Forensic Science

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Before we get started, what are some of the areas of interest in science or engineering?
Is research (Biology, Chemistry, Physics) come up as an option?
Is research (Biology, Chemistry, Physics) come up as an option?

Do you like asking questions, traveling, and have the ability to do something different each day?
My Research Background

• Fish population genetics/migration
• Fish mating behavior
• Earthworm Systematics
• Flower Evo-Devo
• Plant Systematics
Science and CSI
Crime dramas

Are crime dramas, such as CSI and Bones, realistic or complete fiction?
CSI: Fact or Fiction

http://www.youtube.com/watch?v=6iFDphWXjw4
The following event is not based on a true story, and any representation to actual events is pure coincidence...
The following event is not based on a true story, and any representation to actual events is pure coincidence...however the setup came from an actual case.
The crime

- Our resident epiphyteologist, Ryan Moraski, went missing
Epiphytes
The crime

- A week later he was found in a remote area of campus, wrapped in blanket and tied up with *Vitis* vines
Crime Scene
After the crime

• Four suspects were identified
  – Detained and personal belongings collected

• Coroner’s report
  – Evidence of high levels of stress
  – Considerable wear on hands and wrist, most likely from extreme pipetting and typing on a computer
  – Large force blow to the back of the head, possibly from falling down stairs
Suspect 1

- Name: Kayla Ventura
- Association with victim: No direct interactions, but worked in same lab
- Reason for suspicion: Was heard complaining that Ryan always stashed lab supplies, and she was going to get even
Suspect 1 cont
Suspect 1 cont
Suspect 2

• Name: Blaine Marchant
• Association with Victim: Office and lab mate, as well as fellow iDigBio participant
• Reason for suspicion: Has a history of violent behavior, as well as desire to secure more funding and a bigger office
iDigBio Specimen Portal

Start Searching Specimen Records
Press ESC to close auto-complete suggestions.

Scientific Name
Search

iDigBio Specimen Portal
If you are familiar with our portal's interface, you can start searching Specimen Records.
If this is your first time here, you might consider browsing our tutorial.
Our data are based on the Darwin Core and Audubon Core standards.

Specimen Records by Collection Type

Media Records by Collection Type

12,999,602 Specimen Records
1,637,767 Media Records
200 Recordsets
Office space
Office space
Suspect 3

- **Name:** Pam Soltis
- **Association with Victim:** Victim’s advisor
- **Reason for suspicion:** Last seen together arguing about iDigBio productivity and RA status (academic guilt)
Academic Guilt

**Grad Students / Postdocs:**
I’ve only written one journal article this year. I need to improve!

**Professors:**
I’ve only been author on 16 journal articles this year. I need better grad students and postdocs!
Suspect 4

• Name: Barry Kaminsky
• Association with victim: No usual direct contact
• Reason for suspicion: Last seen arguing about lichen collecting, which turned into a heated exchange
Lichen versus lycan
Do any of the suspects have anything they would like to say to advocate their innocence?
CSI Gainesville

This could be you.
Evidence

• Leaf samples
  – Comparative morphology

• DNA markers
  – Four different markers

• Thread samples
  – Hair and fiber samples
Leaf Morphology

- Describe 4 suspects, and compare the crime scene to other samples
- Can your group pick a likely culprit?

<table>
<thead>
<tr>
<th>Describe the leaf material from the Crime Scene</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Describe the leaf material from Suspect 1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Describe the leaf material from Suspect 2</td>
</tr>
</tbody>
</table>
DNA extractions

• Label tubes
• Take hole punch of leaf material
• Extraction solution
• Cook at 95°C for 10 minutes
• Dilution solution
Part One Complete

Now that morphology is done and DNA has been extracted, move on to the second phase of evidence: Genetic markers
Now what do we do?

• We isolated DNA from the plant material into a solution form.
• Will this tell us who committed the crime, or the victim’s identity such as in the CSI clip?
  – Not quite yet
• Additional step needed
• Polymerase Chain Reaction
• Amplify small section of DNA, makes many many copies
• Will use common markers
How PCR works

Melting
Annealing
Extending
Increase in product

[Graph showing the relationship between PCR cycle number and PCR product (incorporated radioactivity).]

[Inset graph showing arbitrary units vs. PCR cycles, with cycles marked from 26 to 36.]
Why do PCR?
PCR steps

- Follow along with the protocol to conduct PCR with 2 separate genetic markers

2. Each PCR reaction will contain the following quantities:

- 10 μL REDExtract-N-Amp Ready Mix
- 2 μL of Forward Primer
- 2 μL of Reverse Primer
- 2 μL of water
- Total of 16 μL per reaction + 4 μL of DNA extract for each sample

3. Calculate the amount of reagents needed to conduct PCR for the 5 extractions + a negative control (total of 6 reactions).

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Total amount needed for Master Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready Mix</td>
<td></td>
</tr>
<tr>
<td>Forward Primer</td>
<td></td>
</tr>
<tr>
<td>Reverse Primer</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
</tbody>
</table>
4. Make a master mix for each primer pair that you received by adding the appropriate reagents into a 1.5 eppendorf tube. After each reagent is added, check it off on the list below to ensure each PCR has the appropriate material.

Primer Pair

- Ready Mix
- Forward Primer
- Reverse Primer
- Water

Primer Pair

- Ready Mix
- Forward Primer
- Reverse Primer
- Water

PCR steps continued
Fiber and Hair samples

• After your PCR is up and running, need to start preparing slides
• Each suspect should have one or two samples, plus there are samples from the crime scene
Crime Scene samples

• Crime scene samples were collected in tape
  – Tape needs to be placed in water to dissolve adhesive
  – Remove samples and dry before mounting on slides
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many samples do you have from the Crime Scene?</td>
<td></td>
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<tr>
<td>How many samples do you have from Suspect 1?</td>
<td></td>
</tr>
<tr>
<td>How many samples do you have from Suspect 2?</td>
<td></td>
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<tr>
<td>How many samples do you have from Suspect 3?</td>
<td></td>
</tr>
<tr>
<td>How many samples do you have from Suspect 4?</td>
<td></td>
</tr>
</tbody>
</table>

![Microscope Diagram](image)
Visualizing slide

When starting out, always use the 4x objective.

Once the slide is in focus, then you can move up to a higher objective if you think necessary.
Do samples match any of the suspects?
Any Questions?