The $illion Dollar Mystery

A Document-based Case Study in Forensics, DNA and Making Scientific Arguments

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Whitney McKinstry, Des Moines CSD
Summer 2014
**INTRODUCTION**

You are about to work on a task designed to strengthen your skills in critical thinking, analytical reasoning, problem solving and communication skills. This performance task contains a series of documents that include a range of information sources. You will first analyze and evaluate the given information, and organize your thoughts in a matrix. You will then look at the evidence collected and prepare a document to share the conclusion of your analysis.

While your personal values and experiences are important, you should base your conclusion on the evidence provided in the attached documents and you should make explicit references to the evidence that supports your conclusion. However, you may need to apply your knowledge of biotechnology in order to properly analyze the documents provided.

**SCENARIO**

The research lab from the Agronomy Department at Iowa State University has contacted the Ames Police Department to report that a transgenic plant that is resistant to the lethal fungus that causes SDS in soy bean plants. This plant is particularly important to world food production because soy beans are the second largest food product in the United States. Without resistances to SDS manufactures will not be able to produces the soy products necessary to feed the country. For example, reduction in soy beans will cause a reduction in soy formula for infants unable to drink cow’s milk.

Ames Police has recruited you, a seasoned Crime Scene Investigator, to analyze the evidence collected from gel electrophoresis, eye witness transcripts, social media documents and a crime scene sketch. Based on your findings the Ames Police Department has asked you to provide a decision on who to prosecute for the crime, Suspect A, Sally, or Suspect B, Jim Bob. In addition you will need to supply sufficient reasoning to support your claim.

**QUESTION-PRODUCT**

Based on the evidence, which suspect should be brought to trial for this crime? After you have analyzed the documents and formed a conclusion you will complete the police report to submit to the detectives who will retrieve the plant and prevent hunger in the United States. If you correctly identify the culprit you will receive a 1 million dollar reward from Iowa State University for your assistance.
PHOTO #1 – CRIME SCENE

PHOTO # 2 – SEED STORAGE AREA

Fingerprint lifted from this point.

DNA Extraction Point
Detective Interrogation
Document of a graduate student
Sally Jones - Suspect # 1

Please state your name for the record.

*My name is Sally Jones*

What time did you arrive at the lab this morning?

I arrived at 8:00am

Where did you go?

I went straight to the lab to start on my research.

Did you see the seeds in question?

No, I work in the front part of the lab.

Tell me what do you know about the seeds.

Very little. Just that they were seeds from a transgenic plant.

Where do you live?

On campus in the Fredricksen Courts.

Why are you here at Iowa State University?

I am here to work on my graduate project on SDS in soybeans.

Can you tell me a little about your educational background?

I am getting my Doctorate degree in plant science here at ISU.

Did you see anyone else enter the lab if so what time?

I saw Jim Bob was here when I left late that night.

Did you steal the transgenic soybean seeds from the storage area?

No, why would I want to?

Detective Interrogation
Document of a graduate student
Billy Bob - Suspect # 2

Please state your name for the record.

*My name is Jim Bob Smith but my mom calls me JB because she says she does not want to use my whole name.*

What time did you arrive at the lab?

I woke up around 7:00 and got to the lab around 8:00am and started right to work.

Where did you go?

I went to my computer and had a cup of coffee and then I went to my lab station where I worked on my research and only my research.

Did you see the seeds in question?

Yes, I have to go to the place where they are stored to get to my lab station but they are always locked up.

Tell me what you know about the seeds.

Very little, the Agronomist does not talk very much about them, all she does run around performing different protocols with the seeds.

Where do you live?

In an apartment building near campus.

Can you tell me a little about your educational background?

I did my undergraduate work at Indiana University an then started here at ISU last year.

Did you see anyone else enter the lab if so what time?

I saw the janitor come and then he left a short time after.

Did you steal the transgenic soybean seeds from the storage area?

No, even though I know that they could be worth millions of dollars.

Detective Interrogation Document of the Agronomist

Please state your name for the record.

*Joy Lui*

What time did you arrive at the lab?.

About 8:30 am

When did you notice that the transgenic soybean seeds were missing?

*When I arrived and went to get them and notice that my seed storage area had been broken into.*
TRANSGENIC SOYBEANS SEEDS STOLEN FROM IOWA STATE UNIVERSITY

On June 26, 2014 recently discovered transgenic soybeans seeds, potentially worth billions of dollars, were stolen from the Iowa State University agronomy lab. The transgenic soybeans seeds were found to be resistant to a fungus found in the soil which causes SDS (Sudden Death Syndrome). This fungus has caused many farmers to lose a large portion of their crops, consequently causing the farmer to lose thousands of dollars.

The Crime Investigators of the Ames Police Department were called in and will conduct a full investigation. Currently there are 2 suspects, both graduate students who work in the lab. The first suspect, Sally Jones, stated that “she had nothing to do with the theft of the transgenic soybeans seeds.” She further stated “I have no motive to steal them because I did not know that they were worth or how important they were.” The other suspect, Billy Bob, is a post graduate and also claims that he did not steal the transgenic soybeans seeds. He stated “there was someone in the lab while I was there at all times”

The importance of this case is that soybeans are one the most important crop species in the United States and is the world leader in soybean production. The US exports soybean crops at a value of 38.9 Billions dollars. SDS causes damage to the soybean plant at a rate .82 billion dollars a year. The discovery of a resistant plant to the fungus would be very beneficial to the United States export of soybeans.
July 20, 2014

Having so much fun in Cancun!

#Summerbreak2014

July 18, 2014

Gotta Take a Selfie...

July 17, 2014

Thanks mom...
<table>
<thead>
<tr>
<th>DNA SAMPLES FROM IOWA STATE UNIVERSITY AGRONOMY LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crime Scene</strong></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image of DNA sample patterns" /></td>
</tr>
<tr>
<td>Document 1</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td><strong>Description of the document</strong></td>
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</tbody>
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<table>
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<tr>
<th>Is this a valid document to determine guilt or innocence? Why?</th>
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<th>Is this a valid document to determine guilt or innocence? Why?</th>
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<th>Why was it written</th>
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<tr>
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<tr>
<th>What aspect of the document shows guilt?</th>
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<th>What aspect of the document shows guilt?</th>
</tr>
</thead>
</table>

<p>| What aspect of the evidence shows innocence? | What aspect of the evidence shows innocence? | What aspect of the evidence shows innocence? |</p>
<table>
<thead>
<tr>
<th>Document 4</th>
<th>Document 5</th>
<th>Document 6</th>
</tr>
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<td>Description of the document</td>
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<td>What aspect of the evidence shows innocence?</td>
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</table>
POLICE REPORT

Case No: 223950649                              Date: 8/20/2014
Reporting Officer:__________________________  Prepared By:__________________________
Incident:________________________________________

Suspect # 1
Evidence and Reason for Innocence:

Reason and evidence for guilt:

Suspect # 2
Evidence and Reason for Innocence:

Reason and evidence for guilt:

Summary:
Suspect to Indict:

Evidence and reasoning:
## Assessment Rubric of the Crime Scene Analysis Report

<table>
<thead>
<tr>
<th>ANLYTIC REASONING AND EVALUATION</th>
<th>Emerging (1)</th>
<th>Developing (2)</th>
<th>Mastery (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Identifies and analyzes few facts or ideas about the evidence presented in the documents.</td>
<td>-Identifies and analyzes several facts or ideas about the evidence presented in the documents</td>
<td>-Identifies and analyzes most of the facts or ideas about the evidence presented in the documents</td>
<td></td>
</tr>
<tr>
<td>-Makes several inaccurate claims about the validity of the information.</td>
<td>-Makes a few accurate claims about the validity of the information.</td>
<td>-Makes most of the accurate claims about the validity of the information.</td>
<td></td>
</tr>
<tr>
<td>-Disregards or misinterprets much of the evidence in the documents.</td>
<td>-Provides some analysis that goes beyond the obvious.</td>
<td>-Provides analysis that goes beyond the obvious.</td>
<td></td>
</tr>
<tr>
<td>PROBLEM SOLVING</td>
<td>-Does not explain how evidence in documents is used to make a decision regarding guilt or innocence.</td>
<td>-Some explanation of how evidence in documents is used to make a decision about guilt or innocence.</td>
<td>-Fully explains how evidence in documents is used to make a decision about guilt or innocence.</td>
</tr>
<tr>
<td>-Does not propose a course of action that follows logically the use of the evidence in the documents.</td>
<td>-Partially proposes a course of action that follows logically the use of the evidence in the documents.</td>
<td>-Proposes a course of action that follows logically the use of the evidence in the documents.</td>
<td></td>
</tr>
<tr>
<td>-Does not Recognize the need for more information in the various documents</td>
<td>-Recognizes the need for some information in the various documents</td>
<td>-Recognizes the need for more information in the various documents</td>
<td></td>
</tr>
<tr>
<td>EXPLANATION OF EVIDENCE</td>
<td>-Provides limited, invalid, overstated or very unclear responses to the document analysis.</td>
<td>-Organizes responses to document analysis in a way that may not be easy to follow but has some logic.</td>
<td>-Organizes responses to document analysis in a logically cohesive way that makes it very easy to follow.</td>
</tr>
<tr>
<td>-The valid and comprehensive description of the evidence document was vague and unclear.</td>
<td>-Has some valid and comprehensive description of the evidence document and clearly some of the sites sources of evidence.</td>
<td>-Provides a valid and comprehensive description of the evidence document and clearly sites sources of evidence.</td>
<td></td>
</tr>
<tr>
<td>AUTHENTIC TASK- INVESTIGATORS REPORT</td>
<td>-The report was poorly organized and written making it difficult to read or follow logic toward the evidence.</td>
<td>-Most of the report was well organized and the logic toward the evidence was easy to follow.</td>
<td>-The report was well organized and easy to follow writer’s logic toward evidence.</td>
</tr>
<tr>
<td>-Over 3 spelling or grammatical errors.</td>
<td>-2 – 3 spelling or grammatical errors.</td>
<td>-No more than one spelling or grammatical error.</td>
<td></td>
</tr>
<tr>
<td>Document ID</td>
<td>NAME OF DOCUMENT</td>
<td>RELEVANT INFORMATION PRESENTED AND CRITICAL THINKING SKILLS ADDRESSED</td>
<td>STUDENTS SHOULD INCLUDE ON DOCUMENT ANALYSIS PROMPTS</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------</td>
<td>---------------------------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>A</td>
<td>Crime scene photos</td>
<td>Visual of the crime scene Analysis of observations made. Validity of the evidence.</td>
<td>The crime scene photo is valid. Should analyze the seeds disorder, storage are broken into, and that the door was open.</td>
</tr>
<tr>
<td>B</td>
<td>Detective Interrogations</td>
<td>Determine the validity of evidence. Recognize bias in document Evaluate the quality of a document’s source Identify logical flaws.</td>
<td>Interrogations maybe valid because of the leading questions of the detectives. Or invalid if the suspects lied. The quality could be based on the suspects answers were they believable.</td>
</tr>
<tr>
<td>C</td>
<td>Newspaper Article</td>
<td>Determine the validity of evidence. Recognize bias in document Evaluate the quality of a document’s source Identify logical flaws.</td>
<td>Article is not very valid due to the personal accounts of the suspects and their bias and we saw only the reporters point of view.</td>
</tr>
<tr>
<td>D</td>
<td>Visuals of soybean leaves from each of the suspects labs.</td>
<td>Analyze data from visual Comparing and contrasting two visuals</td>
<td>Leaves photo not relevant due too many unknowns. Where were the pictures taken, where the seeds for the plants came from, when were they planted.</td>
</tr>
<tr>
<td>E</td>
<td>Fingerprinting results</td>
<td>Analyze data from visual Comparing and contrasting two visuals</td>
<td>Fingerprinting is very valid and relevant because each person has their own set of fingerprints. Must mention the results of comparing the fingerprints</td>
</tr>
<tr>
<td>F</td>
<td>Facebook Page</td>
<td>Analyze data from visual Evaluate the quality of a document’s source Determine the validity of evidence</td>
<td>Facebook invalid evidence because one of the suspects cannot be in two places at one time.</td>
</tr>
<tr>
<td>G</td>
<td>Gel electrophoresis results</td>
<td>Analyze evidence collected from an experiment Analyze data from visual Comparing and contrasting two visuals</td>
<td>Electrophoresis is valid evidence because DNA is the best source of reliable identification.</td>
</tr>
</tbody>
</table>
"THE BILLION DOLLAR MYSTERY" SKIT

CHARACTERS
The Agronomist – Postgraduate student
Graduate Student # 1 – Sally – Graduate Student working on a summer research project on Arabidopsis plants seeds
Graduate Student # 2 – Jim Bob - a Graduate student working on the SDS resistant soybean plant
Crime Scene Investigator (CSI)
Detective

SET
Scene will be set in a lab with 2 tables and some lab equipment.
The two Graduate Students will be working at one of the tables on a research project.

DOOR OPENS
THE AGRONOMIST RUNS IN YELLING
They’re gone! The soybean seeds are all gone!!

THE TWO Graduate students
What’s gone, what happen?

THE AGRONOMIST IN TEARS
When I came in the lab this morning to continue investigating my transgenic soybean seeds, the seeds were gone.

SALLY
We have plenty of soybean seeds. Why were these so important?

THE AGRONOMIST SADLY
My transgenic soybean seeds were discovered to be resistant to a fungus found in the soil and are killing the soybeans (or causing Sudden Death Syndrome, SDS) in the farm fields. Actually, soybeans are the second largest agriculture product in the USA and nets approximately 23 billions dollars a year.

JIM BOB
You mean that your transgenic soybean plant can save the USA billions of dollars. I bet they are going to have a reward for the plants.

SALLY
Cool but I think we better call the police.
The Agronomist reaches into her purse and gets her cell phone.

AGRONOMIST
Hello, I would like to report a theft of my transgenic soybean plants seeds.

PAUSE
Yes I said some soybean seeds, but they are worth millions of dollars.
Thank you I will wait for the Crime Scene Investigator.

PAUSE: KNOCK AT DOOR
THE CRIME SCENE INVESTIGATOR AND A DETECTIVE COMES IN

CRIME SCENE INVESTIGATOR
I understand there was a theft of a very valuable and expensive transgenic soybean seeds today. Can you please take me to the crime scene?

THE DETECTIVE TAKES ALL OF THEM AND THE 2 GRADUATE STUDENTS OVER TO THE CORNER AND BEGAN TO TAKE THEIR STATEMENTS ON A PAPER PAD.

AGRONOMIST TAKES THE CSI OVER TO A CABINET IN THE FRONT OF THE ROOM.
Over here is the private Storage area where the seeds were locked up and I am the only one that goes in there. I have the only key.

CRIME SCENE INVESTIGATOR TALKING TO HIMSELF.
The lock is broken. Now I will take pictures of the crime scene and to show where the DNA samples will be collected from. A DNA analysis will tell us who they belong to.

THEN THE DETECTIVE LEAVES WITH THE NOTES AND THE GROUP IS NOW TALKING TO THE NEWS REPORTER WHO WRITES DOWN THEIR PERSONAL EYE WITNESS ACCOUNTS.

THE CSI INVESTIGATOR
I will go back to my office and analyze the evidence and get back with you with the findings.

EVERYONE LEAVES

AGRONOMIST TURNS TO THE AUDIENCE
This is a crime of epic proportions! The theft of these seeds will affect millions of people worldwide. Since the crime, the Ames Police Department has launched a formal investigation. Detectives have collected evidence and narrowed the pool of persons of interest to two main suspects.

Suspect A, Sally Jo, is a graduate student researcher who is at risk of not graduating. She is a disgruntled student who has previously made threats to sabotage the lab. She is a prime suspect because she has access to the lab and has motive to commit the crime.

Suspect B, Jim Bob, is a high performing graduate student who has ambitions to become a plant geneticist at a prestigious university. He maintains good relationships with his coworkers and has aided in making many scientific breakthroughs in the lab. Although there is little motive for Jim Bob to commit the crime, he spends many hours in the lab and was seen at the scene the night of the alleged crime.

Since the stakes of this investigation are high, the Ames Police Department has called in a seasoned Crime Scene Investigator...YOU! Your mission is to become the CSI and analyze all of the evidence that will be given to you. Based on this evidence you will need to determine a guilty party. Remember, finding the missing plant can save millions of lives and earn you a million dollar reward.

The End
**Intended Audience**

Check all that apply...

- ☐ 9th grade audience
- ☑ 10th grade audience
- ☐ 11th grade
- ☐ 12th grade
- ☐ general
- ☐ advanced

Check all that apply...

- ☐ general science
- ☑ biology
- ☐ earth science
- ☐ chemistry
- ☐ physics/phys sci
- ☐ biotechnology
- ☐ environmental science

**Time Required**

- 50-60 Minutes

**Introduction/Background**

This case study is best suited at the end of genetics or DNA unit. Students will need to be familiar with DNA concepts and have practice performing gel electrophoresis.

**Objectives of the Case**

1) Students will be able to connect the concepts learned in class to a simulated real world scenario (Integrating theory into practice).
2) Students will be able to use evidence to evaluate a problem.
3) Students will be able to identify valid sources of evidence.

**Major Issues**

In this case study students will need to analyze evidence to determine the person responsible for stealing an invaluable transgenic plant. Without an eyewitness, students will have to look at evidence collected by the local police department to determine who will be charged with the crime. Students will find that some sources of evidence, such as Facebook, may not be reliable or relevant. DNA from the crime scene will be analyzed and the results show that the DNA belongs to the professor of the lab. Students should determine that it is expected that the professor’s DNA would be expected at the crime scene and therefore the evidence is not useful in the investigation. However, fingerprint analysis will show that suspect B was in the lab. Although suspect B’s Facebook page suggests he was not in the country at the time of the crime, students should deduce that physical evidence from a leaf analysis and fingerprint analysis suggests that suspect B is the likely culprit.

**Classroom Management**

Before introducing the case, it is important that students be familiar with DNA and gel electrophoresis. Students will not be successful in completing the case study unless they are proficient in these topics.

To introduce the case, the teacher should have 6 students perform the attached skit. This skit will provide background about the crime, as well as familiarize students with the importance of soy beans and transgenic plants. This short scenario will take only 5-10 minutes to execute, but will engage students in the case.

Following the introduction teachers may use the following resource to introduce SDS and transgenic plants: [http://passel.unl.edu/ge/](http://passel.unl.edu/ge/)

Students will then be presented with the documents necessary to solve the crime. Students will evaluate each document to identify important information. After students review the documents in groups the teacher should lead a discussion on
the validity of the documents. Students will share which documents they feel are relative to the case and defend their reasoning. As they work through each document

Students will then be asked to evaluate the evidence, and complete the police report with their findings. If they correctly deduce the criminal they will receive a 1 million dollar reward.

<table>
<thead>
<tr>
<th>References &amp; Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Journey of a Gene:</strong> <a href="http://passel.unl.edu/ge/">http://passel.unl.edu/ge/</a></td>
</tr>
<tr>
<td>This reference will be useful to teachers to introduce students to SDS and transgenic plants</td>
</tr>
<tr>
<td><strong>Electrophoresis simulation:</strong> <a href="http://learn.genetics.utah.edu/content/labs/gel/">http://learn.genetics.utah.edu/content/labs/gel/</a></td>
</tr>
<tr>
<td>This electrophoresis simulation may be a helpful resource to students struggling to understand gel electrophoresis</td>
</tr>
<tr>
<td><strong>Fingerprinting Activity:</strong> <a href="http://www.connectionsacademy.com/resources/instructographics/fingerprinting.aspx">http://www.connectionsacademy.com/resources/instructographics/fingerprinting.aspx</a></td>
</tr>
<tr>
<td>This case study includes a fingerprint analysis. This activity is a good supplement to teach the science behind fingerprints.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Assessment of product</th>
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<tbody>
<tr>
<td>After analyzing each document and sorting through the information students will complete a decision matrix to choose the correct culprit of the crime. This decision matrix is presented as a final police report that students will submit. Students will be evaluated on how they support their claim using information in the documents. Each document will be evaluated using the attached rubric.</td>
</tr>
</tbody>
</table>