MODIFIED ATWOOD MACHINE

A hanging mass pulling a block across a table

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How does each mass affect the acceleration of a modified Atwood system?**

TIME 30 minutes	SIMULATION BuildPhysics > Modified Atwood machine	UNIT 2 Force & Translational Dynamics

Learning targets

- Write a system equation for a hanging mass connected to a table mass.
- Test how the hanging and table masses affect acceleration differently.
- Compare ideal and frictional models.

Model before you measure

Keep the table frictionless for Parts A and B. Let m_h be the hanging mass and m_t be the table mass.	$a = m_h g/(m_h + m_t)$ $T = m_t a$

Important: Use $g = 9.8\ m/s^2$. The weight of the hanging mass is the external driving force on the two-block system.

Pre-lab prediction | 4 minutes

1. What should happen to acceleration when the hanging mass increases?

_____

2. What should happen when the table mass increases but the hanging mass stays fixed?

_____

3. Is rope tension equal to the hanging mass's weight while the system accelerates? Explain.

_____

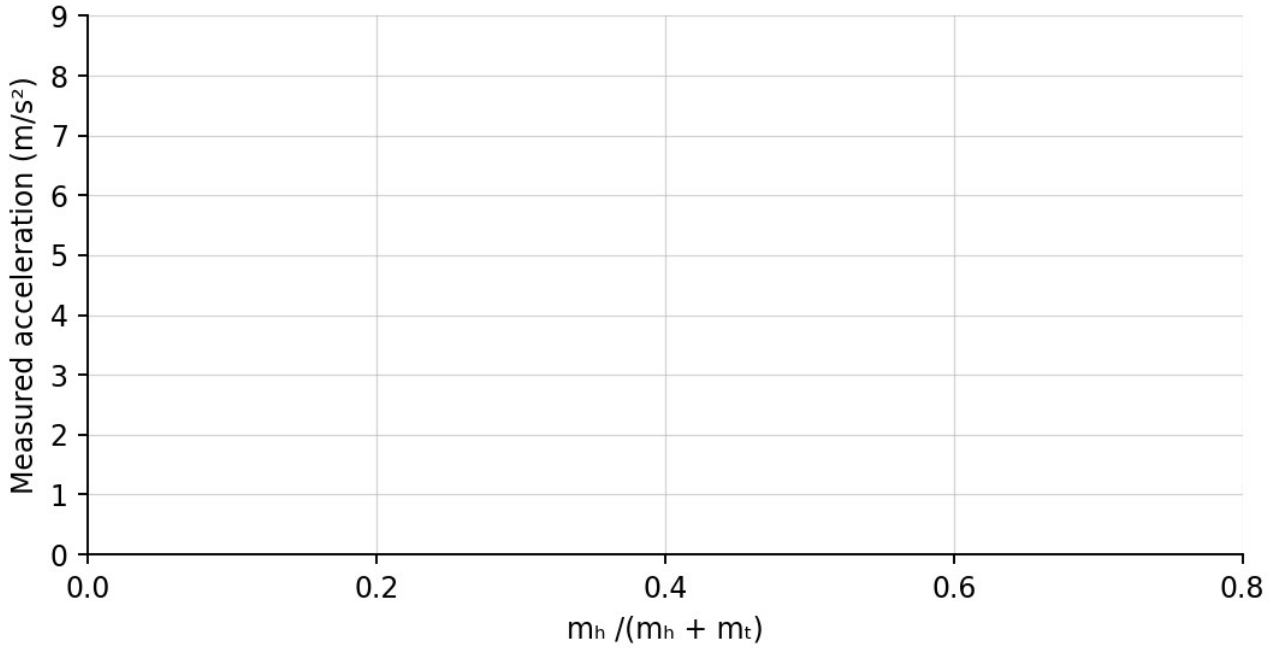
PART A Change the hanging mass

Setup | 3 minutes

- ☐ Load Modified Atwood machine. Confirm the table is frictionless and the pulley is massless.
- ☐ Keep the table mass at 1.0 kg. Change only the hanging mass.
- ☐ Display acceleration and tension values. Reset before every run.
- ☐ Run briefly and pause before the hanging mass reaches the bottom.

Data table | 10 minutes

m_h (kg)	$m_h/(m_h+m_t)$	Predicted a (m/s²)	Measured a (m/s²)	Measured T (N)
0.50				
1.00				
1.50				
2.00				
3.00				



4. Plot measured acceleration versus $m_h/(m_h + m_t)$. Draw a best-fit line.

PART B Change the table mass and test friction

Table-mass test | 6 minutes

Constant input: Keep m_h = 2.0 kg. Change only m_t.

m_t (kg)	Predicted a (m/s²)	Measured a (m/s²)
0.50		
1.00		
2.00		
3.00		

Friction challenge | 3 minutes

Return to m_h = 2.0 kg and m_t = 1.0 kg. Turn friction on, run one trial, and record the new acceleration: _____ m/s².

Analysis | 6 minutes

5. What did the slope of the Part A graph represent?

6. Why did adding table mass reduce acceleration even though the hanging weight stayed constant?

7. Compare tension with $m_h g$. Why are they not equal during acceleration?

8. How did friction change the system net force and acceleration?

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “Increasing the table mass cannot change acceleration because the hanging force is unchanged.”

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measurements or graph features.
REASONING	Connect your evidence to the force model and Newton's laws.

Exit ticket

Find the ideal acceleration when m_h = 1.5 kg and m_t = 2.5 kg. Use g = 9.8 m/s².