

Art Heist

Case File

Team Members

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Note for Teachers

Art Heist activity has been designed for middle and high school children keeping in mind certain science and maths topics that appear in the curriculum of Central Board of Secondary Education (CBSE) and Maharashtra State Boards (MSB). For example in CBSE textbooks, topics like separation of substances and DNA find a mention in class 6, 7 and 9. In MSB textbooks, chromatography, DNA fingerprinting, forensic science are mentioned in classes 7, 9 and 10. Additionally, basics of mathematics involving measurement, ratio-proportions, pattern recognition, are an integral part of primary and middle school maths curriculum.

Art Heist weaves the above mentioned topics of science and maths (and even English) into a fun crime solving game. It requires students to work together methodically and meticulously as they logically piece together a set of clues provided to them. The activity is designed not just as an extension of regular science and maths curriculum topics but also with an intent to provide opportunities for children to better their skills of observation and pattern recognition, as well as engaging in deductive reasoning.

So let the crime-solving begin!

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Acknowledgements: Disha Dbritto, Amish Parmar, Shubham Kushwaha, Anisha Malhotra-Dalvi, Mohamed Hakif.

Case Study

A million dollars worth of paintings have been stolen from the world's most prestigious art gallery in Europe. The local police have been working on the case for over a month now. While they have some leads and suspects, they are unable to crack the case.

They have got in touch with an expert team from India who will help them solve this huge burglary.

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Updates

The local police have narrowed down on 30 suspects who are all interns at the art gallery. They were all present during the time of the heist. They are almost sure that one of them is the culprit. But they need to eliminate the ones who are innocent.

Your job is to decode the clues given to you and eliminate people from the **suspect list** who no longer are a suspect.



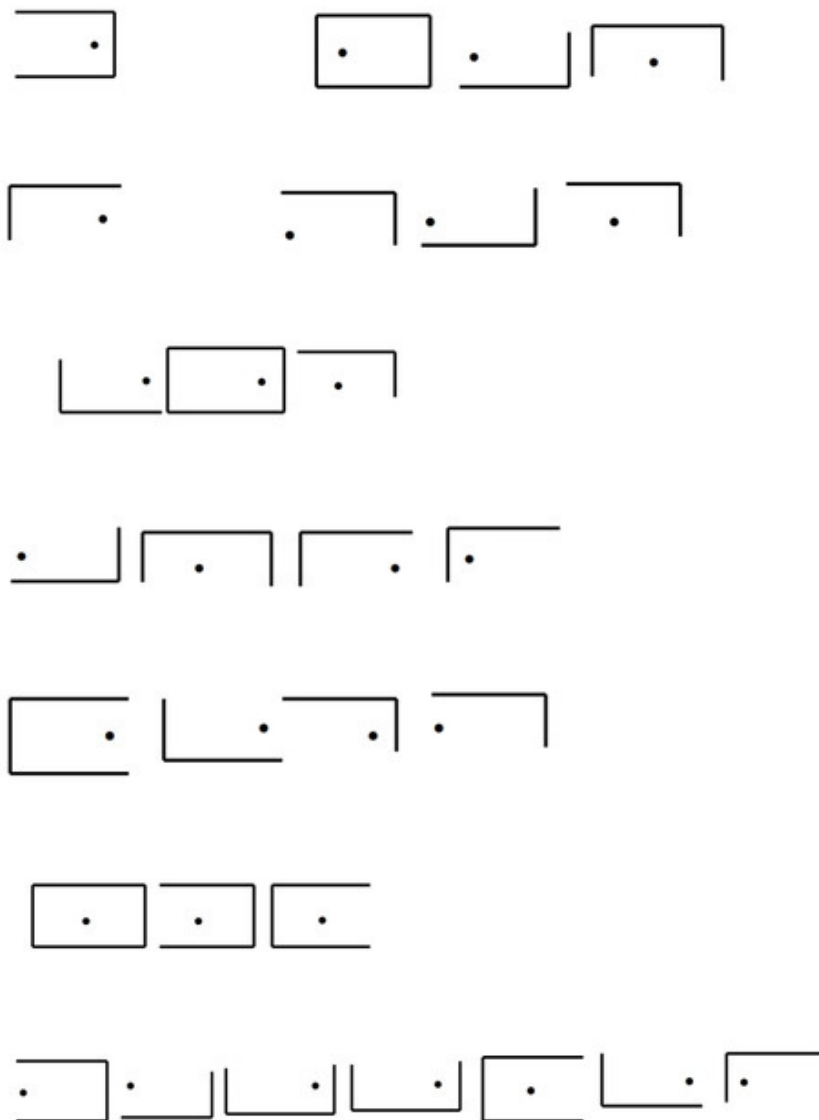
CLUE #1

You got lucky. The day you joined the case, an **anonymous tip** was sent to the police station. The message is most likely an eye-witness account. But it's coded so that no one else would understand it.

Decode the message and eliminate suspects.



CLUE #1

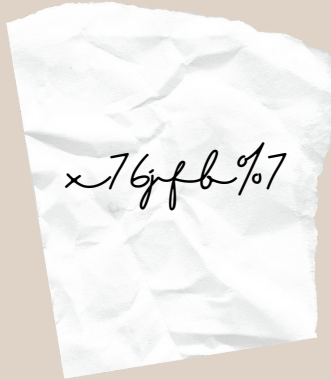


Decode the above message using the clue provided on the right.

Based on the decoded message, eliminate suspects from your list.

| | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| A | B | C | J | K | L | P | Q | R |
| G | H | I | S | T | U | D | E | F |
| M | N | O | V | W | X | Y | Z | A |

CLUE #2




One of the evidence collected at the crime scene was a crumbled piece of paper with some scribbling on it.

The handwriting analysis did not lead to anything useful. But you decide to do an ink-analysis of the evidence collected, using chalk chromatography. Finish the analysis and eliminate some more suspects.




Clue #2

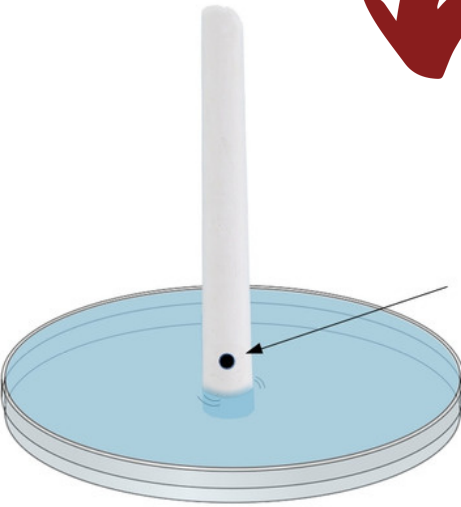
Ink Analysis



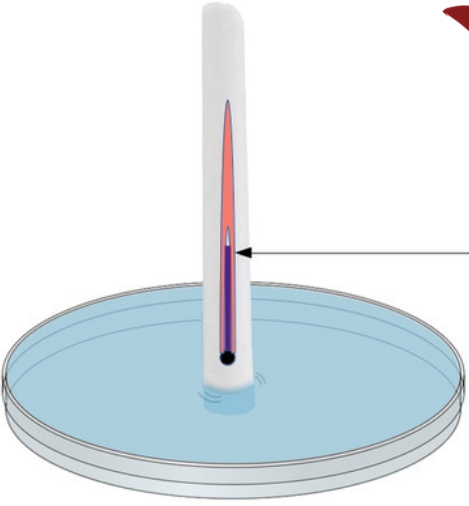
Step 1: Make a hole with a pin/sharp object at the base of the chalk (approximately 0.75cm to 1cm from the base)



Step 2: Dip the tip of the sketch pen into the hole of the chalk such that some amount of ink gets absorbed into the hole.



Step 3: Place a tray/cup of water and immerse the chalk in it such that the level of the water is **BELOW** the level of the ink spot.



Step 4: Wait for 5-7 minutes and observe the colour separation that happens. Wait till the water has reached the top of the chalk. Note down your observations.

Based on your ink analysis, the suspect used:

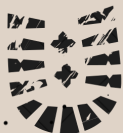
BRAND1

BRAND2

Tick the correct box.

CLUE #3

The forensic team found some shoe-prints at the crime scene. They were consistently observed near all the stolen paintings. There was no way to check if any of the suspects owned a pair of shoes that left this mark.



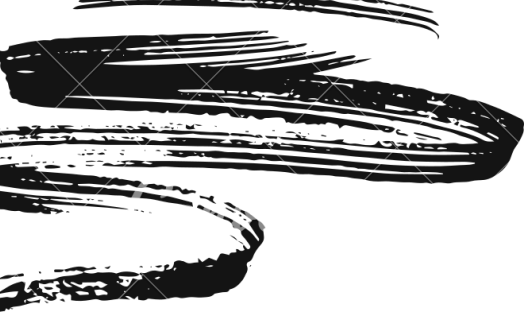
CLUE #3

But your expert team finds a way to inspect the shoe print evidence and further narrow down the list of suspects.

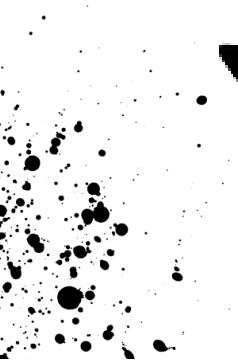
Collect some data from your peer group and reach an inference, quickly!

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CLUE #3



Disclaimer: Printing this page on different paper sizes, printer settings leads to discrepancies in the length. So for the purpose of this activity, consider the length of this shoe-print to be 24.7cm.



Foot - Height Analysis: Is there a pattern?

Team Name: _____

| No | Name | Height in cms (H) | Foot Length in cms (F) | $\text{Foot Length} = x \% \text{ of Height of a person}$ $\text{Foot Length} = \frac{x}{100} \text{ of Height of a person}$ $x = \frac{\text{Foot Length} \times 100}{\text{Height of the person}}$ |
|----|------|-------------------------|---------------------------------|--|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

Assumption: Shoe-print size is more or less equal to footprint size.

Inference: Foot Length is approximately _____ percent of the person's height. (Consider a range of +1 and -1). For eg, if you are getting an answer of 8%, then consider the range as 7 to 9%

Based on the above results:

The evidence collected by the forensic team shows a foot length of 24.7cms. So the criminal is likely to be between the height range of _____ and _____ cms.

CLUE #4

While you have been working on the case, the Europe team managed to create a profile of the suspect. They have shared their findings in a coded message for your expert team to figure out.

Decode the message and make your deductions.

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CLUE #4

Based on a detailed analysis of the case file, the Europe team have sent you the following message.

Message from Europe team:

SKSZQOT IYRQ NVMOU YX TCQ
PMG YA TCQ CQDST. TCQ
SKSZQOT DS WYSTVG M WMVQ
ICY DS MBQP NQVYI TIQXTG.
CQ DS VDUQVG TY NQ M
SWYUQR, CMS STRYXB MAAQOTDYX
AYR CDS SDNVDXBS, MXP VDUQS
PYBS.

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CLUE #4

A to E were replaced by M to Q respectively.

Q was changed to L.

I and J were converted to D and E respectively.

Z to U were replaced by F to K respectively.

R, S, T, were used as it is.

All F's became A

All G's became B

All H's became C

K to P were changed to U to Z respectively.

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CLUE #5

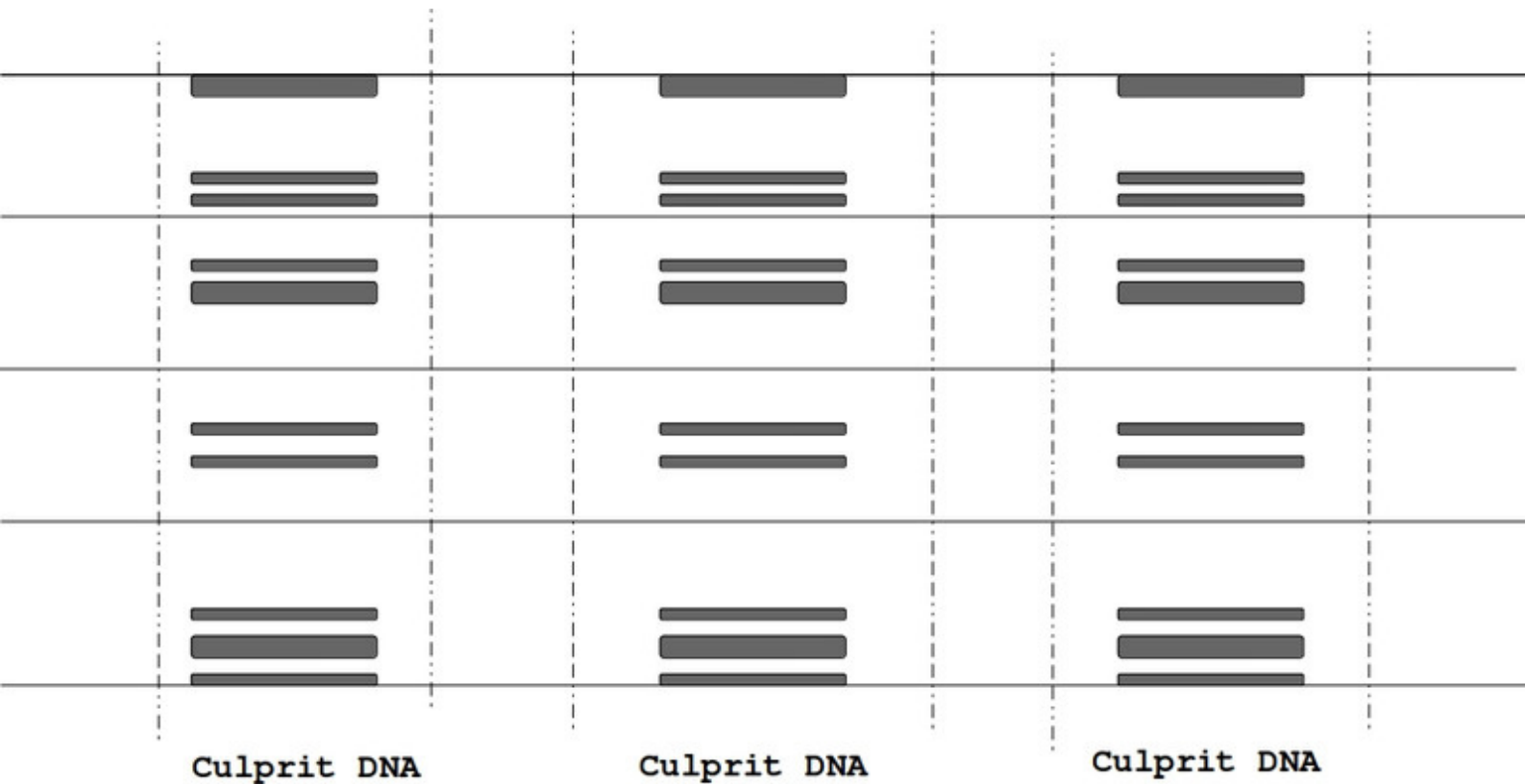
There has been major
breakthrough in the case!

The forensic team found some
"trace DNA" from the crumbled
piece of paper (Clue #2)!
The DNA sample has been sent
for sequencing.

All we need is a match of DNA!

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CLUE #5 DNA Fingerprinting



You can cut these into stripes,
along the dotted line and do the DNA matching.



CLUE #5 DNA Fingerprinting

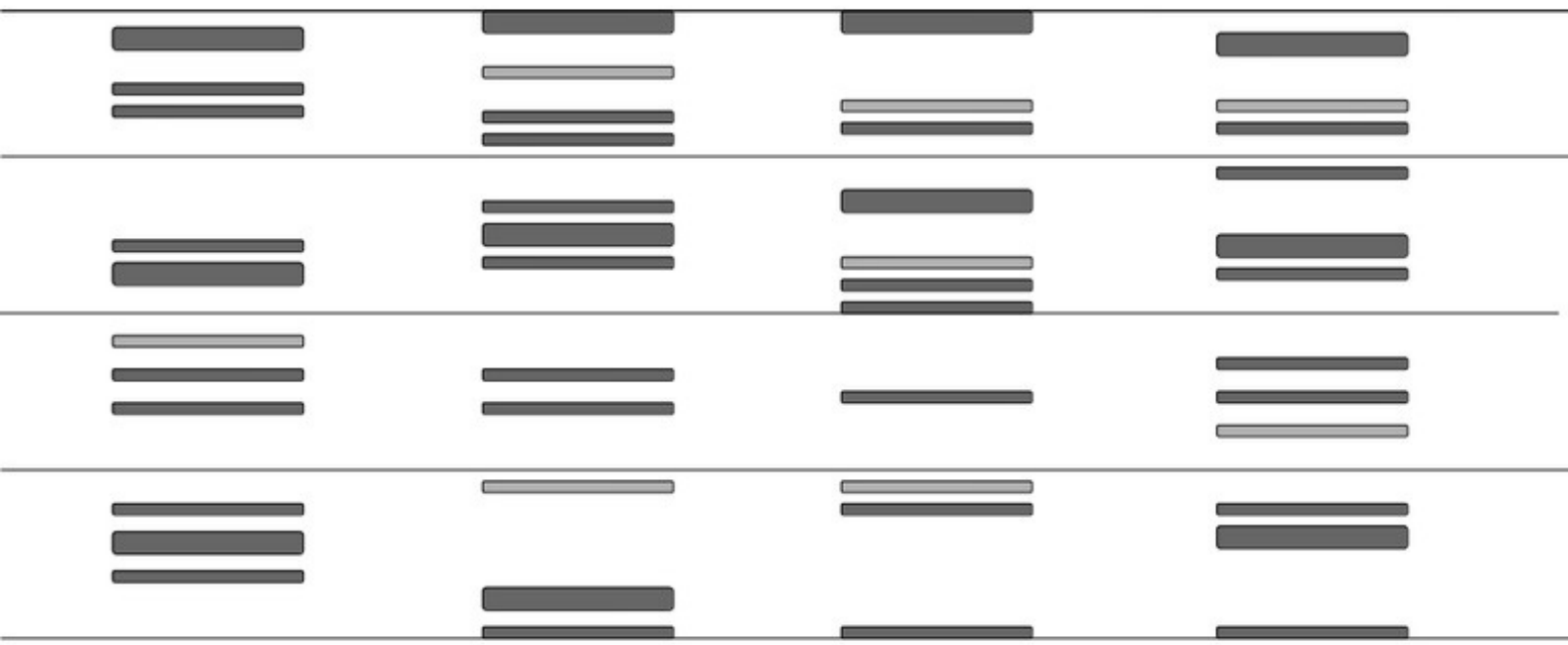


Harriet

Fred Claus

Jackie Brown

Steve Zissou



Barton Fink

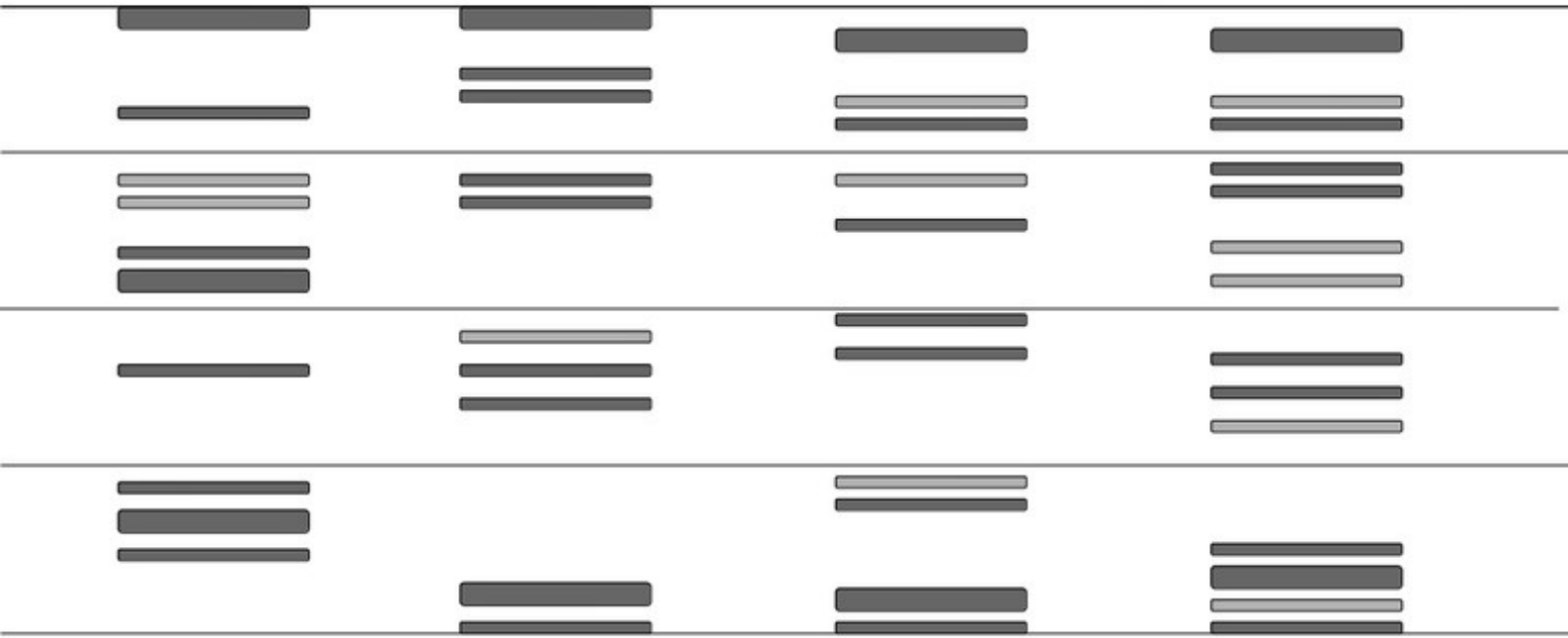
Ed Wood

Max Payne

Annie Hall



CLUE #5 DNA Fingerprinting

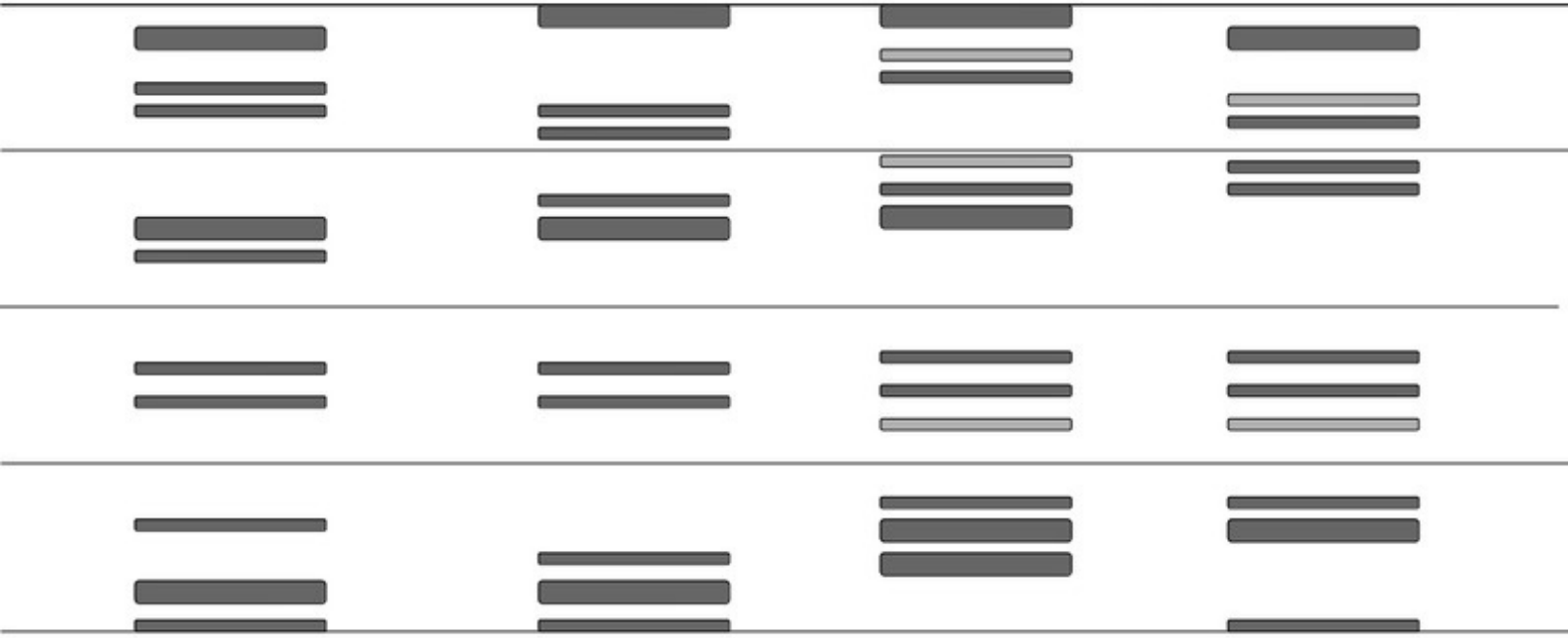


Rambo

Don Jon

Amelie

Indian Jones



Erin Brockovich

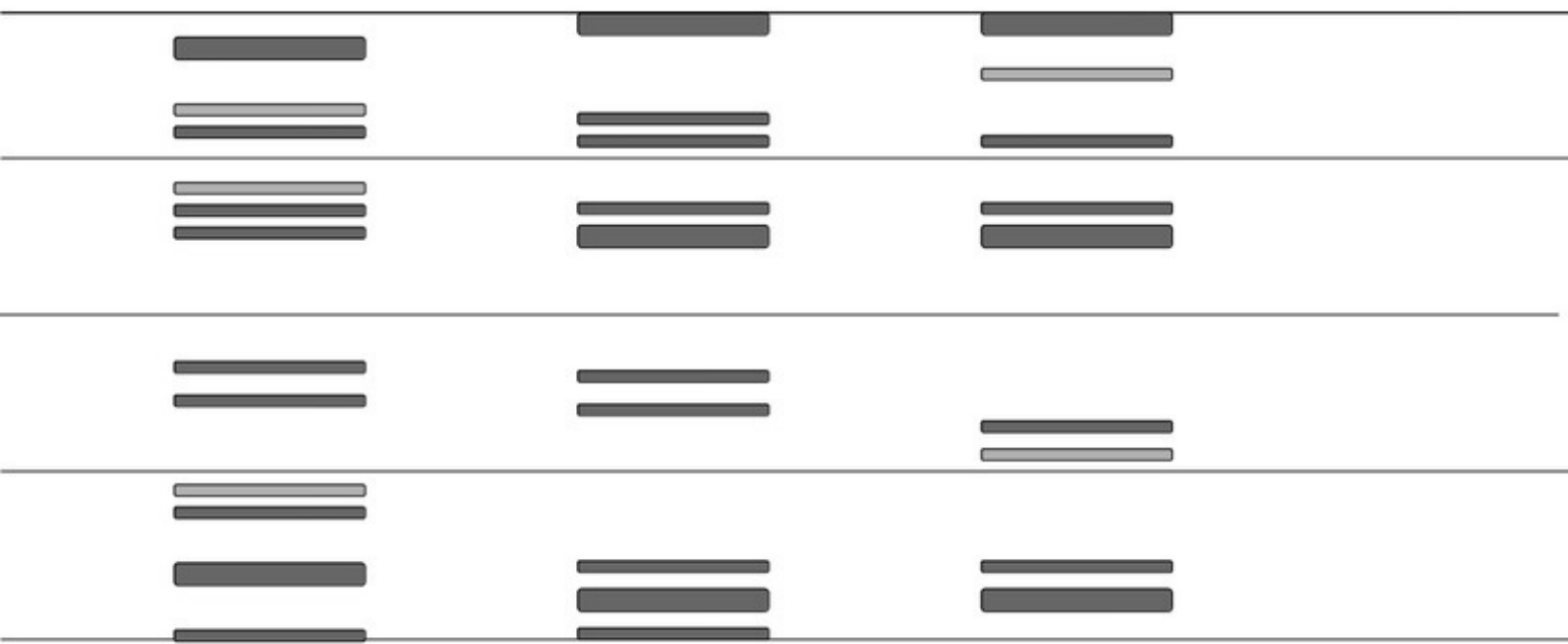
Logan Jackson

Leon

Camille Claudel



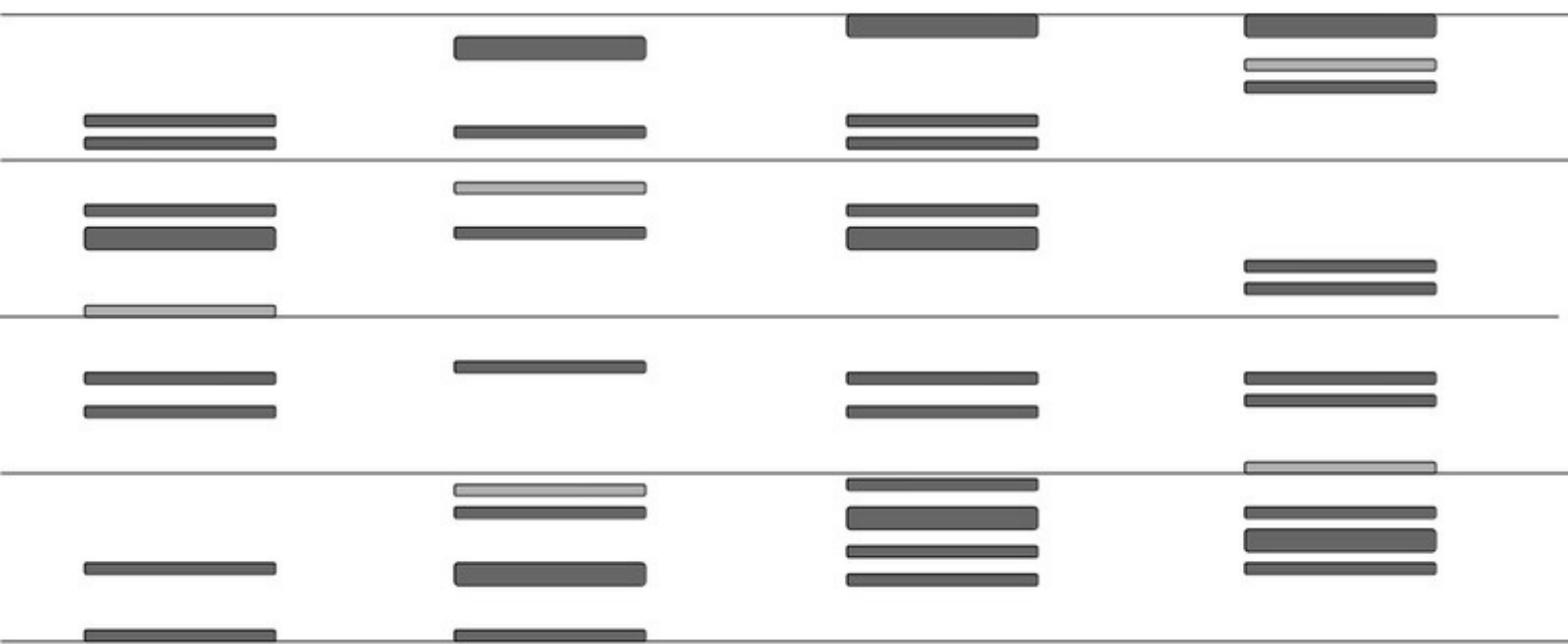
CLUE #5 DNA Fingerprinting



Robin Hood

Percy Jackson

Harry Potter



John Wick

Bridget Jones

Drillbit Taylor

Donnie Brasco

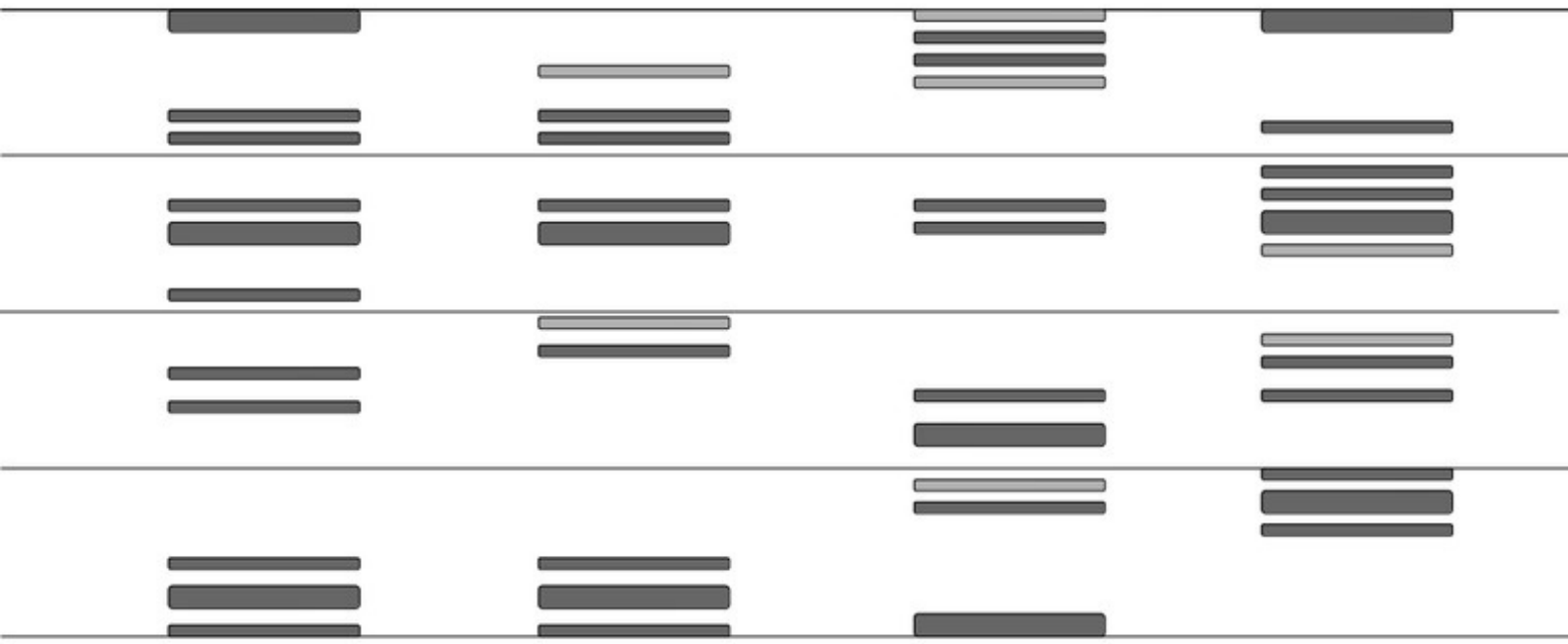
CLUE #5 DNA Fingerprinting



Bobby Deerfield

Florence Foster

Michel Vaillant



Jerry Maguire

Pocahontas

Donnie Darko

Philomena

CLUE #5

The DNA matched with 2 people! But how is that possible? Well, that is because both the suspects are identical twins. But how do we figure out who is the real culprit among the two?

What do we do?

Is there anyway we can eliminate one of them based on the clues we have gathered so far?

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Dear Teacher,

This activity may take anything between 2 hours to 3 hours to implement depending on which class you work with. If you choose to execute the lesson plan in your daily school timetable, you can conduct it in 3 classes of 40 mins (Clue 1+2; Clue 3; Clue 4+5).

Teacher preparation notes follow this section.

If you tried out this activity with your students and you have some feedback, do share it with us! We would love to hear from you. *Which class did you conduct this activity with? How many children participated in the session? Did children work in groups, pairs or alone? Are there any flaws in the current plan? How can we make this activity better? During the implementation of this activity, what did children enjoy the most and the least. Did they find something difficult or boring?*

If you also have ideas to make this activity more interesting for children, then feel free to share your ideas with us and we can try to incorporate those ideas in the revised version of the Art Heist lesson plan.

You are also welcome to share photographs of your Art Heist Session with us, which we can put up on our website (dnte.hbcse.tifr.res.in/) so that your efforts can be shared with the larger community of teachers and educational practitioners! We look forward to hearing from you.

Our Email ID: [dnte\[at\]hbcse\[dot\]tifr\[dot\]res\[dot\]in](mailto:dnte@hbcse.tifr.res.in)

Teacher Preparation

To undertake this activity, the teacher would need to keep ready the following items:

- Print outs of the case-files (page 1, pages 3 to 22)
- Print outs of Suspect List appended at the end of this document.
- Rough sheets, pencils, erasers, highlighters, sketch pens.

FOR CLUE #1

- Multiple print-outs of page 6 may be taken in case students want to work simultaneously and individually in the group.

FOR CLUE #2

- Chalks (2 for each group)
- Two types of black sketch pens (which definitively give 2 different separation patterns on chalk chromatography). So the teacher will have to **check this prior to the session**. Label the two different sketch pens as Brand 1 and Brand 2.
- The teacher should have already run Brand 1 ink on the chalk chromatography. So a chalk with colours already separated (for Brand 1) will be presented to students as "Evidence" for Clue #2
- Safety pin for each group (to make a small hole in the chalk)
- Petri-dish or flat-base cup with little water in which chalks can stand vertically without your hand supporting it. Each group gets one dish/cup.

Teacher Preparation

To undertake this activity, the teacher would need to keep ready the following items (contd):

FOR CLUE #3

- Make sure to print page 11 on an A4 sheet only, with printer setting set at 100% scale. The length of the shoe-print should be around 24.7cms. Please note that printing page 11 on different printer settings and/or paper sizes, leads to discrepancies in the length.
- **So for the purpose of this activity, consider the length of (evidence) shoe-print to be 24.7cm (even if actual measurement on the printed page shows different).**
- **Measurements have to be taken consistently.** If students are measuring height and shoe-size, then all measurements should be height and shoe-size. You cannot have few measurements on the basis of foot-size and others as shoe-size.
- Ruler/ Scale
- Measuring tape

FOR CLUE #4

- Rough sheets
- Multiple print-outs of page 14-15 may be taken in case students want to work simultaneously and individually in the group

FOR CLUE #5

- Scissors

For the answer key, please email us at
dnte[at]hbcse[dot]tifr[dot]res[dot]in

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Art Heist Case File

Suspect list

| No | Name of Suspect | Gender | Age (years) | Height (cms) | Suspect was found with the following pen brand: | Suspect clothes colour | Profile of the suspect |
|----|-----------------|-----------|-------------|--------------|---|------------------------|--|
| 1 | John Wick | Male | 19 | 180 | Brand 1 | Black | He lives with 3-4 friends. He likes to party and specialises in black and white sketches. |
| 2 | Harry Potter | Male | 18 | 181 | Brand 1 | Red | He is an orphan, wears black framed specs and enjoys his time with brothers and sisters. |
| 3 | Bridget Jones | Female | 35 | 179 | Brand 1 | Black | She stays alone in a big house she inherited and has a pet dog. |
| 4 | Leon | Not known | 19 | 164 | Brand 1 | Red | Does not get along with the family. Owns a Ferrari car but in reality wants to sell it and buy a cheaper car. Hates junk food but smokes a lot. |
| 5 | Rambo | Male | 25 | 145 | Brand 2 | Red | A non-smoker, he lives with his parents. He enjoys modern art and wishes to open his own art gallery. |
| 6 | Don Jon | Male | 18 | 164 | Brand 1 | Black | For him, art is a hobby, and smoking is a habit. He likes to travel and is mostly out of town during weekends. He is a single child and lives with his parents. |
| 7 | Amelie | Female | 30 | 182 | Brand 2 | Black | She lives with her husband and has taken up art classes as a way to pursue her childhood dream of becoming an artist. She is very close to her brothers and sisters. |

Art Heist: A critical thinking STEAM based exercise

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| | | | | | | | |
|----|-----------------|--------|----|-----|---------|-------|---|
| 8 | Indiana Jones | Male | 28 | 183 | Brand 2 | Black | He lives alone and has a passion for animals. He is actually a veterinarian and also helps in adopting homeless cats and dogs. Art is his other passion. |
| 9 | Jerry Maguire | Male | 18 | 189 | Brand 1 | Red | He lives with his brother and sister in a small flat. He hails from a poor family but came to the big city with his siblings to earn their livelihoods by working hard. |
| 10 | Pocahontas | Female | 19 | 187 | Brand 1 | Red | She lives alone and runs a nursery. But she does not make big profits. She is keen to expand her business but has been struggling to make enough money. |
| 11 | Donnie Darko | Male | 22 | 142 | Brand 1 | Red | He lives alone and drives a cycle. He is environmentally conscious person who tries to lead a life which has a low carbon footprint. He is passionate about gardening and art. But he has a habit of smoking! |
| 12 | Philomena | Female | 25 | 150 | Brand 2 | Red | She is a part-time nurse in a hospital and a single parent. She has no siblings and does not talk to her parents any more. She juggles 2-3 jobs but almost never misses her art classes. |
| 13 | Logan Jackson | Male | 19 | 164 | Brand 1 | Black | He does not get along with his family and lives in a flat with his friend who is an Engineer. Both he and his flatmate like to party and they have a bad habit of drinking and smoking. |
| 14 | Robin Hood | Male | 45 | 165 | Brand 2 | Black | He lives with his wife and 2 children. He was an IT consultant. He felt too much stress and used to smoke a lot. He quit his job and decided to pursue art. |
| 15 | Erin Brockovich | Female | 25 | 165 | Brand 2 | Black | She is a student pursuing her PhD in History. She loves to travel and collect painting from all over the world |
| 16 | Camille Claudel | Female | 30 | 167 | Brand 1 | Black | She lives with her sister and has 2 dogs. She is passionate about art and video games. She also is a fitness freak. |

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| | | | | | | | |
|----|-----------------|-----------|----|-----|---------|-------|---|
| 17 | Bobby Deerfield | Male | 18 | 188 | Brand 2 | Black | He is pursuing his under graduation in literature. He lives with his parents and sister. He helps people with odd jobs and earns little pocket money. |
| 18 | Florence Foster | Female | 19 | 185 | Brand 1 | Red | She is the only child, and lives with her parents. She also has 2 dogs and loves to cook different dishes. |
| 19 | Michel Vaillant | Male | 18 | 182 | Brand 1 | Red | He grew up in an orphanage and has currently enrolled into a Bachelor of Arts program in a nearby college. He spends his free time in the Art Gallery. |
| 20 | Donnie Brasco | Not known | 45 | 164 | Brand 1 | Black | Short tempered person. Does not like people being hypocritical. Enjoys music and art to a great deal. |
| 21 | Harriet | Female | 19 | 138 | Brand 1 | Black | She is studying to become a teacher . She lives with her parents and siblings and their dog Juby. |
| 22 | Fred Claus | Male | 18 | 181 | Brand 2 | Black | He is a skilled plumber and works on a free lancing basis. He has always loved art and is an excellent painter. He wishes to travel the whole world and see the different art forms that exist. |
| 23 | Jackie Brown | Female | 19 | 182 | Brand 1 | Black | She is a student of Art and specialises in pencil sketching. He lives with her brother and they have a cat. |
| 24 | Steve Zissou | Male | 18 | 144 | Brand 2 | Red | He lives with parents and siblings. He has a heart condition which does not let him exert himself too much. He loves art, music and movies. |
| 25 | Barton Fink | Male | 30 | 164 | Brand 1 | Red | He is a lawyer who took up art as way to relieve his stress. He has two bad habits. He smokes a lot and lies a lot. |
| 26 | Ed Wood | Male | 19 | 181 | Brand 2 | Red | He is studying to become a designer. He lives with his family. He loves his parents and sister and will do anything for them. He hates pets and people who have pets. |

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| | | | | | | | |
|----|-----------------|--------|----|-----|---------|-------|--|
| 27 | Max Payne | Male | 18 | 164 | Brand 1 | Black | He lives with his 3 room mates who are all working as waiters in a nearby cafe. He is working part time to earn money so that he can join a full time art course. But he also ends up spending a lot of money on smoking and partying. |
| 28 | Annie Hall | Female | 18 | 189 | Brand 2 | Red | She is a sportswomen and trains 5 days a week. She lives with her husband who is an IT consultant. |
| 29 | Percy Jackson | Male | 19 | 164 | Brand 1 | Black | He lives alone in a flat. He owns a guitar and raises a puppy in his home. His teeth are yellow stained because of his bad habit of smoking. |
| 30 | Drillbit Taylor | Male | 18 | 164 | Brand 1 | Black | He is estranged from his family and lives alone in a flat. He drives a very fancy car and likes to listen to classical music. |

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