

KINEMATICS

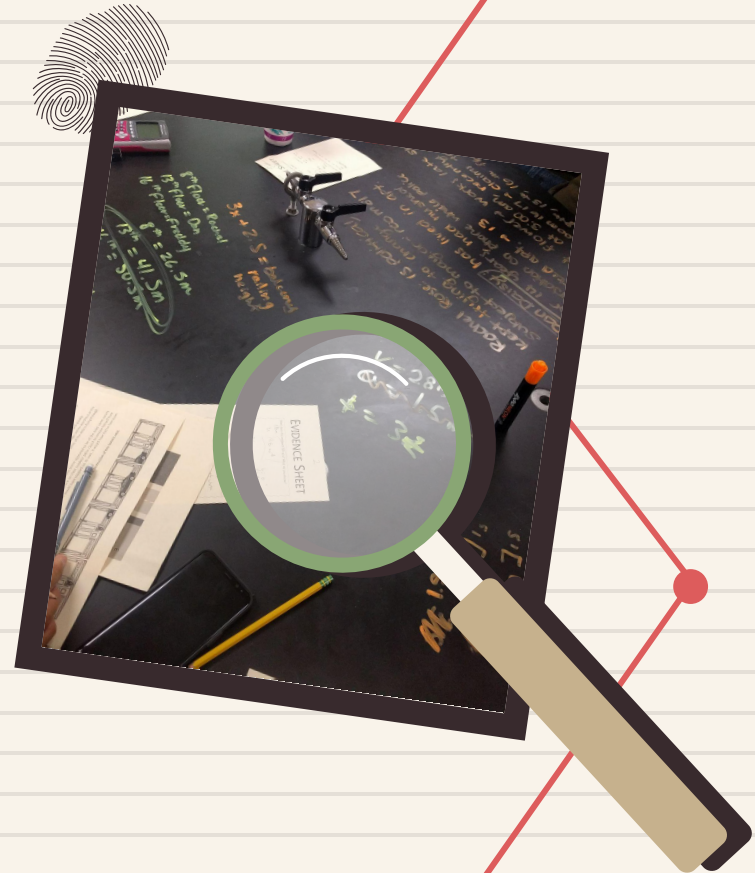
CRIME SCENE



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PLAN FOR THIS SESSION

01

Overview

There's Been a Crime...

02

Kinematics Tune Up

Refresher for non-physics teachers

03

Kinematics Crime Scene

Solve the mystery in groups

04

Debrief and Discuss

Thinking about task from teacher lens





LEARNER

STANCE

For much of this session, you will participate from the student perspective

01

THERE'S BEEN A CRIME!

Assemble clues and use evidence to figure out who is responsible for the destruction of this historic vase



As experts in physics, you have been recruited by the local Police Department to help solve a recent crime

Early this morning around 6:15 am, Wilma Wilshire, was preparing to transfer an empty antique vase that once belonged to the city's first mayor, David Daisy. It was scheduled to be installed in the lobby of the Gardens Apartment Complex as part of a traveling antiques exhibit. Wilma parked around the corner of the apartment lobby's front door, unwrapped the precious antique from its packaging, and started to walk it toward the entrance. Just before she made it through the lobby doors, she remembered that she left her van running. Since the street was pretty much deserted so early in the morning, she decided to set the vase down on the sidewalk for a moment while she ran to her van around the corner to turn off the engine. While she was walking back, she saw a blue car zip by and heard a loud crash. To her horror, she returned to find her priceless historic vase destroyed beyond repair and scattered among a mess of ceramic, potting soil, and red geraniums.

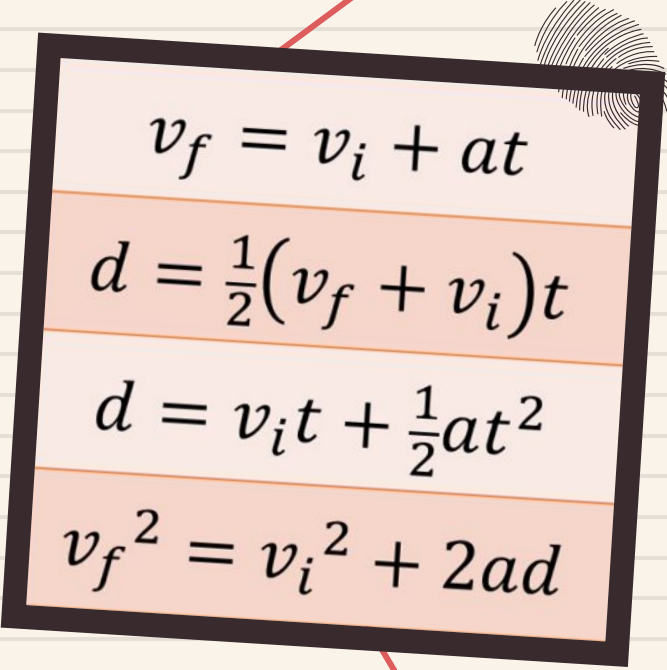
The policeman that arrived first to the scene noticed a security camera outside of the ATM across the street and quickly requested the footage in hopes of catching the perpetrator in the act. Unfortunately, the camera footage seems worthless as the crash must have occurred in the exact moment that the blue car drove past. You can even see some of the debris flying through the air at this moment.

The apartment manager noted that the red geraniums scattered about the crime scene appeared to be of the exact same variety as the potted plants that the apartment provided to each resident to place on their outdoor patio. Quick to remove himself from the scenario, he further explained that there is no way that one of these plants would have toppled on its own, it would have had to have been intentionally tampered with.

Your task is to assemble clues and use evidence to figure out who is responsible for the destruction of this historic vase.

Security Camera Footage:




$$v_f = v_i + at$$

$$d = \frac{1}{2}(v_f + v_i)t$$

$$d = v_i t + \frac{1}{2}at^2$$

$$v_f^2 = v_i^2 + 2ad$$

02

KINEMATICS TUNE UP

Refresher for
non-physics teachers

KINEMATICS TUNE UP

The key variables of motion are related by formulas known as the KINEMATIC EQUATIONS

**Acceleration
due to gravity**
 $g = 10 \text{ m/s}^2$

Variables

v_i → initial velocity

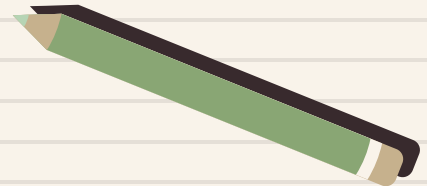
v_f → final velocity

d → displacement

a → acceleration

t → time

A	$v_f = v_i + at$
B	$d = 0.5(v_f + v_i)t$
C	$d = v_i t + 0.5at^2$
D	$v_f^2 = v_i^2 + 2ad$



EXAMPLE PROBLEM

If you drop a bowling ball off of the Leaning Tower of Pisa, it will take about 3.36 seconds to hit the ground.

How tall is the tower?

v_i	0 m/s
v_f	
d	??
a	10 m/s ²
t	3.36 s

$$d = v_i t + 0.5at^2$$

$$d = (0)(3.36) + 0.5(10)(3.36^2)$$

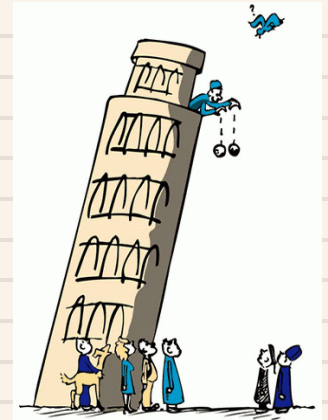
$$d = \mathbf{56.5 \text{ m}}$$

A $v_f = v_i + at$

B $d = 0.5(v_f + v_i)t$

C $d = v_i t + 0.5at^2$

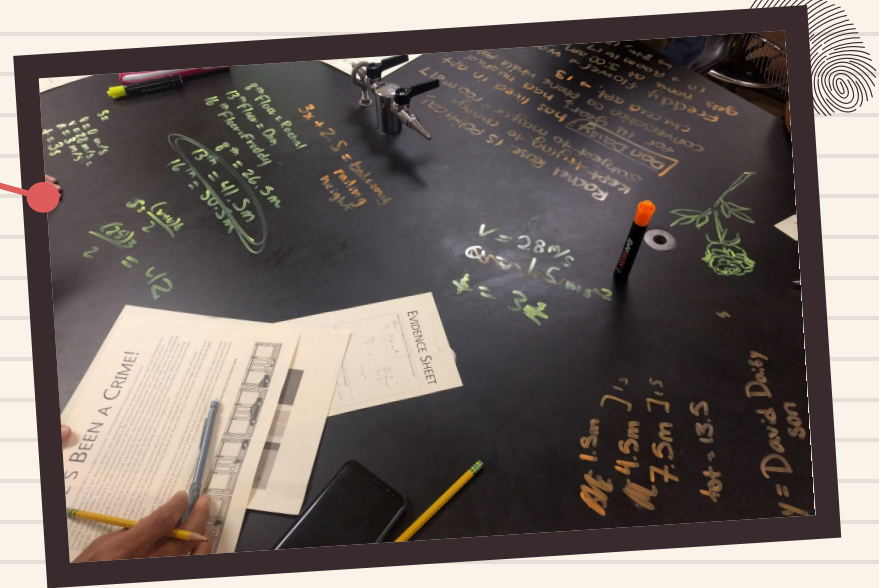
D $v_f^2 = v_i^2 + 2ad$



03

KINEMATICS CRIME SCENE

Collect and assemble evidence to solve the crime



ASSEMBLE YOUR CLUES...

Take a moment to assign members to the different clues

Clue 2 - **Physics**

Clues 3 & 6 - **Math**

Clues 4 & 5 - **Details**

CLUE #1 The Scene of the Crime

CLUE #2 The Car Trail...

CLUE #3 Apartment Balconies

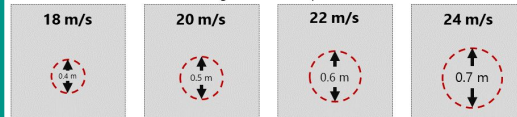
CLUE #4 The Suspects

CLUE #5 The Man in the Car

CLUE #6 Drop Test

You hear from the crew on the scene that there is a significant amount of debris left from the impact of the plant. They believe that this debris pattern could be used to help describe the events of the crime. You decide to do a little test to figure out if a debris pattern can tell you more information about the impact speed. You simulate the impact by launching the same brand of potted plant towards the concrete at different impact velocities. Not knowing the exact nature of the debris pattern observed by your team, you decide to develop an equation to relate debris diameter to impact speed.

Data below taken from the lab testing at different impact velocities:



COLLECTING EVIDENCE

You are only allowed to return to your group with the evidence that you have recorded

3 minutes | Individual

3 minutes | With Clue Group

ALL clues will be important to solve this mystery

EVIDENCE SHEET

What does the evidence tell you? What do you know?

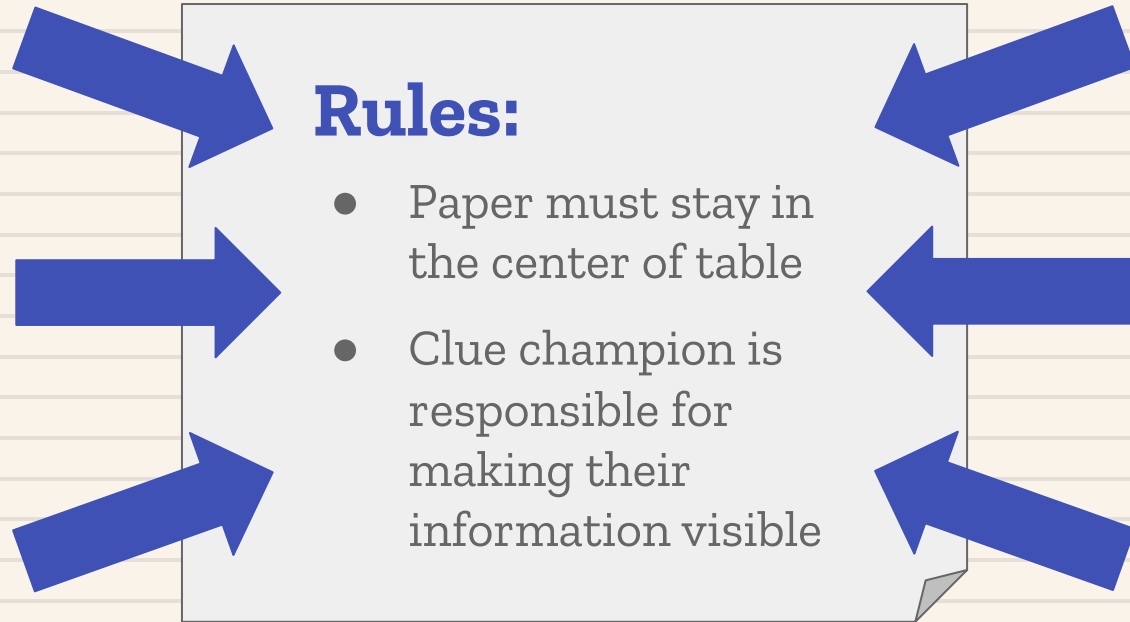
OBSERVE

How might this evidence help solve the mystery?

INTERPRET

MAKE EVIDENCE VISIBLE

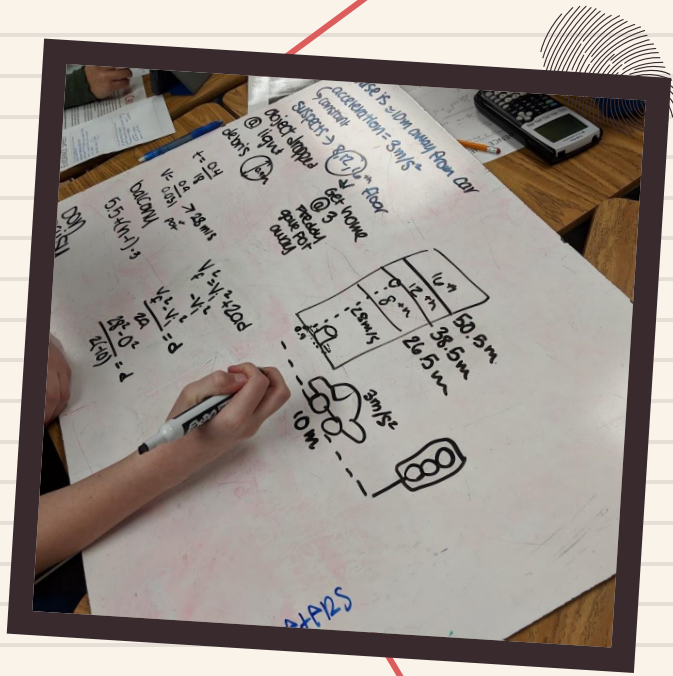
Start piecing together your evidence to make connections.





WHAT'S THE

VERDICT?



04

DEBRIEF AND DISCUSS

Thinking about task
from teacher lens

DEBRIEF AND DISCUSS...

In your groups, evaluate the experience:

Some ideas to get you thinking

- What did you notice?
- What did you feel?
- What supported you?
- What challenged you?

WHAT I DID AND WHY

Driving Motivation:

Can I design a task where students HAVE to collaborate to be successful

Keeper of the Marker

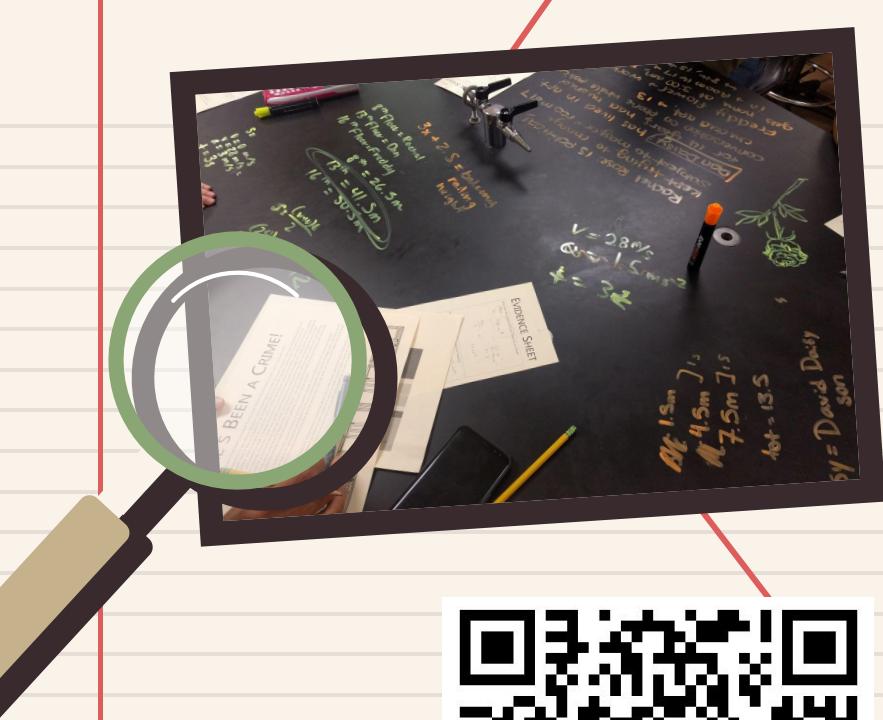
Clue Champions

Safety Nets

Nobody "wins"

**"Make Evidence
Visible" Norms**

**Multiple levels
of success**



THANKS

Session materials posted at
bit.ly/cossettemncose

For more resources like these:
passionatelycurioussci.weebly.com

Any questions? You can reach me at
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