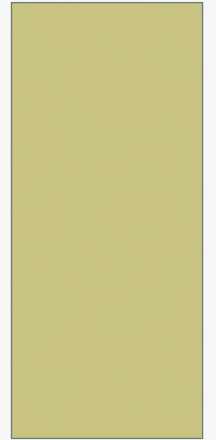


# GRAVITY

FORCES AND MOTION TO GRAVITY



# OPENER

- How good are you at having an open mind and considering possibilities other than what you believe to be true? Give an example.

HUMANS TEND TO LOOK FOR  
EVIDENCE TO CONFIRM WHAT THEY  
ALREADY BELIEVE. SCIENCE TRIES TO  
DO THE OPPOSITE.

- Watch: Can you solve this? (5min)
- <https://www.youtube.com/watch?v=vKA4w2O61Xo>

# GRAVITY LAB



DO ALL THINGS FALL AT THE  
SAME RATE?

WHAT FACTORS CAN EFFECT  
THE RATE AT WHICH THINGS  
FALL?

# ARISTOTLE VS. GALILEO OPENER

- **Take a stand: Do you agree with Aristotle or Galileo or neither? Why?**
- **What kinds of things might cause error in the lab today? How can we minimize error or improve the experiment so that we get better data?**

# COMPLETE IN YOUR JOURNAL:

- Homework: complete **GRAVITY LAB Parts I and II** in Journal

Gravity Lab - Part I

Inquiry Question(s):

Hypothesis: (If...then...because...)

Materials: (read procedure and figure it out)

Illustration: (detailed, labeled)

Procedure: (numbered steps)

Results: (create a data table)

Skip a page for analysis

Gravity Lab - Part II

Inquiry Question(s):

Hypothesis: (If...then...because...)

Materials: (read procedure and figure it out)

Illustration: (detailed, labeled)

Procedure: (numbered steps)

Results: (create a data table)

Skip a page for analysis



# HW

- Complete Analysis and Reflection Questions for Part I and Part II of Lab
- Analysis requires a CLEAR paragraph with 1 piece of evidence (specific data from your lab).
- **Do additional research** if you are not certain your lab data or results are correct.



# GRAVITY OPENER

- 
- 1. Is Gravity a <sup>strong Force</sup> Strong Force or a weak force?
- 
- 2. Though it is a \_\_\_\_\_ force, gravity is responsible for which of the following?
- 
- \_\_\_\_\_ the elliptical orbits of planets
- \_\_\_\_\_ the Moon's orbit around the Earth
- \_\_\_\_\_ the spherical shape of the Sun, planets and other \_\_\_\_\_ celestial objects
- \_\_\_\_\_ Much of the structure of the universe
- \_\_\_\_\_ Life on Earth
-

# SO WHY STUDY GRAVITY?

- Is Gravity a Strong Force or a weak force?
- **WEAK compared to electromagnetism or the other fundamental forces**
- 
- 
- Though it is a weak force, gravity is responsible for which of the following?
- 
- X the elliptical orbits of planets
- X the Moon's orbit around the Earth
- X the spherical shape of the Sun, planets and other celestial objects
- X Much of the structure of the universe
- X Life on Earth
- 
- If we had a switch to turn off gravity... what would happen to life on earth?

# GALILEO VS ARISTOTLE

- <http://video.mit.edu/watch/aristotle-vs-galileo-the-race-of-all-time-14252/>
- Stop at 2:30
  
- Share your paragraphs in groups
- Choose best at table to share with class.

# CHECK REFLECTION QUESTIONS

- 1. Define gravity

A force that attracts all objects with mass to all other objects with mass.

- 2. In what direction does the force of gravity always act?

Gravity acts towards the center of the Earth. It is always a downward force on Earth.

- 3. Which fruit had a greater mass? Does the more massive fruit always hit first (10 times heavier, ten times faster) as Aristotle predicted?

The orange has more mass, but hits at the same time as the grape when released at the same time from the same height. Aristotle was wrong.

- 4. Do you think a banana would hit the ground at the same time, or do you think they would hit differently.

If air resistance was negligible they would both hit at the same time.

terminal  
velocity

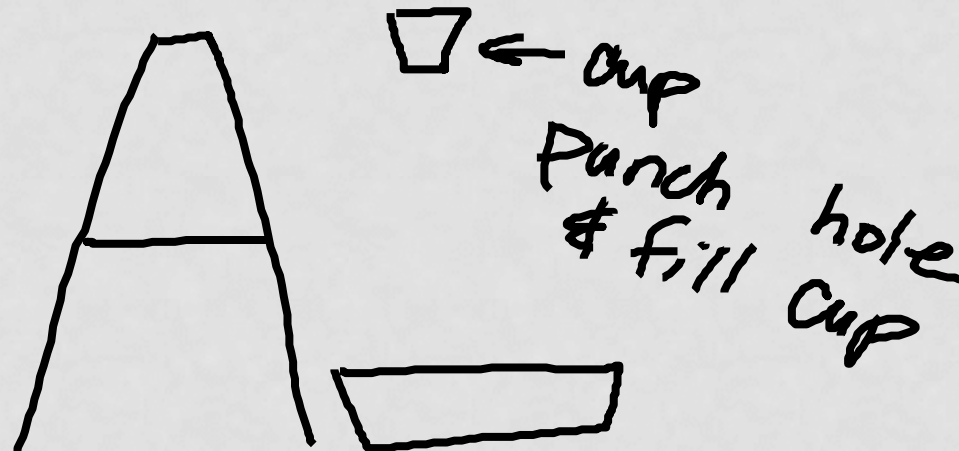
Surface  
area

5. How do you think a parachute works?

When the force of air resistance acting in an upward direction exactly balances the force of gravity acting in a downward direction, the object stops accelerating and continues to fall to the ground at a constant speed.

# POE

- What will happen if you put a hole in a cup and drop it?



- Why do you think so? Use the words force, rate, gravity



# ARE THERE INSTANCES WHERE ALL THINGS DON'T FALL AT THE SAME RATE?

- Things like surface area, low mass to large surface area ratio, or falling from great height can affect how things fall.
- Robbie's Video <https://drive.google.com/drive/folders/0ByOkGTZBZYJzcFdMMEFvbGInd0U>
- Stove vs. Pillow    Cannonball vs. soccer ball
- [http://www.youtube.com/watch?v=AYz\\_K3mwq6A](http://www.youtube.com/watch?v=AYz_K3mwq6A)
- Amended Conclusion:

**All things fall at the same rate as long as they are not significantly affected by air resistance.**

WHAT DID WE LEARN TODAY?

# GALILEO'S EXPERIMENTS

- [Check HW](#)
- <http://www.pbs.org/wgbh/nova/physics/galileo-experiments.html>

# MORE DATA: ARISTOTLE VS GALILEO

- [http://www.youtube.com/watch?v=\\_Kv-U5tjNCY](http://www.youtube.com/watch?v=_Kv-U5tjNCY)
- At the Tower of Piza 2009
  
- <http://www.youtube.com/watch?v=GRWxNMZFB5c>
- Shoes

# ANSWER THE INQUIRY QUESTION(S)

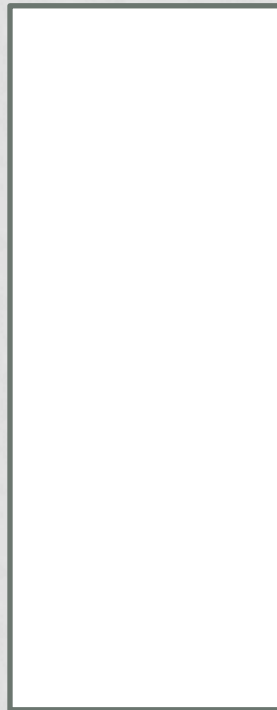


- Do you agree with Aristotle or Galileo or neither?
- Do all things fall at the same rate?
- Is this rate a constant speed or does it change?
- What factors can effect the rate at which things fall?
- Does the force of gravity pull down with equal force on all objects?

WHAT WOULD THE MOTION OF THE FALLING ORANGE LOOK LIKE IF YOU COULD TAKE STOP ACTION PICTURES AT REGULAR INTERVALS AS IT FELL?



Constant  
Speed



Acceleration



Deceleration

# FINISH CHECKING REFLECTION QUESTIONS

- QUIZ – go over

# WHAT TO DO NEXT

1. Read the exit slip questions carefully. Be sure you understand all of the answers to these questions today before you leave.
2. Are there any answers you already know?
3. With your table partner, read the highlighted text from Science Matters
4. Answer number one and two on exit slip



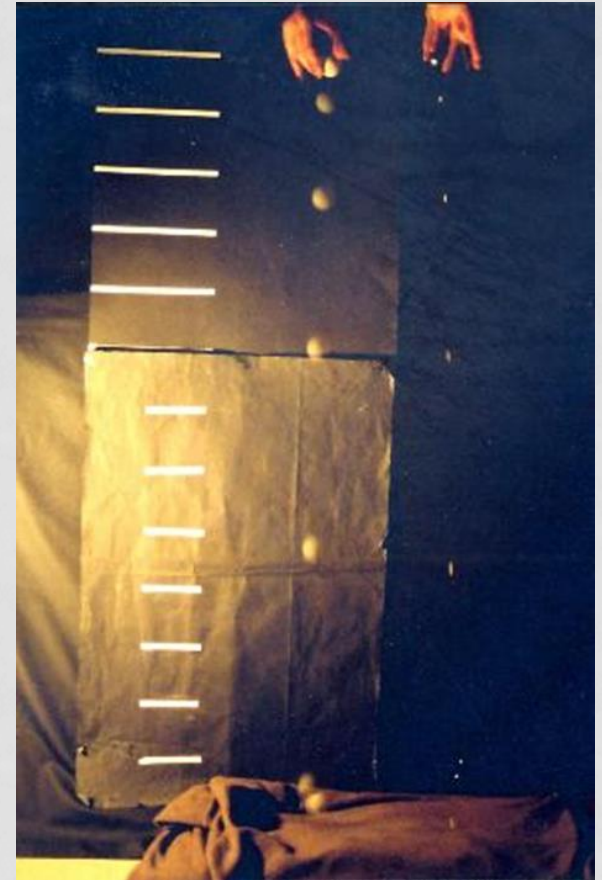
# WATCH AND TAKE NOTES

- Eureka: Gravity

<http://www.youtube.com/watch?v=W4Oq3SiVSR4&list=PL07249EFA9038FDC1&index=4>

# WHAT DOES A CONSTANT ACCELERATION DUE TO GRAVITY MEAN?

- What is the difference between speed and acceleration?
- [Eureka Acceleration Part 2 -](#)
- Constant Speed = same distance every second
- Acceleration = increasing distance every second



What will happen if you drop a feather and a hammer on the moon? Why?

- [http://www.youtube.com/watch?v=5C5\\_dOEyAfk](http://www.youtube.com/watch?v=5C5_dOEyAfk)
- Apollo 13 version  
<http://www.youtube.com/watch?v=XtvESpQipcw>



# HOW DOES GRAVITY CHANGE THE MOTION OF OBJECTS?

- Gravity is a force that constantly pulls objects towards the center of the earth, so **falling objects are constantly accelerating!**
- **The acceleration of gravity is about  $10 \text{ m/s}^2$  ( $9.81 \text{ m/s}^2$ )**



# COMPLETE FALLING OBJECTS GIZMO

# EXIT SLIP

- 1) Define the following:
  - Constant speed
  - Acceleration
- 2) What kind of motion is gravity?
- 3) If we doubled the force of gravity, what would happen to the acceleration caused by gravity?
- 4) If we went to the moon, which has  $1/6^{\text{th}}$  the mass of Earth, what would the gravitational force be?  
What is the acceleration of gravity on the moon if it is  $9.81 \text{ m/s}^2$  on the Earth?

# OPENER

- Name an object that is in orbit around the Earth right now.
- What does it mean when something is in orbit around the Earth?



# NEWTON'S GRAVITY THOUGHT EXPERIMENT

# WHAT SHAPE DO LIQUIDS TAKE IN MICROGRAVITY (IN SPACE)?

- <http://www.youtube.com/watch?v=LIFc351sCzl>
- <http://www.youtube.com/watch?v=jn5KuSHguUE>
- Vintage Footage
- <http://www.youtube.com/watch?v=RPwEmjBfY64>
- Wringing Washcloth in space
- <http://www.youtube.com/watch?v=zUla685ETgo>
- FLAMEs in microgravity
- [http://www.youtube.com/watch?v=DKxAs\\_f1SP8](http://www.youtube.com/watch?v=DKxAs_f1SP8)

# EXIT SLIP - GRAVITY

- What is gravity?
- How does gravity change the motion of objects?
- What does acceleration due to gravity mean?