

Earth Systems - Matter and Energy in Space

Unit 2 Packet

Name _____ Period _____ Score _____ / 76

Canvas Assignments in italics and underlined

- Day 1: Light, Redshift, and *Hubble's Law Lab* (____/ 6 pts)
- Day 2: The Big Bang Theory (____/ 16 pts)
- Day 3: Energy Transfer and *What If? Energy Transfer Report* (____/ 9 pts)
- Day 4: *Solar Oven Lab*
- Day 5: The Four Fundamental Forces (____/ 9 pts)
- Day 6: The Nebular Hypothesis and Space Chemistry (____/ 15 pts)
- Day 7: Star Life Cycle (____/ 21 pts)
- Day 8: *How It's Made Report*
- Day 9: Review (separate paper. **THE REVIEW WILL BE THE NOTES YOU CAN USE ON THE TEST**)
- Day 10: *Test*
- Day 11-12: *Space Exploration Challenge (Rockets), on Term 2 grade*
- *End of Term 1*

Day 1: Light, Redshift, and Hubble's Law (___ / 6 pts)

Kickstart Question

NOTES

Link to Slides: <https://science.dbuckley.dev/slides/earth-systems/02/light-and-redshifting>

What are some things that astronomers can deduce from analyzing light (list at least 4)? (2 pts)

What are the two most abundant elements in the universe? (1 pt)

What is an absorption spectrum? (1 pt)

What is a cosmological redshift? (1 pt)

What does Hubble's Law tell us about the space between galaxies and the universe? (1 pt)

Day 2: The Big Bang Theory (___ / 16 pts)

Kickstart Question

NOTES

Video: <https://tinyurl.com/lawtheorydiff>

What is the difference between a theory and a law? (2 pts)

Videos: <https://tinyurl.com/bigbangkurzg> (if time); <https://tinyurl.com/profdavebigbang>

Background: Cosmology is the study of the origin and development of the universe. The Big Bang Theory is an explanation for the origin of the universe based on evidence.

How long ago was the Big Bang? (1 pt)

What two assumptions form the *cosmological principle*? (2 pts)

What was Hubble's evidence that the universe is expanding? (1 pt)

Describe how the cosmic microwave background radiation (CMB) is evidence of the big bang theory. (1 pt)

How does the Big Bang Theory predict the amount of Hydrogen and Helium in our universe? (1 pt)

How do particle accelerators demonstrate events that would have happened in the Big Bang? (1 pt)

RESEARCH AND RESPOND

While the Big Bang Theory is the most widely accepted theory for how the universe began, the jury is still out on how the universe will end. Some theories that have gained traction include:

- Big Crunch
- Big Freeze
- Big Rip
- Big Bounce

First, do a little research about each theory. After evaluating each, pick one and answer the questions below for ONE of the theories.

What theory did you choose? **(1 pt)**

What is the evidence for this theory? **(2 pts)**

What is the speculation or uncertainties associated with this theory? **(2 pts)**

What are your personal thoughts about the theory and why it could be how the universe ends? **(2 pts)**

Day 3: Energy Transfer (___ / 9 pts)

Kickstart Question

NOTES

From <https://tinyurl.com/eiaenergy1> (reading)

Fill out the table (5 pts)

List 4 types of Potential Energy	List 5 types of Kinetic Energy

From <https://tinyurl.com/eiaenergy2> (reading)

What is the conservation of energy? (1 pt)

What is energy efficiency? (1 pt)

From <https://tinyurl.com/punkinchunk> (video)

Punkin Chunk Video: Circle one of the types of chunkers: (air cannon, trebuchet, torsion catapult), What are the energy transfers happening? Where is energy lost and not efficiently transferred? (2 pts)

Day 5: The Four Fundamental Forces (___ / 9 pts)

Kickstart Question

SLIDES

Link to Slides: <https://science.dbuckley.dev/slides/earth-systems/02/four-fundamental-forces>

Fundamental Force Particles

Force	Particles Experiencing	Force Carrier Particle	Range	Relative Strength*
Gravity acts between objects with mass	all particles with mass	graviton (not yet observed)	infinity	much weaker ↓ much stronger
Weak Force governs particle decay	quarks and leptons	W^+ , W^- , Z^0 (W and Z)	short range	
Electromagnetism acts between electrically charged particles	electrically charged	γ (photon)	infinity	
Strong Force** binds quarks together	quarks and gluons	g (gluon)	short range	

RAPID FIRE SIMULATIONS

Strong Nuclear Force (1 pt)

PhET Nuclear Fission: <https://phet.colorado.edu/en/simulations/nuclear-fission>

1. Nuclear fission is the process of overcoming the strong force to split nuclei. Describe the circumstances under which nuclear fission occurs in this simulation.

Weak Nuclear Force (1 pt)

PhET Build A Nucleus: <https://phet.colorado.edu/en/simulations/build-a-nucleus>

2. The weak nuclear force causes beta decay by transforming a neutron into a proton, electron and antineutrino. Describe the circumstances under which beta decay occurs in this simulation.

Electromagnetic Force (2 pts)

PhET Charges and Fields: <https://phet.colorado.edu/en/simulations/charges-and-fields>

3. How do electric fields affect charged particles?

PhET Faraday's Law: <https://phet.colorado.edu/en/simulations/faradays-law>

4. Move the magnet around along the wires and coils. What's the relationship between magnetism and electric current?

Gravitational Force (1 pt)

PhET Gravity Force Lab Basics: <https://phet.colorado.edu/en/simulations/gravity-force-lab-basics>

5. Are the forces equal and opposite even when the masses are very different? Are you exerting a gravitational force on the Earth?

Summary (4 pts)

6. (research on computer if needed) Where do we see the four fundamental forces (gravity, electromagnetism, strong force, weak force; 1 pt each) on Earth and in Space? Give specific examples.

Day 6: The Nebular Hypothesis & Matter (___ / 15 pts)

Kickstart Question

NOTES

Slides: <https://science.dbuckley.dev/slides/earth-systems/02/nebular-hypothesis>

How does the nebular hypothesis (n.h.) explain the formation of our solar system? **(1 pt)**

How does the n.h. explain the disk-like nature of a solar system and a galaxy? **(1 pt)**

How does the n.h. explain the arrangement of planets? **(1 pt)**

Definitions

Nebula **(1 pt)**

Accretion Disk (1 pt)

Protostar (1 pt)

Protoplanet (1 pt)

How are the elements distributed in the solar system? (1 pt)

THE SOLAR SYSTEM AND THE PERIODIC TABLE

Use this resource to answer the questions below: <https://tinyurl.com/periodicsolar>

What are common elements in the sun? (1 pt)

What are common elements in the terrestrial (rocky) planets? **(1 pt)**

What are common elements in the jovian (gas) planets? **(1 pt)**

Why are the elements arranged this way in our solar system? **(1 pt)**

What is the most common element in the solar system? Consider the size of the sun and planets relative to each other. **(1 pt)**

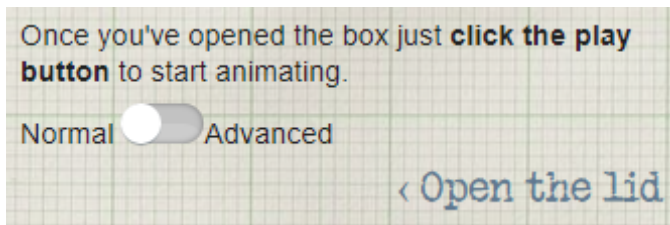
Pick one of the objects and read the page after the graphic about it. Describe in more detail the chemical composition of the object and how scientists were able to come to these conclusions about the composition.

Day 7: Star Life Cycle (____ / 21 pts)

Kickstart Question

STAR IN A BOX

Visit <https://starinabox.lco.global>. Select “Normal” and then “Open the Lid.”



Complete the table. (3 pts)

Mass (<i>measured in solar masses</i>)	Stages (<i>e.g. Main Sequence, Red Giant, White Dwarf</i>)	Does it supernova? (<i>Y or N</i>)

True or False; circle the right answer. (2 pts)

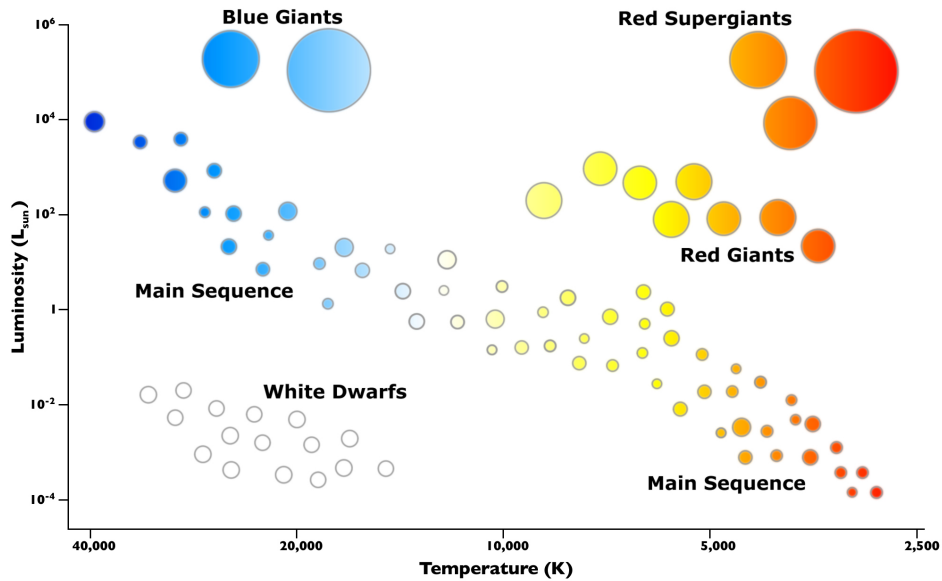
True / False - Red stars are the hottest stars.

True / False - All stars that supernova end as black holes.

Hertzsprung-Russell Diagram (HR Diagram)

Used for star classification. You can tell the luminosity, temperature, size, and age of a star by its position on the HR Diagram.

About 90% of stars are in the main sequence.



NOTES

Video: <https://tinyurl.com/profdavestar>

Concepts: Where did the elements beyond hydrogen and helium come from? What is the lifecycle of stars?

Describe the life of Low Mass Stars (like our Sun). (1 pt)

Describe the life of High Mass Stars (greater than 8 solar masses). (1 pt)

How are elements heavier than Iron created? **(1 pt)**

Describe the properties of white dwarfs and how they are created. **(1 pt)**

Describe the properties of neutron stars and how they are created. **(1 pt)**

Describe the properties of black holes and how they are created. **(1 pt)**

YOU'RE A STAR! INTRODUCE YOURSELF (10 pts)

Remember introducing yourself in kindergarten? We're doing the same thing, but for stars! (Some questions modified from your kindergarten days).



Figure 1: I'm A Star!!

My name is .

I am years old.

I am solar masses big.

My temperature is Kelvin.

My luminosity is solar luminosities.

I am in class.

(what is the spectral classification of the star?)

I live in and I am
light years away from the Sun.

(what constellation is the star a part of or near?)

My favorite foods are .

(what is the chemistry of the star?)

Self portrait: