Earth and Space Science

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_ Block: \_\_\_\_

Mr. Ruggiero

<http://www.pbs.org/wgbh/nova/space/invisible-universe.html>

First aired: April 22, 2015

1. Hubble is the size of a \_\_\_\_\_\_\_\_\_\_\_\_\_ travelling at \_\_\_\_\_\_\_\_\_ miles per hour.
2. The Pillars of Creation is a place where stars are \_\_\_\_\_\_\_\_\_\_\_\_\_
3. Places where stars die are called planetary \_\_\_\_\_\_\_\_\_\_\_\_\_
4. As NASA’s first Chief Astronomer, Nancy Roman is known as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. The major challenge facing Astronomers was the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This is caused by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the atmosphere
6. Edwin Hubble did most of his work in the 1920s, studying \_\_\_\_\_\_\_\_\_\_\_\_\_\_ variables to determine distance to stars in space. He discovered that there are other (planets / galaxies) in the universe. When he looked at other galaxies he saw their light being (red / blue) shifted, which meant those galaxies were moving (away from / closer to) earth. The further away they were the ( slower / faster) galaxies were moving. This is the basis of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ theory.
7. The plans were approved in 1977. Hubble’s power would come from an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ wide mirror.
8. What was wrong with the first images scientists received from the Hubble?

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1. What was wrong with the Hubble?

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1. What was the solution to the Hubble problem?

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1. Where do stars & planets come from?

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1. How many stars are there in one galaxy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Galaxies are made of \_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_.
3. How many galaxies are in the observable universe? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is a Supernova? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Observing red shift in supernova, what did Astronomers discover about the Universe’s expansion? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. What is fueling the movement of the universe? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. How old is the Universe? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. What is the center of the mystery about how galaxies form? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. How massive is black hole in galaxy M87? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. When was the last visit to Hubble? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. What did Hubble help us find on a planet 729 trillion miles from Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. When was the Space Shuttle decommissioned? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
13. What is the ultimate fate of Hubble? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
14. What new, larger telescope will replace Hubble? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Hubble is the size of a schoolbus travelling at 17,000 miles per hour.
2. The Pillars of Creation is a place where stars are born
3. Places where stars die are called planetary nebula
4. As NASA’s first Chief Astronomer, Nancy Roman is known as the \_ mother of the Hubble\_.
5. The major challenge facing Astronomers was the twinkle of the stars. This is caused by the \_\_\_\_distortion\_\_\_\_\_\_ of the atmosphere
6. Edwin Hubble did most of his work in the 1920s, studying Cepheid variables to determine distance to stars in space. He discovered that there are other (planets / galaxies) in the universe. When he looked at other galaxies he saw their light being (red / blue) shifted, which meant those galaxies were moving (away from / closer to) earth. The further away they were the ( slower / faster) galaxies were moving. This is the basis of the \_\_Big Bang or Expanding Universe\_\_\_ theory.
7. The plans were approved in 1977. Hubble’s power would come from an \_\_\_8 foot\_\_\_\_\_\_ wide mirror.
8. What was wrong with the first images scientists received from the Hubble?

Distortion in the images - blurry

1. What was wrong with the Hubble?

Mirror was creating 2 focal points – spherical aberration – mirror was polished too flat

1. What was the solution to the Hubble problem?

Putting small corrective mirrors inside the telescope “Costar” – install by using a robotic arm

1. Where do stars & planets come from? \_\_\_\_ hydrogen gas, gravity pulls the hydrogen together & form nuclear reactions – protoplanetary disks\_\_\_
2. How many stars are there in one galaxy? \_\_\_ 100 billion stars\_\_\_
3. Galaxies are made of \_\_\_\_\_\_stars\_\_\_\_\_\_\_, \_\_\_\_dust\_\_\_, and \_\_\_planets\_\_\_.
4. How many galaxies are in the observable universe? \_\_\_ 200 billion\_\_\_
5. What is a Supernova? \_\_\_ exploding star\_\_
6. Observing red shift in supernova, what did Astronomers discover about the Universe’s expansion? \_\_ it is speeding up, not slowing down – sped up 5 billion years ago\_\_
7. What is fueling the movement of the universe? \_\_\_ dark matter / dark energy \_\_
8. How old is the Universe? \_ 13.7 billion years \_\_
9. What is the center of the mystery about how galaxies form? \_ black holes \_\_
10. How massive is black hole in galaxy M87? \_3 billion times the mass of our sun\_
11. When was the last visit to Hubble? \_2009\_
12. What did Hubble help us find on a planet 729 trillion miles from Earth? \_water\_
13. When was the Space Shuttle decommissioned? \_2011\_
14. What is the ultimate fate of Hubble? \_ will fall from the sky\_
15. What new, larger telescope will replace Hubble? \_James Webb\_