

Lab #4 How Holy is a Black Hole?

Introduction

From science fiction to science fact, few space objects have incited the curiosity of humans as much as black holes. Like many concepts that become part of popular culture, especially through Hollywood movies and TV shows, black holes are often misrepresented and poorly understood. In this lab, we will learn some concepts about these fascinating stellar bodies, and dispel some of the common misconceptions around them.

To start, your preparation begins with reading these two online resources:

<http://science.nasa.gov/astrophysics/focus-areas/black-holes/>

<http://news.discovery.com/space/first-ever-black-hole-created-on-earth.htm>

Pay particular attention to the differences between real black holes and some of the experimental approaches that scientists have taken to study them. Remember, there is always a quiz.

Lab exercise (work in pairs or small groups)

In this lesson, you will explore an online module called “No Escape: The Truth about Black Holes.” Use your computer to connect to this link:

<http://amazingspace.org/resources/explorations/blackholes/lesson/index.html>

- 1) You can move your cursor over the words in the front page. Click on the question: **Is a Black Hole Really a Hole?** Follow the instructions to gain information on the features of black holes. With this information, describe briefly the following features in your own words (3 points):
 - Jets of Gas
 - Accretion Disk
 - Event Horizon

2) On the upper right corner, there will be a circle flanked by two triangles in opposite directions (arrows). Click on the right arrow to go to the next page. There will be a list of titles with titles. Click on the one that says **See a Black Hole in Action** (2 points).

Play the video and describe what you see.

3) Click on the back arrow and then click **What Types of Black Holes Are There?**
Read about the three types of black holes and describe each one in your own words (3 points):

- Stellar Black Holes:
- Supermassive Black Holes:
- Miniature Black Holes:

4) Open a new browser window by clicking on this link:
<http://amazingspace.org/resources/explorations/blackholes/lesson/whatisit/hunt.html> You will get to a page called: **Hubble Hunts Black Holes**
Describe the images that you see. What do they tell you about black holes (8 points)?

- Image 1:

- Image 2:

- Image 3:

- Image 4:

5) On the right of the page are the **Tools of the Hunt**. Using this information, describe the instruments used by the telescope and their use. Based on what you have learned in class, discuss which types of evidence were obtained using each instrument (9 points):

1.

2.

3.

6) Go back to the previous page and click on **Pathway to Discovery**:

In terms of their discoveries, what is the relation between Einstein, Schwarzschild, and Hawking (5 points)?

7) Go back and click on **What Do You Know About Black Holes?** This will open an online quiz.

a. Read the statements carefully before answering and discuss them with your partner. Then fill out your replies in the table below by marking your answer (and X or ✓ will do). Take the entire quiz and then corroborate your answers. After the table, explain what concepts you misunderstood and correct them. This is not a quiz for points but rather a way to check your own knowledge. As long as you answer the table and the following part you will get the points, regardless of how many you missed (5 points).

	Myth	Fact
The volume of a black hole is huge.		
Black holes have no mass.		
A rotating black hole may lie at the center of our galaxy.		
Gravity bends light.		
Our sun will eventually become a black hole.		
Light cannot escape from a black hole.		
Black holes will pull in everything in the universe and eventually destroy it.		
NASA sent a space probe into a black hole.		
The gravity of a black hole is felt everywhere.		
The gravity that your body creates is felt everywhere.		

b. Correct any wrong answers and explain why they were wrong in the space below.