

# The Mechanical Universe CURVED SPACE & BLACK HOLES 13min



This film tells the story of Einstein's General Theory of Relativity.

Read the following questions before the video begins. Answer the questions while the video is in progress. This is an **INDIVIDUAL** effort, so complete it by yourself.

**DON'T ASK OTHERS FOR ANSWERS** since doing so would be cheating.

Most of the important information (and answers to the questions on this sheet) is in the text spoken during the presentation. So don't become entranced by the visuals and imagery; concentrate and stay focused on the words!

1. The mass ( $m$ ) in  $F = ma$  is called inertial mass.

2. The masses ( $m_1$  and  $m_2$ ) in  $F = Gm_1m_2/R^2$

A. have something to do with inertia.

**B. have nothing to do with inertia.**

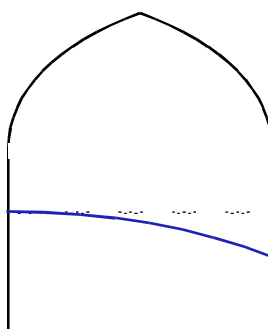
3. The law of falling bodies means both kinds of mass have to be

identical

4. Einstein's Principle of Equivalence refers to the equivalence between constant

gravity and constant acceleration.

5. What is the path of a light beam aimed horizontally across a room on Earth? Draw the beam on the diagram below (as it is shown in the video).



6. Eddington's observation of a solar eclipse in 1919

A. disproved Einstein's initial Theory of General Relativity.

B. relegated Einstein to relative obscurity for several years.

C. Both of these.

**D. None of these.**

continued...

7. The shortest path between two points on any surface (*regardless of geometry*) is a(n)

- A. straight line      B. great circle      C. elliptical arc      **D. geodesic**

8. According to Einstein, the Earth orbits the Sun

- A. by traveling inertially along a geodesic in the local space-time.**  
B. in a compromise between the Earth's inertia and the Sun's gravitational force.

9. Einstein's General Theory of Relativity

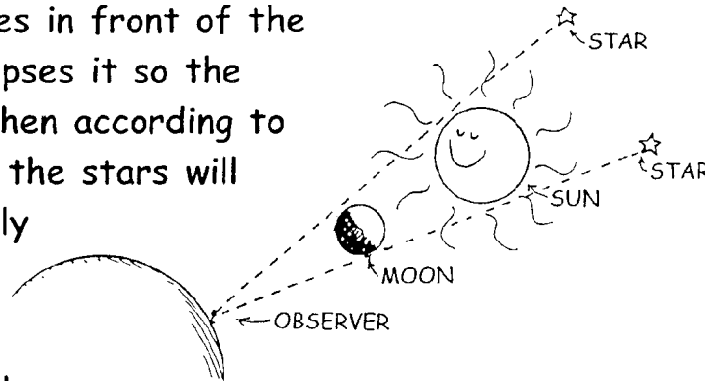
- A. expands on Newton's Universal Gravitation.  
**B. improves on Newton's Universal Gravitation.**  
**C. replaces Newton's Universal Gravitation.**  
D. does a little dance on Newton's Universal Gravitation, then uses a loud and mocking tone to alledge that Universal Gravitation's mother prefers military footwear.

10. Black holes are most likely

- A. remnants of collapsed stars**      B. left over from the Big Bang  
**C. Both of these**      D. Neither of these

## FIGURING PHYSICS

If the sun passes between the earth and a pair of stars as shown, and the moon passes in front of the sun and totally eclipses it so the stars are visible, then according to General Relativity, the stars will appear to be slightly



- a) closer together.  
**b) farther apart.**  
c) distorted, but not closer or farther apart.

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1. The mass ( $m$ ) in  $F = ma$

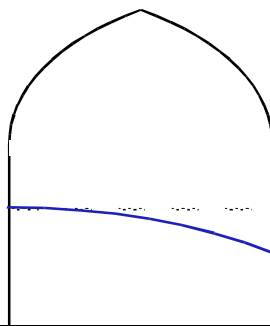
- A. has nothing to do with gravity.
- B. has something to do with gravity.

2. The masses ( $m_1$  and  $m_2$ ) in  $F = Gm_1m_2/R^2$  are called gravitational mass

3. The law of falling bodies means both kinds of mass have to be  
identical

4. Einstein's Principle of Equivalence refers to the equivalence between constant  
gravity and constant acceleration.

5. What is the path of a light beam aimed horizontally across a room on Earth? Draw the beam on the diagram below (as it is shown in the video).



6. Eddington's observation of a solar eclipse in 1919
- A. confirmed Einstein's Theory of General Relativity.
  - B. made Einstein a world-famous folk hero.
  - C. Both of these.
  - D. None of these.

continued...

7. The shortest path between two points on a sphere is a(n)  
A. straight line      **B. great circle**      C. elliptical arc      D. geodesic

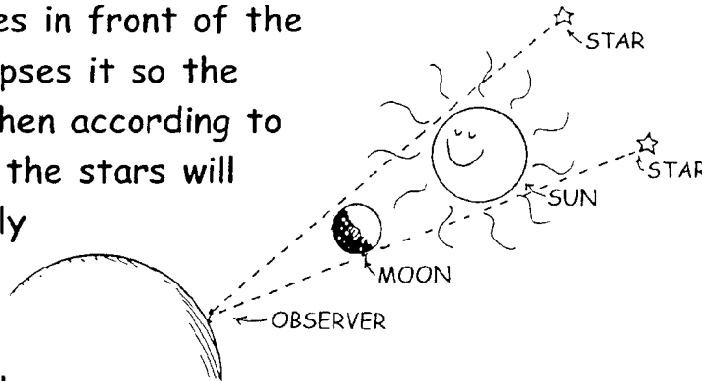
8. According to Einstein, the Earth orbits the Sun  
A. in a compromise between the Earth's inertia and the Sun's gravitational force.  
**B. by traveling inertially along a geodesic in the local space-time.**

9. Einstein's General Theory of Relativity  
A. expands on Newton's Universal Gravitation.  
**B. improves on Newton's Universal Gravitation.**  
**C. replaces Newton's Universal Gravitation.**  
D. steals Newton's Universal Gravitation's lunch money, then gives Universal Gravitation a high-tension wedgie.

10. A black hole is a place where the \_\_\_\_\_ *space-time* \_\_\_\_\_ is so warped, nothing can escape from it.

## FIGURING PHYSICS

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