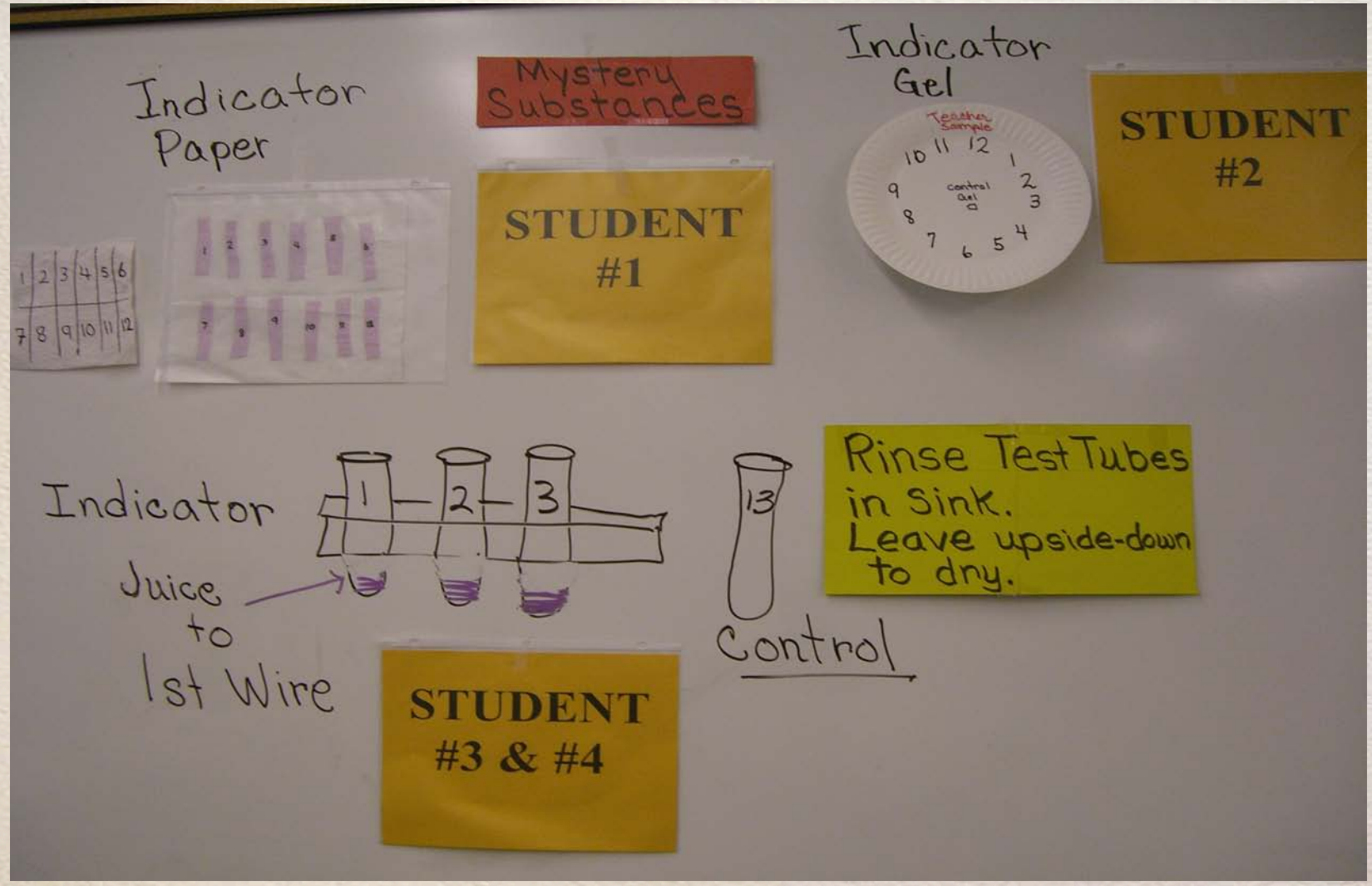
- **Indicator Paper:**
  - Rinse paper towels in juice
  - Gently squeeze towels/Lay out to dry
  - Cut dry towels in 1/4's --- (1/4 per group)

- **Dropper Bottles:**
  - Number each set of dropper bottles #1-12; organize sets: red, black, green numbers
  - 3 or 4 sets can be shared
  - Fill 12 dropper bottles with familiar acids and bases found at home
  - Include distilled water as a neutral

# SUGGESTED MYSTERY SUBSTANCES

Vinegar
Grapefruit juice
Ammonia - diluted
Lysol
Baking Powder in $H_2O$
Simple Green - 50% $H_2O$
Lime juice
Lemon juice
7-Up
Distilled $H_2O$
Liquid hand soap - diluted
Malox in $H_2O$

# Student Roles



# Student Lab:
# Testing Mystery Substances

**OBJECTIVE: Determine the acidic or basic property of 12 unknown Mystery Substances with 3 lab partners using 3 organic indicators. Compare and record the various results. The identities of the mystery substances could be determined as an added interest. Demonstrate knowledge related to pH by completing post lab questions.**

**PROTOCOL:**

1) **Three activities will be taking place at the same time due to using 3 indicators: paper, gel, juice.**
2) **Each student will test each Mystery Substance with his/her assigned indicator according to procedures listed below. Carefully match numbers.**
3) **Must share dropper bottles with lab partners and other groups.**
4) **Compare observations with lab partners. Fill in all columns of data table.**
5) **Third column is for fun F.Y.I. Try to fill it in.**
6) **Following clean-up, complete Post-lab Questions.**

## STUDENT ROLES AND PROCEDURES:

**STUDENT #1:**

1) Trace, number, and cut 12 strips of cabbage paper from ¼ paper towel. Number each on as shown below:

| | |
|---|---|
| 1 | 2 |
| 3 | 4 |
| 5 | 6 |
| 7 | 8 |
| 9 | 10 |
| 11 | 12 |

2) Place one drop from numbered dropper bottles Mystery Substances on corresponding number of cabbage indicator paper. Unchanged edges will serve as the control.

3) Record observation on Data Table.

4) Clean-up: Place all paper items into waste container.

**STUDENT #2:**

1) Number 1-12 on paper plates using a marker, as in a clock face.
2) Cut 12 small pieces of cabbage gel; ¼or less cm each (smaller is better)
3) Place gel pieces on clock face near each number.
   P lace 13th gel in clock center; save as an untouched control.
4) Place several drops of each Mystery Substance on corresponding number of gel. Use equal number of drops per gel.
5) Needs to sit for a short time.
6) Record observation on Data Table
7) Clean-up: Place paper plate with gels into waste container.

STUDENT #3: (#4 also if you have one)

1) Set up & number 12 test tubes in 1 rack; 13th tube can be a control.
2) Pour 1/3 C of cabbage juice into small pitcher; return to lab station
3) Measure 5 ml cabbage juice, using a graduated cylinder, into each test tube.
4) Add 5 drops of each Mystery Substance to the corresponding number of each test tube. (Concentrated strength of juice will determine the number of drops needed. Use equal number of drops per tube.)
5) Record observation on Data Table.
6) Clean-up: Pour juice down drain; flush with water.
Rinse & brush/scrub tubes; place upside down in rack.

# MYSTERY SUBSTANCES LAB DATA TABLE

| Mystery Substances | Paper Color | Gel Color | Juice Color | Base or Acid | Guess the Identity |
|---|---|---|---|---|---|
| #1 | | | | | |
| #2 | | | | | |
| #3 | | | | | |
| #4 | | | | | |
| #5 | | | | | |
| #6 | | | | | |
| #7 | | | | | |
| #8 | | | | | |
| #9 | | | | | |
| #10 | | | | | |
| #11 | | | | | |
| #12 | | | | | |

## POST LAB QUESTIONS:

1) What color changes were observed in this lab?
   a)
   b)

2) Each color change was an "indication" of ?
   a)
   b)

3) Explain possible reasons for no color change in a Mystery Substance test.

4) What would the pH number be in a substance lacking a color change?_____

5) Did the pH color test of your group's three indicators (paper, gel, juice) generally match? _____ Explain why or why not.

6) How many acids did your lab group discover today? _____ Bases? _____

7) Why was it a good plan to have three students performing similar lab tests?

***Refer to class discussion, activity, and text book.***

**8) Red and blue litmus paper appeared _____ when indicating a base, and _____ when indicating an acid.**

**9) The gold wide-range indicator paper appeared_____ when indicating a base, and _____ when indicating an acid.**

**10) On a pH scale which numbers indicate bases?_____ Acids? _____**

**11) Where can you find most common acids and bases?**

**12) Name two acids and list their pH numbers:**

**a)**

**b)**

**13) Name two bases and list their pH numbers:**

**a)**

**b)**

**14) What numbers on the pH scale indicate a dangerous base?_____**

**A dangerous base? _____**

**What is more dangerous, an acid or a base? _____**

**15) A pH solution is measured on a logarithmic scale, so changing one number reflects a _____ change.**

**16) What does pH stand for? _____ of _____**

**17) The symbol and charge for the hydrogen ion is _____, and the symbol and charge for the hydroxide ion is _____.**

**18) When a water molecule separates forming the ions of hydrogen and hydroxide, what process was used? _____**

**19) How could an acid or a base be neutralized?**

**20) The most common neutral substance is _____ having a pH of _____. It contains equal amounts of _____ and _____.**

**21) Another adjective for "basic" is _____.**

**22) Commercial soap is produced by reacting a base with a _____.**

**23) Some acids such as ascorbic acid are important to your health. Ascorbic acid is found in what vitamin?_____**

**24) Hydrochloric acid, another important acid, is necessary for digestion. It is found in the _____ and functions best at a pH of _____.**

**25) Most human cells function best at a pH near _____.**

**26) Controlling a healthy pH balance in a living organism is important in maintaining h_____.**

# SUMMARY

- Involves Inquiry and Active Learning
- Young scientists compare/cooperate
- All students engaged
- Appealing - bright color changes
- Inexpensive