Problem-based learning through the use of clickers

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What is problem-based learning (PBL)?

- Students are arranged in groups
- Cases for discussion vary in size & complexity
- In “smart-classrooms” it is possible to access online resources to flesh-out the case.

Why PBL?

- PBL involves active, cooperative & focused learning directed at problem solving.
  - It is effective because students learn both processing skills & content
  - It also stimulates students' interest more than conventional lecturing.

What are limitations to PBL?

- Encouraging active engagement by all students is challenging, especially in large classes
  - A few students tend to dominate
- There is no penalty for non-engagement
  - Grading a PBL activity can be a challenge
- The question is how to increase participation?

What is a clicker?

- Clickers (or classroom response systems) are small RF transmitters used by students to participate in classroom activities
- Responses are captured by the classroom receiver
- Results may be displayed & later entered into grade book

Why use clickers?

- Answer to poor attendance
- Encourages the reading of assignments
- Lessens the “Sage on the Stage” – encourages involvement by students in the course

Mini case study

A worker at a semiconductor manufacturing plant with generalized weakness

Background:
A referral from an MD asking for help.

- 30 year old patient who reports low energy & dark colored urine.
- The skin & eyes are jaundiced.
- What does this immediately sound like??
- Liver disease such as hepatitis infection

Work history

- Worker started a new job at microprocessor assembly plant last week
- His job is to clean & reclaim gallium arsenide wafers using nitric acid.
- He noticed the release of bubbles from the acid bath & a garlic like odor.

What is your 1st step?

- Do some research on gallium arsenide
- Use a resource from the NLM called HAZMAP

http://hazmap.nlm.nih.gov/cgi-bin/hazmap_generic?tbl=TblAgents&id=79

- A search reveals that this metal powder is hazardous upon inhalation.

How could this metal make him sick?

- No evidence of inhalation of metal powder.
- What about those bubbles?
  - http://hazmap.nlm.nih.gov/cgi-bin/hazmap_generic?tbl=TblProcesses&id=97
- When the metal is placed in acid, a toxic byproduct called **arsine** is released.

What is arsine?

http://www.mathesontrigas.com/pdfs/msds/MAT02100.pdf

MATHESON TRI•GAS
ask. . .The Gas Professionals™

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
150 Allen Road Suite 302
Basking Ridge, New Jersey 07920
Information: 1-800-416-2505

Emergency Contact:
CHEMTREC 1-800-424-9300
Calls Originating Outside the US:
703-527-3887 (Collect Calls Accepted)

SUBSTANCE: ARSINE

TRADE NAMES/SYNONYMS:
MTG MSDS 7; HYDROGEN ARSENIDE; ARSENIC TRIHYDRIDE; ARSENIC HYDRIDE; ARSENIURETTED HYDROGEN; ARSENOUS HYDRIDE; UN 2188; MAT02100; RTECS CG6475000

CHEMICAL FAMILY: inorganic, gas

CREATION DATE: Jan 24 1989
REVISION DATE: Dec 11 2008

The next step is to do an environmental survey

- You simulate our worker's tasks & take air samples at the work station
  1. Cleaning chips – 15 minute exposure
  2. Reclaiming chips – 2 hour exposure

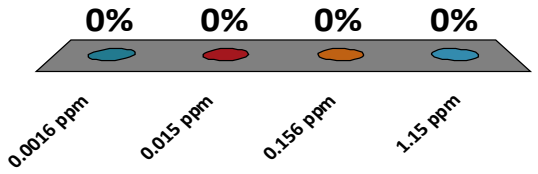
Next: calculate exposure results

- Survey results for arsine.
  - 15 minute sample = 1 ppm
  - 2 hour sample = 0.5 ppm
  - 5 ¾ hour = 0 ppm
- Convert this to an 8 hour TWA.

$$C_{TWA} = \frac{C_1T_1 + C_2T_2 + C_3T_3 \ldots + C_nT_n}{T_f}$$

What was the TWA/8?

1. 0.0016 ppm
2. 0.015 ppm
3. 0.156 ppm
4. 1.15 ppm



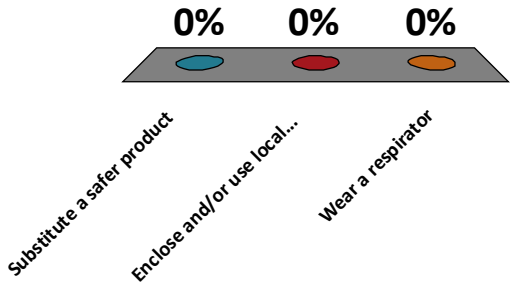
$$\frac{0.25\ \text{hr}(1\ \text{ppm}) + 2.0\ \text{hr}(0.5\ \text{ppm}) + 5\tfrac{3}{4}\ \text{hr}(0\ \text{ppm})}{8\ \text{hr}} = 0.156\ \text{ppm}$$

Is this safe?

How do we control the problem?

Which is the best control strategy to solve this worker's problem?

1. Substitute a safer product
2. Enclose and/or use local exhaust ventilation
3. Wear a respirator



1st choice always should be substitution with a safer product – not an option here

What about a respirator? - A self contained breathing apparatus (SCBA) is recommended

What are the limits to clicker use in PBL?

- Questions need to be shaped into multiple choice or true/false format
- This can pose a challenge when dealing with complex issues.

Summary

- PBL is an effective way to stimulate student interest in both content & in learning the process
- Clickers offer the advantage of immediate feedback & forcing engagement by all participants
- Students seem to like the approach