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Freshman Seminar: Critical Thinking through Science and Justice

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So, you want to teach forensics...

Step 1: Attend a Forensic Science Workshop

Major Advantages

Larry Kaplan, Chief Criminalist

Laboratory Manual

Criminalistics, Richard Saferstein

Sample supplies and sources

Extensive bibliography!

Step 2: Jump in!



Center for Workshops in Chemical Sciences

Why forensics?

Potential for enhancements across the curriculum:

General education science course

Analytical chemistry ✓

Student research projects and internships ✓

Freshman seminar ✓

Background: SUNY/Old Westbury

Public comprehensive
college

Long Island, New York

≈ 3,340 students

50% racial or ethnic
minorities

60% female



Many are the first in their families to go to college

Background: Freshman Seminar

Required of all freshman

Linked in a learning community

Writing intensive

Must include:

Content (domain knowledge)

Introduction to campus services and resources

Strategies for academic success

including critical thinking

Critical Thinking?

According to cognitive psychologist Daniel Willingham:

- Critical reasoning, weighing the evidence
- Decision making based on reasoning
- Problem solving in new situations
- Must be self-directed

From Daniel T. Willingham, Critical Thinking: Why is it so hard to teach?, American Educator, Summer 2007.

Some common pitfalls...

- Seeing one side of issue
- Lack of supportive evidence for statements
- Discounting evidence contrary to beliefs
- Emotion rather than logic

Can critical thinking be taught?

- Maybe!
 - Make explicit
 - Practice with content

From Daniel T. Willingham, Critical Thinking: Why is it so hard to teach?,
American Educator, Summer 2007.

With Science and Justice...

Logical analysis

arguments: premise and conclusion

inference vs. deduction

Source analysis

Wikipedia vs. *Journal of Forensic Science*

Science as needed

increasing domain knowledge

practicing with content

Skills you would like to see in a jury!

Logic exercise: justice

There are no signs of forced entry at any of the windows and both doors are locked. So the burglar probably had an accomplice inside the house.

Are there any other possibilities?

From Patrick Shaw, *Logic and Its Limits*, Oxford University Press, 1997.

Logic exercise: science

If Einstein's theory is true then light rays passing close to the sun are deflected. Careful experiment reveals they are deflected. Therefore Einstein's theory is true.

If A, then B. B. Therefore A.

From Patrick Shaw, *Logic and Its Limits*, Oxford University Press, 1997.

Logic exercise: forensic science

If Moriarty committed the murder, then his fingerprints will be on the weapon. Moriarty's fingerprints are on the weapon. Therefore Moriarty committed the murder.

If A, then B. B. Therefore A.

Circumstantial evidence.

From Liberal Arts Chemistry, Rothberger and Webb

Science, Justice, and the Expert

- Frye vs. United States, 54 App.D.C. 46, 293 F. 1013 (1923)
- Daubert vs. Merrell Dow Pharmaceuticals 509 U.S. 579; 113 S. Ct. 2786 (June 28, 1993)

...and an introduction to library resources

FY1000: Science and Justice

- Case study approach
- Draw the students into studying material they might otherwise avoid (chemistry!)
- Increase the student's confidence in their own ability to understand science

Remember, not a chemistry course!

Case: The JFK Assassination

- Conspiracy theories
- Lone gunmen theories
- Websites galore
- Government documents, many sealed
- Incorporates national and international history and politics

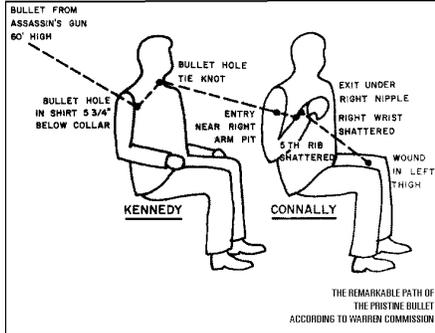


The Magic Bullet

And investigating the evidence requires science and critical judgement

Case: The JFK Assassination

The "magic" or single bullet theory.



Another diagram of the single bullet theory.

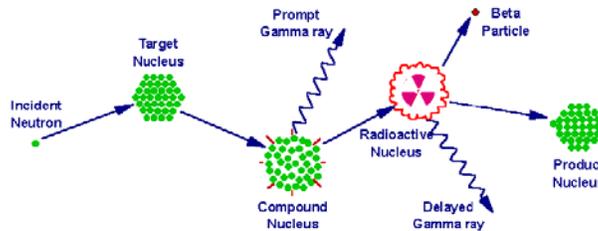
Source: HIGH TREASON



Two conflicting opinions on the path of the bullet

And the science topics include...

- Atomic structure
- Atomic number
- Elemental symbol
- Neutron activation analysis
- Scientific notation
- Mean and standard deviation
- Concentration units



Case: The Stallings, 1989

- Ryan born in spring; hospitalized in summer
- Blood tests show ethylene glycol poisoning; removed to protective care
- Mother has supervised visit in September; feeds child; Ryan dead 3 days later
- Lab results positive for ethylene glycol; calcium oxalate crystals in brain
- Ethylene glycol found in home, on baby bottle
- Mother arrested; convicted

Student response: Guilty! Guilty! Guilty!

From Johl, M.E., *Investigating Chemistry*, W.H. Freeman and Company, New York, 2007.

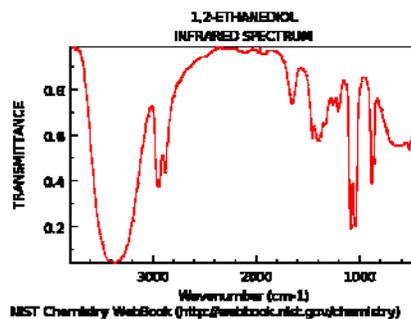
The plot thickens...

- Mother was pregnant at time of Ryan's death
- At David's birth, immediately put in foster care
- David starts showing same symptoms

From Johl, M.E., *Investigating Chemistry*, W.H. Freeman and Company, New York, 2007.

And the science topics include...

- Organic structures
- Organic nomenclature
- Precipitation reactions
- Old fashioned wet chemistry
- FTIR
- Biochemistry
- Genetic disorders



Comments from students...

You have no idea how frustrated I am when I leave this class. We never have answers! No other class is like this. I call this my questioning class.

Comments from students...

There is a lack of skepticism when it comes to matters of science... Skepticism is not a bad thing, though people generally hold the assumption that being a skeptic is a negative trait. It simply means that one would question what they hear and not as readily trust everything they hear as fact.

Comments from students...

More autopsy pictures!

And for the future...

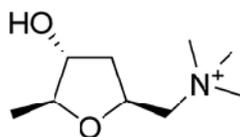
The Documents in the Case, by Dorothy L. Sayers
with Robert Eustace



Amanita muscaria

And the science topics include...

- Chirality
- Optical activity
- Racemic mixtures
- Polarized light
- Biochemistry
- Relativity



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Thank you!
