

Instructions:

Welcome to the murder mystery and crime scene investigation for ages 13-15.

This project is suitable when working with blood and infections, but also genetics. The students should be familiar with DNA, blood type analysis using antibodies and the problem with antibiotic resistance finding novel antibiotic drugs.

Preparations:

The project requires some preparations. All evidence material can be saved and used for another class saving time for “next year”. Please feel free to set the crime scene to make it dramatic. The crime scene may include:

- theatrical blood
- broken glass
- a bottle with a coloured liquid to represent a novel antibiotic drug
- barricade tape
- a painted body on the floor (using white tape it comes off easy)

First go through all the material and make preparations. The **suspects** (AI generated) are cut out and attached to a wall or board so all students can walk up to it and read and discuss. There is no specific order for the suspects to be placed on the wall. Also print the **notes sheets** for the students to keep track of their evidence and suspects.

The **identification keys** are installed on walls inside the classroom so the students can walk around and use their evidence to rule out suspects.

There are a total of **six evidence** materials where most are provided in this material pdf. Print the evidence in advance and place it in small bags.

The evidence that is missing from this material are cats hair and small vessels with antibiotics. You may alter the material or the story for your own needs if you don't have the possibility to access this evidence. See suggestions in the material information.

How to do the project:

Divide your students in groups of four or five. Inform them before entering the classroom that a brutal murder has taken place at a hospital and that they are crime scene investigators! The students can be given the evidence material directly, or have to solve problems to get the material. Such problems may include answering questions related to your current work area.

The students will start by going through the evidence. To keep track of the evidence the students may use the note paper. Using the board of suspects and the identification keys they will end up with two people: Sara Mycelium and Maria Friendly. Since the DNA was collected from the dead body it has to come from the murderer, making Maria Friendly the killer and Sara Mycelium the victim. Both women are working on research related to antibiotics, but there is no clear motive provided in this material.

When the students have identified the two women they get to construct a story of what has happened. What was the motive for the murder, and why is there more than two fingerprints at the scene? This part can be used as part of an interdisciplinary project. Suitable subjects are social studies (talking about crime and laws), language (reading crime novels), or drama class. The students can act out their story in front of each other, or make movies.

Answers to clues:

1. The DNA sample indicates that the murderer must have **blue eyes**. Potential killers: Adam, Daniel, Stephen, Filip, Maria and Helena
2. The **fingerprints** found at the scene are from: Adam, Maria, Sara, Stephen
3. The blood type analysis gives type **0-** and **A+**. Leif, Daniel, Helena, Maria, Filip, Sofie, Sara
4. The animal hair found on the victims clothes are from **a cat**. Potential victims: Johan, Sara, Marten, Filip, Leif
5. The bacterial spores are from the extremely lethal **bacillus anthracis**, is this the murder weapon or the motive? The students come up with the story.
6. The antibiotics found are labeled "top secret **new antibiotics**", is this the motive? The students come up with the story.

Material:

Material not provided:

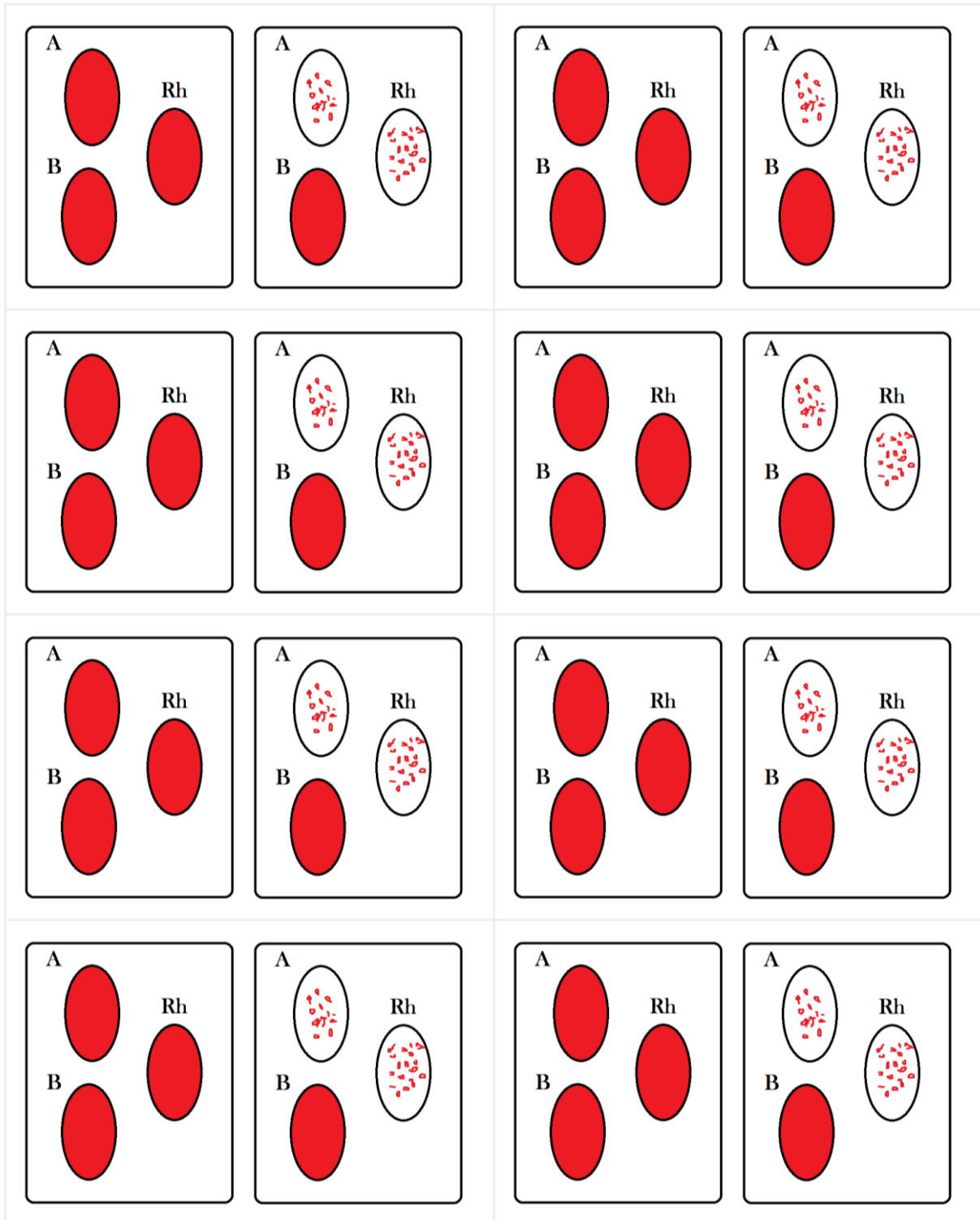
1. small sample of “antibiotics”. Eppendorf tube with colored water is a suggestion. Labeled “top secret new antibiotics”.
2. Real animal hair (cat) for microscopy. You may take copies of how cats' hair look under the microscope and use as material (Identification key 1), in that case this project is of no need for a microscope. If you do have access to cats hair this is a fun identification using a microscope!

Material provided:

- **Two blood type analyses to print and cut out.**
Each group gets a pair of blood type analysis. The students need to be familiar with blood analysis using antibodies. The blood types found at the crime scene were 0 - and A +. Write that the samples were collected at the crime scene.
- **DNA sequence to print and cut out. One for each group.**
Each group needs to get one full sequence. The DNA sequence used is from a gene relevant for eye color (OCA2- gene), but the mutations are fictitious for this material. Write that the DNA was collected from a cigarette on top of the dead body.
- **Four sets of fingerprints to print and cut out.**
Each group gets a copy of the four different fingerprints found at the crime scene. Write that all four fingerprints were collected at the crime scene.
- **Handwritten note with a bacterial name**
Each group gets one note. Place it in a bag with a small amount of sugar (suggesting that it is the spores from anthrax, a possible motive?)
- **Identification key 1 for animal hair.**
Printed and set up in the classroom at an area of own choice.
- **Identification key 2 for different species of pathogenic bacteria**
Printed and set up in the classroom at an area of own choice.
- **Identification key 3 for DNA code for different eye color.**
Printed and set up in the classroom at an area of own choice. The mutations are fictitious.

Blood type analysis for printing (one pair per group)

Place one set of blood analysis in a bag with the information that blood from two people was found at the crime scene



DNA sequence for printing (one copy for each group)

Place the DNA strands in a bag with a note that it was collected from a cigarette found on top of the dead body.

1	2	3	4	5
A - T	G - C	T - A	G - C	T - A
T - A	T - A	G - C	A - T	C - G
G - C	A - T	C - G	A - T	G - C
C - G	C - G	A - T	C - G	G - C
A - T	C - G	G - C	T - A	G - C
T - A	C - G	A - T	T - A	G - C
C - G	C - G	C - G	G - C	A - T
T - A	G - C	G - C	T - A	G - C
G - C	G - C	T - A	G - C	C - G
G - C	C - G	C - G	G - C	C - G
A - T	G - C	C - G	C - G	G - C
G - C	C - G	G - C	C - G	G - C
G - C	G - C	T - A	G - C	T - A
G - C	C - G	G - C	G - C	G - C
C - G	C - G	C - G	C - G	G - C
A - T	G - C	C - G	A - T	A - T
G - C	G - C	C - G	A - T	G - C
A - T	C - G	A - T	G - C	C - G
G - C	G - C	G - C	C - G	T - A
A - T	G - C	C - G	G - C	G - C
C - G	T - A	G - C	C - G	A - T
G - C	G - C	G - C	A - T	C - G
G - C	G - C	A - T	G - C	C - G
C - G	A - T	C - G	G - C	C - G
A - T	G - C	T - A	C - G	C - G
G - C	C - G	C - G	T - A	T - A
G - C	T - A	G - C	T - A	C - G
C - G	C - G	C - G	C - G	G - C
G - C	C - G	T - A	C - G	C - G
1	2	3	4	5

Fingerprints (one set of four per group)

Place one set of fingerprints in a bag with the information that all four prints were found at the crime scene.



Handwritten note with bacterial name (one for each group)

Place the note in a bag with small amounts of sugar (representing bacterial spores)

<i>bacillus anthracis</i>	<i>bacillus anthracis</i>
<i>bacillus anthracis</i>	<i>bacillus anthracis</i>
<i>bacillus anthracis</i>	<i>bacillus anthracis</i>
<i>bacillus anthracis</i>	<i>bacillus anthracis</i>

Identification key 1 for microscopy on animal hair.



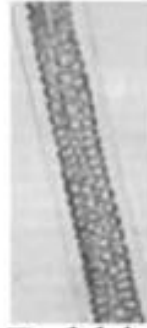
Human



Dog



Deer



Rabbit


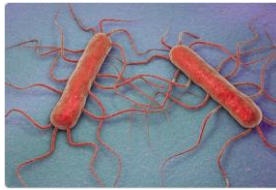
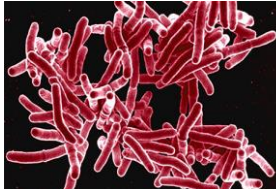






Cat



Mouse

Identification key 2 for species of pathogenic bacteria

Disease	Bacterial name	Mortality without antibiotics	Image
Cholera	<i>vibrio cholerae</i>	50%	
Listeria	<i>listeria monocytogenes</i>	30%	
Tuberculosis	<i>mycobacterium tuberculosis</i>	33%	
Plague	<i>yersinia pestis</i>	70%	
Botulism	<i>clostridium botulinum</i>	60%	
Anthrax	<i>bacillus anthracis</i>	97%	
Legionnaires disease	<i>legionella pneumophila</i>	20%	

Identification key 3 for genetic code for eye color

Brown



GAG CTC CTG CAG ACG TCC GTG CCC AGC GCA CTC GCT GAA CTT GTG GCC
CTC GAG GAC GTC TGC AGG CAC GGG TCG CGT GAC CGA CTT GAA CAC CGG

Green



GAG CTC CTG CAG ACG TTC GTG CCC AGC GGA CTC GCT GAA CTT GTG GCC
CTC GAG GAC GTC TGC AAG CAC GGG TCG CCT GAC CGA CTT GAA CAC CGG

Blue



GAG CTC CTG CAG ACG TCC GTG CCC AGC GGA CTC GCT GAA CTT GTG GCC
CTC GAG GAC GTC TGC AGG CAC GGG TCG CCT GAC CGA CTT GAA CAC CGG