

Death By Black Hole Reading Guide

Chapter Completion

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Questions, things to ponder, discussion points
Prologue: The Beginning of Science pg 16 What is he referring to with myopic precedence? pg 18 How was Newton wise to defer? pg 18-20 How did Einstein overtake Newton's ideas, yet, Newton's ideas are still considered ok? pg 20 What does the reference about Darwinian vs Lamarckian change mean? pg 20 What did Edwin Hubble find out? pg 20 What is dark matter, and how do we know it exists?
Pro Facts/Interesting Things-

Pro Chapter Summary-

Chapter 1: Coming to our Senses

pg 25 Which sense do we rely on the most?

pg 29 What do you know about radon gas and our basement?

During a solar eclipse, what percent of the sun must be blocked in order for us to perceive the sky as being darker?

How many giant gamma ray bursts occur in the universe each day?

1 Facts/Interesting Things-

1 Chapter Summary-

Chapter 2: On Earth as in the Heavens

Ch 2

pg 31 Directing sunlight through a prism reveals two things. What are they?

pg 32 Name an element that was discovered on the sun before it was found on earth.

pg 33-34 What are Pioneer and Voyager

pg 34 What is "bigG"?

pg 34-35 We'll never what

pg 36 Dark matter either means that there is a new form of matter, or that gravity itself needs to be "fixed". The law of gravity was last adjusted in 1916 by Albert Einstein when he published his _____ Theory of Relativity.

pg 37 cocoa and whip cream story

pg 37 "After the laws of physics, everything else is _____."

2 Facts/Interesting Things-

2 Chapter Summary-

Chapter 3: Seeing Isn't Believing

38 39 What is luminosity and how does it relate to stars?

pg 39 Why does light intensity decrease with distance away from the source?

pg 40 Why did we think stars were fixed?

pg 40 What are the wanderers? and why were they called that?
pg 41 What were arguments for a stationary Earth?
pg 45 What did we learn about Andromeda

3 Facts/Interesting Things-

3 Chapter Summary-

Chapter 4: The Information Trap

pg 48-49 How can being too close to a situation be a bad thing
pg 52-53 Is the Earth a perfect sphere? Why or why not?
pg 53 How did Kepler improve upon Copernicus' ideas?
pg 54 Consider the Earth-Moon system complexity
pg 57 Saturn's rings are composed of _____ and _____.
pg 58 Define and explain Roche Limit.

4 Facts/Interesting Things-

4 Chapter Summary-

Chapter 5: Stick-in-the-Mud Science

On any given day, when shadows are shortest, it is local _____.
On the day of an equinox, the sun rises and sets _____ each other in the sky.
When do we have the longest and shortest shadows of the year?
Define solar day, state how you measure it, and state how long it is.
Define sidereal day, and state how long it is.
Rocks at Stonehenge align with _____ and rising and setting points of the _____.
pg 60-62 Where will the sun rise and set in the winter months? summer month? spring and fall equinox?
pg 64-65 How can pendulums be used?

5 Facts/Interesting Things-

6 Chapter Summary-

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Chapter 6: Journey From the Center of the Sun

It takes light _____ years to reach the surface of the sun when starting from the core.

In the outer 25% of the sun's radius, energy moves through _____.

What drives convection currents in the sun?

6 Facts/Interesting Things-

6 Chapter Summary-

Chapter 7: Planet Parade

The Greek word "planete" means

Instead of observing canals on Mars, what has an optometrist determined that Lowell was actually seeing?

Why does the author argue that Pluto is not a planet?

State the evidence for past water on Mars.

What is meant by "habitable zone"?

How are Jupiter's moons given internal energy?

What did Galileo's "Starry Messenger" book proclaim that went against the church and current thinking of the time, and what did he use as evidence?

How have we managed to get the Pioneer and Voyager space probes to travel so far?

7 Facts/Interesting Things-

7 Chapter Summary-

Chapter 8: Vagabonds of the Solar System

The moon contains how many more times the mass than all the asteroids combined?

Describe differentiation as it applies to protoplanets.

How did the iron found in the middle of the solar system probably come to be there?

Define albedo.

What is the Oort Cloud?

pg 89-90 How do we determine the composition of asteroids?

8 Facts/Interesting Things-

8 Chapter Summary-

Chapter 9: The Five Points of Lagrange

When the Apollo 8 astronauts the third stage of their Saturn V rocket that helped them get to the moon, how fast were they moving?

The Apollo 8 spacecraft became the first manned object to leave earth orbit. What percent of the total energy needed to reach the moon was used just to get Apollo 8 up to earth orbit?

Define Lagrange Point and state how many the earth-moon system has.

What is special about the L4 and L5 spots for the earth-moon system and why do they make great spots to locate space stations?

Why would you want to start a long space trip from a Lagrangian point?

9 Facts/Interesting Things-

9 Chapter Summary-

Chapter 10: Antimatter Matters

What is the famous equation that Einstein worked with, what do the variables stand for, and what does the formula mean?

Where has antihydrogen been created on earth?

10 Facts/Interesting Things-

10 Chapter Summary-

Chapter 11: The Importance of Being Constant

In Newton's 2nd Law of Motion, $F=ma$, which term acts like a constant?
In Einstein's Special Theory of Relativity, as speed increases, what physical property also increases?
Explain the Uncertainty Principle.
pg 118 How are scientists working to learn more about constants?

11 Facts/Interesting Things-

11 Chapter Summary-

Chapter 12: Speed Limits

Describe how Ole Rømer measured the speed of light.
If the speed of light is constant, what two effects must happen as a consequence?

12 Facts/Interesting Things-

12 Chapter Summary-

Chapter 13: Going Ballistic

Name the first object to be launched above the earth's atmosphere. Who developed it and for what reason? Where did he end up?
How many planets in our solar system have a circular orbit?
Some comets, on parabolic or hyperbolic orbits, will _____ return.
When trying to solve a gravitational problem involving the sun, Jupiter, and one of Jupiter's moons, why can scientists ignore the sun?
What evidence do we have for the existence of black holes in the centers of galaxies?
What will happen to us and the Andromeda galaxy and when?

13 Facts/Interesting Things-

13 Chapter Summary-

Chapter 14: On Being Dense

If water was less dense than ice, how would that affect the living organisms in a lake that freezes?

As the mass of a black hole increases, what happens to the size of its event horizon? What happens to the black hole's density?

Compare the density of the sun to the density of earth and of water.

Why is it better to have telescopes on top of mountains?

141 What is our sun's future, and how does this relate to us?

14 Facts/Interesting Things-

14 Chapter Summary-

Chapter 15: Over the Rainbow

Describe Joseph von Fraunhofer's experiment and his findings.

Describe the work of Gustav Kirchhoff and Robert Bunsen as well as their findings.

How can we have pictures of stars that don't use visible light?

15 Facts/Interesting Things-

15 Chapter Summary-

Chapter 16: Cosmic Windows

In 1932 Karl Jansky recorded radio signals from the center of the Milky Way Galaxy. What was historic about his discovery?

What is a quasar?

Why do galaxies with a lot of gas emit a lot of radio waves?

Molecules are detected in what part of the electromagnetic spectrum?

Energy left over from the Big Bang is now ____ degrees above absolute zero.

Why are infrared (IR) observations important when trying to detect an object within the plane of the Milky Way Galaxy?

Why are space-based telescopes needed to make UV, x-ray, and gamma ray observations?

Matter spiraling around a black hole produces copious amounts of _____ and _____ radiation.

Why are neutrinos difficult to detect?

How are gravity waves produced?

16 Facts/Interesting Things-

16 Chapter Summary-

Chapter 17: Colors of the Cosmos

Stars come in three colors: _____, _____, _____. And what do those colors tell us?

Our sun has this color: _____.

Describe how a black hole can evaporate.

Astronomers use CCDs to record images and collect data. Where would you find a CCD in your home?

How can our brain misinterpret colors?

17 Facts/Interesting Things-

17 Chapter Summary-

Chapter 18: Cosmic Plasma

Give four examples of plasmas you'd find on earth.

What percent of all visible matter in the universe is plasma?

The solar wind ejects how much mass from the sun per second?

What is the corona of the sun?

pg 170 What is the blackout phase experienced by reentering NASA astronauts

pg 172 What happens with AM and FM waves and our ionosphere?

pg 174 What were the Dark Ages of astronomy and why?

18 Facts/Interesting Things-

18 Chapter Summary-

Chapter 19: Fire and Ice

pg 175 176 As soon as the universe started what started to happen to the temperature?

List the two coldest objects in the solar system.

What does temperature measure?

Why does the temperature on the moon vary so widely from the sunlit side to the dark side?

If the universe keeps expanding, what will its ultimate temperature become?

177 What are extremophiles, give examples. How does this make the search for life elsewhere in our solar system and beyond interesting?

pg 180 By measuring the volumes of gases at different temperatures Kelvin's predecessors extrapolated that the -273.15 C for what?

pg 181 What are the extremes of temperatures you can experience on the sun?

182 What is meant by the "heat death of universe?"

19 Facts/Interesting Things-

19 Chapter Summary-

Chapter 20: Dust to Dust

What did Galileo call his telescope?

Explain why the Milky Way Galaxy's distant stars look redder than similar, closer ones.

pg 186 Large molecules are called _____, although this isn't like the kind you find in your house

pg 187 How many stars are in the Milky Way?

Interstellar dust emits in the _____ and _____ portions of the spectrum.

Dust will absorb _____ and reemit the energy as IR.

Within a collapsing cloud, once the temperature reaches _____ million degrees, protons will fuse into helium nuclei.

Stars range in mass from _____ to _____ times the mass of the sun.

Explain why stars at the upper mass limit can't accept more mass.

20 Facts/Interesting Things-

20 Chapter Summary-

Chapter 21: Forged in the Stars

When a neutron within a nucleus decays, what two particles are created, and what happens to the atomic number of the element?

At the end of each stage of fusion, what happens to the size and temperature of the core?

Why does a core collapse and explode when Fe is attempting to fuse? pg 196 What happens in a supernova?

21 Facts/Interesting Things-

21 Chapter Summary-

Chapter 22: Send in the Clouds

Ninety percent of the nuclei created from the Big Bang were _____, and most of the rest was _____, and just some _____.

How does the creation of molecules within a gas cloud allow it to cool and collapse?

pg 206 With complex molecule formation comes of the possibility of what?

22 Facts/Interesting Things-

22 Chapter Summary-

Chapter 23: Goldilocks and the Three Planets

- Four billion years ago, the sun was one-third less luminous than today and the earth's temperature would have been even lower. How could liquid water have existed?
- For a planet in the habitable zone around a low mass, low luminosity star, what can one conclude about its prospects for actually harboring life? Explain.
- Explain why high mass, high luminosity stars are not well suited for supporting life on planets that may orbit them.
- How is it possible that even though Jupiter's moon Europa is outside of the sun's habitable zone, it may still have liquid water below its surface?
- What are thermophiles and how do they get their energy?

23 Facts/Interesting Things-

23 Chapter Summary-

Chapter 24: Water, water

What did the Clementine lunar orbiter possibly find evidence of in the bottom of lunar craters?

Describe one process by which the earth may have acquired its water.

Why would the earth's atmospheric pressure increase tremendously as a result of a runaway greenhouse effect?

Where else has this taken place?

Pg 218 What is interesting about Io?

24 Facts/Interesting Things-

24 Chapter Summary-

Chapter 25: Living Space

Which element is responsible for making more molecules than all the other elements combined?

The streams, rivers, and lakes on Saturn's moon Titan are all made of liquid _____.

25 Facts/Interesting Things-

25 Chapter Summary-

Chapter 26: Life in the Universe

The three most abundant, reactive elements are: _____, _____, and _____.

The top three elements found in living organisms on earth are: _____, _____, and _____.

26 Facts/Interesting Things-

26 Chapter Summary-

Chapter 27: Our Radio Bubble

Ever since the invention of radio, our radio transmissions have leaked into space and encompass an ever growing sphere. At present, that sphere is about 200 light-years across. How many stars are contained within that volume? Even if an alien civilization existed and detected our signals, why isn't it likely they could make sense of them

27 Facts/Interesting Things-

27 Chapter Summary-

Chapter 28: Chaos in the Solar System

How can launching things from Earth have an impact on our future?

28 Facts/Interesting Things-

28 Chapter Summary-

Chapter 29: Coming Attractions

- Are you more likely to be killed by an asteroid or airplane crash?
- An asteroid or comet impact may create a crater that is _____ times the diameter of the object.
- If one of these objects did survive its journey through the atmosphere, what would it most likely be made of?
- Why can we not detect incoming asteroids/comets that are smaller than one kilometer across? Why aren't we terribly concerned about objects smaller than this anyway?
- In 1994, comet Shoemaker-Levy 9 hit Jupiter with 24 separate impacts. Each impact had the energy of the _____ impact that killed the dinosaurs on earth!
- On Friday, April 13, 2029, the asteroid Apophis will fly by earth at an altitude
- pg 257 Why is matter more likely to go from mars → earth

29 Facts/Interesting Things-

29 Chapter Summary-

Chapter 30: Ends of the World

- List three events that would spell the physical end of the earth:
- The sun has how many more years of stable life left?
- List the sequence of events that happen after the sun burns He into C in its core:
- When will the Milky Way Galaxy and the Andromeda Galaxy collide?
- New stars can't be made from these 3 stellar end-points:

30 Facts/Interesting Things-

30 Chapter Summary-

Chapter 31: Galactic Engines

What is a quasar? Compared to the Milky Way, how luminous are they? Their energy comes from an area the size of _____.

What powers active galaxies?

How does the gas around a black hole allow us to detect the presence of the black hole itself?

Why will the stars being sucked into a massive black hole emit less radiation than ones being pulled into a less massive black hole?

If you observe stars near the center of a galaxy to be traveling at a high rate of speed, what can you conclude lurks in the core of that galaxy?

31 Facts/Interesting Things-

31 Chapter Summary-

Chapter 32: Knock 'Em Dead

1. What was significant about the type of rock Eugene Shoemaker discovered?
2. Why is the layer of iridium found in 65 million year old rocks a good indication that an asteroid lead to the extinction of the dinosaurs?
3. The Chicxulub Crater in the Yucatan Peninsula is _____ km wide and _____ million years old.
4. Based on the geologic record, a mass extinction has happened about every _____ million years.
5. If a supernova explosion happened within a distance of 30 light-years of earth, what would happen to us?
6. At least once a day, somewhere in the universe, a gamma ray burst releases the energy of _____ supernovas.
7. How were gamma ray bursts first detected?
8. To survive a mass extinction, it helps to be a _____, or to live on _____, or under _____, or in _____.
9. pg 279 What helps absorb our uv?

32 Facts/Interesting Things-

32 Chapter Summary-

Chapter 33: Death by Black Hole

What is the name given to the boundary around a black hole from which light cannot escape?

What defines the size of a black hole?

Describe what would happen to you if you were to fall toward a black hole.

A black hole's diameter is proportional to its _____.

Explain how you can determine if the core of a galaxy contains a black hole.

33 Facts/Interesting Things-

33 Chapter Summary-

Chapter 34: Things People Say

The Catholic Church adopted Aristotle's views of the universe. What did these views say about the state of stars and the earth's place within the universe?

How many stars can you see with your unaided eyes?

Explain why there are never exactly 12 hours of daylight and 12 hours of darkness.

34 Facts/Interesting Things-

34 Chapter Summary-

Chapter 35: Fear of Numbers

How much does a space mission cost each person living in the US?

35 Facts/Interesting Things-

35 Chapter Summary-

Chapter 36: On Being Baffled

Why is it a good thing for scientists to be baffled from time to time?

pg 304 How are the workings of our universe like an unknown chess game?

pg 307 Our universe is not only expanding, but also _____!

36 Facts/Interesting Things-

36 Chapter Summary-

Chapter 37: Footprints in the Sands of Science

Two-thirds of all stars have _____ names. Give some examples.

Why was the Vatican Observatory created?

How is the date of Easter Sunday set?

Why was the Gregorian calendar established? (we still use it today)

Because of the _____, the US was the world leader in nuclear physics for 50 years.

Why will the US no longer be the top nation in terms of nuclear research?

37 Facts/Interesting Things-

37 Chapter Summary-

Chapter 38: Let There be Dark

Why is light pollution bad for astronomy?

Why is there less and less open bandwidth in the radio and microwave portion of the spectrum? How will this affect astronomy?

One reason that the moon would be an ideal location for a telescope is because it has no atmosphere. With no atmosphere, images will not be _____, and the sky will always be dark because light cannot be _____.

38 Facts/Interesting Things-

38 Chapter Summary-

Chapter 39: Hollywood Nights

What was incorrect about the depiction of stars in the 1997 movie *Titanic*?

However, what was accurately represented in the movie about the nighttime sky on the night the ship sank?

North of the equator, the moon's illuminated surface grows from _____ to _____.

39 Facts/Interesting Things-

39 Chapter Summary-

Chapter 40: In the Beginning

Everything is governed by the laws of _____.

-Gamma ray photons with 200,000 times more energy than visible light photons can spontaneously create electron-positron pairs which in turn will annihilate and create _____.

-Gamma rays with 2,000 times more energy than this can create _____ and _____.

-To explain the early universe, we must _____ the four forces, and merge _____ mechanics and general _____.

-Describe the order in which the unified force broke into the four separate forces we observe today.

By the time the universe was one second old, _____ and _____ had stopped forming.

What was done forming by the end of two minutes?

Why did atoms not form until 380,000 years after the Big Bang?

Explain what Hawking Radiation is and its importance in the life of a black hole.

What happened before the Big Bang?

40 Facts/Interesting Things-

40 Chapter Summary-

Chapter 41: Holy Wars

-Religion relies on faith. What does science rely on?

-State two ways in which a scientist can advance our understanding of nature.

41 Facts/Interesting Things-

41 Chapter Summary-

Chapter 42: The Perimeter of Ignorance

Why did Newton invoke God in his *Principia*?

One hundred years later, what did LaPlace prove?

During a solar eclipse, what percent of the sun must be blocked in order for us to perceive the sky as being darker?

If your eyes could detect radio waves, what part of the Milky Way could you “see”?

If your eyes could detect x-rays, what type of object could you “see”?

How many giant gamma ray bursts occur in the universe each day?

42 Facts/Interesting Things-

42 Chapter Summary-