Biology Inquiry and Outreach with Boston University Graduate Students (BIOBUGS)

Whodunit Lab

Forensic detectives analyze evidence from a variety of sources to solve crimes. In this lab we will study biological evidence, trace evidence, DNA analysis, and physiology from several suspects. The students will role-play the forensics team, not the suspects, to find out whodunit. Each successive test depends on proper elimination of suspects to pinpoint our perpetrator. The techniques learned are blood determination and typing, fingerprint analysis (their own fingerprints first), DNA fingerprinting, and electrocardiogram analysis (their own ECG recordings first). In the end, all the evidence points to 1 suspect.

Massachusetts Educational Standards addressed by this lab:

- Scientific Inquiry Skill Standards:
  1. SIS2 – Design and conduct scientific investigations
  2. SIS3 – Analyze and interpret results of scientific investigations
- Biology Standards:
  1. Genetics
  2. Anatomy and Physiology

The Crime:

- Who: Victim is Shawn Johnson, an Olympic gymnast; 9 suspects based on interviews
- What: Shawn Johnson's gold medal was stolen
- Where: Shawn Johnson's hotel room in Beijing
- When: during a post-Olympics party
- Why: Various motives, depending on the suspect
- How: Shawn Johnson saw the perpetrator, chased them, and was unable to keep up!

The Schedule:

9:00 – 9:15	Welcome class and go over lab safety, etc.
9:15 – 9:30	Brief class on crime scenario using Whodunit Lecture on powerpoint
9:30 – 10:00	Learn about blood types and analyze blood found at crime scene. Rule out suspects accordingly
10:00 – 10:30	Learn about fingerprints and fingerprint analysis; gather student fingerprints to learn techniques, then analyze crime scene fingerprints. Rule out suspects accordingly
10:30 – 10:45	Learn about theory and techniques of DNA analysis so gels can be loaded and placed in current boxes
*have a 10 minute bathroom break somewhere in here.	
10:45 – 11:30	Learn about ECG and how ECG data could be used forensically; record student ECGs on machines and discuss
11:30 - noon	Finish up ECG and unveil DNA results. Use DNA results to determine who committed the crime!
Noon – 1:00	Pizza Party

Materials (for 24 students)
For each part of the lab, aliquots of all reagents per bench/group are easiest for timing of the lab and prevention of contamination.

- Projector (dept and Lernet have one)
- Computer (dept and Lernet have one)
- Chalkboard (or if you use intro to Bio rooms, just use powerpoint and user interface)
- Whodunit Student Worksheet
- Name tags (Lernet)
- Gloves
- 20ul Pipettes (Bio labs)
- Pipette tips (Bio labs)
- Biohazard disposal bins (Bio labs)
- Microcetrifuge tubes (1.5 or 2.0ul size)
- Part 1: Is it blood?
  - Hydrogen Peroxide
  - Sheep's blood
  - Fake blood (make with 25mL Karo Syrup, 500ul Water, 1mL Red Food Coloring, and 500ul Yellow Food Coloring)
  - 1 tray per group (or per person if enough blood and fake blood is available)
- Part 2: Blood typing (Ward's Whodunit Blood Typing Kit, can order whole kit or refills)
  - 6 tubes of Type A blood labeled "crime scene, Suspects 1, 2, 4, 6, 9"
  - 2 tubes of Type B blood labeled "victim, Suspect 10"
  - 2 tubes of Type AB blood labeled "Suspects 5, 7"
  - 1 tubes of Type O blood labeled "Suspect 3"
  - 11 testing plates (pre-numbered) per group
  - toothpicks
- Part 3: Fingerprint
  - Pencils
  - Scotch tape
- Part 4: DNA fingerprinting
  - #211012A EXPL ELECT FORENSIC FOIL PK from Carolina (3 samples of pre-digested DNA, 20ul of DNA in blue glycerol solution ready-to-use, have students load 5ul per well, set up 4 tubes labeled x, y, z, and perp) order 1 pack per class/day
  - 0.8% Agarose gel (+ a microwave, a lab, and expertise to make gel)
  - Gel electro boxes (Bio labs)
  - Gel trays (Bio labs)
  - Ethidium Bromide
  - TBE buffer
  - Light box for visualizing (Bio labs, need hood for this step)
- Part 5: ECG (Phys labs)
  - Computers with LabScribe software and iWorx unit
  - ECG leads
  - ECG electrodes
  - Rulers

Introductory Lecture: (9-930)

- (15 min) This lecture will be important for setting the tone of the lab. Welcome students to BU, pass out name tags, volunteers introduce themselves, show students the outline for the day, and go over lab safety.
- (15 min) Explain the basics of the lab (they are the forensics team with the goal of solving the crime), pass out the handouts so they can take notes during the briefing
    - Use the power point for the briefing to explain the crime, the evidence that was collected, and introduce the suspects (ask them who they think did it based on the motives)
    - Students will work in groups of ~3, but will sometimes work as a bench
    - Before each part, there are background and procedure slides in the power point

Parts 1 and 2: Is it blood? and Blood typing (930-10)

- Use the power point to describe why its important to determine if the substance at the crime scene is blood or not, blood typing and outline the procedures
- Point out the page where students will write down the results from the catalase test (reacts with H_2O_2) on real blood (sheep's blood) and fake blood
- Point out the page where students will write down the blood types from each sample **if students are late arriving and/or supplies are limited, a bench can divide up the suspects' samples and combine data (each group could do 3 samples); or not do the catalase test
- Ask students which suspects have not been eliminated

Part 3: Fingerprinting (10-1030)

- Use the power point to describe fingerprinting and outline the procedure
- Point out the page where students will tape their own fingerprints to characterize their patterns, THEN match latent prints taken from the crime scene with fingerprints from our suspects **hint: students should cross off the suspects they've eliminated from Part 2
- Ask students which suspects have not been eliminated

Part 4: DNA fingerprinting (1030-1045)

- Use the power point to describe DNA fingerprinting and outline the procedure
- Students will first load their samples and start their gels so they can run while they do Part 5
- AFTER PART 5:
    - Reveal the results and see if our perpetrator's DNA matches the suspect they pinpointed after all the other evidence was analyzed

Part 5: ECG (1045-1130)

- Use the power point to describe an ECG and outline the procedure
- Point out the page where students will record their measurements and calculate the electrical axis of their own hearts AND then examine ECG data from the remaining suspects to determine who could have outrun Shawn Johnson!
- Ask students whodunit

Closing Discussion (1130-noon)

- Ask which groups correctly determined the correct perpetrator
- If they didn't, determine where they went wrong and why (human error or ambiguous test?)
- Pass out student and teacher surveys!