# Unit 2 Study Guide

This document identifies the terms, concepts, and skills that we invite you to master as part of your learning for this unit. It also includes a description of the test.

## List of Terms & Concepts

The list below provides the terms and concepts that we invite you to learn, organized by topic #. The space to the right allows you to define/describe each term/concept.

| **#** | **Term/Concept/Skill** | **Definition/Description** |
| --- | --- | --- |
| 2.6 | Planet (rocky, gaseous, or icy) |  |
| 2.6 | Planetesimal |  |
| 2.6 | Solar/planetary system |  |
| 2.6 | Star |  |
| 2.6 | Normal star |  |
| 2.6 | Giant star |  |
| 2.6 | Mini star |  |
| 2.6 | Nebula(ae) |  |
| 2.6 | Galaxy |  |
| 2.6 | Spiral galaxy |  |
| 2.6 | Elliptical galaxy |  |
| 2.6 | Irregular galaxy |  |
| 2.6 | Galaxy cluster |  |
| 2.6 | Galactic Void |  |
| 2.6 | Universe |  |
| 2.7 | When humanity observes light from an astronomical object such as a star or galaxy, what does the distance to the object indicate about the age of the light? | |
| 2.7 | Wavelength |  |
| 2.7 | Amplitude |  |
| 2.7 | Spectrum |  |
| 2.7 | Continuous Spectrum |  |
| 2.7 | Emission Spectrum |  |
| 2.7 | Absorption Spectrum |  |
| 2.7 | Color of a star |  |
| 2.7 | Brightness of a star |  |
| 2.7 | Doppler Effect |  |
| 2.7 | Redshift |  |
| 2.7 | Blueshift |  |
| 2.8 | Nebula(ae) |  |
| 2.8 | Nuclear fusion |  |
| 2.8 | Stable isotope |  |
| 2.8 | Radioactive isotopes |  |
| 2.8 | Half-life |  |
| 2.8 | Where do most heavy elements form? | |
| 2.9 | White Dwarf star |  |
| 2.9 | Neutron star |  |
| 2.9 | Black hole |  |
| 2.9 | Life cycle of stars (general) |  |
| 2.9 | What states and transitions comprise the life cycle of low-mass stars (<8 times the Sun’s mass)? | |
| 2.9 | What states and transitions comprise the life cycle of high-mass stars (8-20 times the Sun’s mass)? | |
| 2.9 | What states and transitions comprise the life cycle of high-mass stars (>20 times the Sun’s mass)? | |
| 2.9 | What types of materials combine to form planetesimals and planets? | |
| 2.9 | Is the matter in our solar systems uniformly distributed (diffuse) or clumpy (concentrated)? If clumpy, describe what produces the pattern. | |
| 2.9 | Are the materials that comprise planetesimals and planets in our solar system (rock, metal, ice, gas) uniformly distributed or do they display a pattern? If patterned, describe the pattern and explain what produces the pattern. | |
| 2.9 | Do planetary bodies in our solar system orbit the sun randomly or in approximately the same direction? If they orbit in about the same direction/plane, describe the pattern and explain why. | |
| 2.9 | Do the planets in our solar system spin randomly or in about the same direction? If they rotate approximately uniformly, describe the pattern and explain why. | |
| 2.9 | Do the ages of the oldest samples from planetary bodies in our solar system form a pattern? If they form a pattern, describe the pattern and explain why. | |
| 2.9 | Accretion |  |
| 2.9 | Proplyd |  |
| 2.10 | Galaxy |  |
| 2.10 | Spiral galaxy |  |
| 2.10 | Elliptical galaxy |  |
| 2.10 | Irregular galaxy |  |
| 2.10 | Galaxy cluster |  |
| 2.10 | Galactic Void |  |
| 2.10 | Universe |  |
| 2.10 | Is matter in the Universe uniformly distributed (diffuse) or clumpy (concentrated)? If clumpy, describe what produces the pattern. | |
| 2.10 | Are galaxies uniformly distributed (diffuse) in the Universe, or do they form a pattern? If patterned, describe the pattern. | |
| 2.10 | Do the objects in spiral galaxies orbit randomly or in a pattern(s)? If orbits follow a pattern, explain why. | |
| 2.10 | Do the ages of galaxies and the oldest stars form a pattern? If they form a pattern, describe the pattern and explain why. | |
| 2.10 | Have the characteristics of galaxies such as size, composition, complexity, & galaxy type always been about as they are today, or have they changed through time? If they’ve changed, explain the pattern(s). | |
| 2.11 | How did Western Civilization perceive the Universe before Copernicus? | |
| 2.11 | How did Western Civilization perceive the Universe between Copernicus and Newton? | |
| 2.11 | How did Western Civilization perceive the Universe between Newton and Hubble? | |
| 2.11 | How does humanity currently perceive the Universe today? | |
| 2.11 | Hubble’s Law |  |
| 2.12 | Cosmic microwave background |  |
| 2.12 | Dark Matter |  |
| 2.12 | Dark Energy |  |

## List of Skills

The list below describes the skills that we invite you to develop, organized by topic #.

| **#** | **Skill** | **Description** |
| --- | --- | --- |
| 2.6 | Scale of the solar system & galaxy | Given the scale model of the Solar System discussed in class (based on the Sun as a 12” ball), provide the relative sizes of and distances from the Sun of Earth and Jupiter, a typical relative distance between stars near the Sun, and the relative diameter of our galaxy (the Milky Way). |
| 2.6 | Scale of the Universe | Given the scale model of our galaxy discussed in class (the Milky way as a DVD), identify the relative distance to the Andromeda galaxy, relative diameters of the largest and smallest galaxies, the size of the Universe, and the distribution of galaxies in the Universe (e.g., spread out? clumped in one spot? …). |
| 2.7 | Determining stellar temperatures | Given the color of two (or more) stars, determine their relative temperatures—and vice-versa |
| 2.7 | Determining stellar distance | Given the true and observed brightness of two (or more) stars, determine their relative distances—and vice-versa. |
| 2.7 | Determining stellar distance | Given the apparent shift in position (parallax) of two (or more) stars, determine their relative distances—and vice-versa. |
| 2.7 | Determining stellar composition | Given the emission spectrum of an element(s) and the absorption spectrum of a star, determine whether the star contains the element(s). |
| 2.7 | Determining stellar motion | Given spectra for the Sun and sun-like stars, determine the motion of the sun-like stars relative to the Sun (e.g., moving towards or away from the Sun; and fastest, …, slowest). |
| 2.8 | Stellar change | Given a change in the rate of fusion, predict how the temperature and diameter of a star will evolve—and vice-versa. |
| 2.8 | Star formation | Given the starting state of a nebula—with or without net rotation, describe what will form when the cloud collapses. |
| 2.9 | Gravitational collapse and the start of fusion | Describe how gravity produces nuclear fusion and gives birth to normal stars. |
| 2.9 | Demise of stars | When fusion stops, predict how the temperature and diameter of a star will evolve. |
| 2.9 | Analyzing order in stars | Given a persistent state of a star (e.g., normal star, giant star), identify the aspects of the star that correspond to the elements of the complexity template. |
| 2.9 | Analyzing stellar transitions | Given a transition between the persistent states of a star (e.g., end/restart-fusion transition between a normal and a giant star; star-demise transition between a giant star and the remnants of a star) and using these terms—temperature, diameter, fusion, & gravity—describe what happens during the transition. |
| 2.10 | Analyzing order in the solar system | Given an ordered aspect of the solar system discussed in class, use appropriate terms (e.g., orbit, gravity, temperature, rock, metal, ice, gas, accretion, planet, planetesimals, planetary body) to describe how that order emerged (i.e., what natural processes produced that order). |
| 2.10 | Origin of the solar system | Using appropriate terms (e.g., nebula, orbit, gravity, temperature, gas, dust, rock, metal, ice, accretion, proplyd, planet, planetesimals, planetary body), describe how our planetary/solar system formed. |
| 2.11 | Analyzing order in galaxies | Given a galaxy type (i.e., spiral, elliptical, or irregular), describe the nature of its ordered pattern and how gravity and motion produce that order. Also, identify whether the galaxy type is a persistent state or a transition between persistent states; support your answer. |
| 2.12 | Implications of Hubble’s law | Describe whether Hubble’s Law implies that galaxies are moving through the Universe or that the Universe is expanding and was once infinitely small; in other words, are galaxies moving like shrapnel from an exploding grenade through pre-existing space or is space-time expanding between (and in) galaxies. |
| 2.12 | Geometry of the Universe | Describe whether the Universe has a center and an edge, or not. |
| 2.13 | Big Bang Theory predictions | Describe three predictions of Big Bang theory (e.g., an expanding, cooling, complexifying Universe; CMB; etc.) and identify if they have been observed. |
| 2.13 | Subject of Big Bang Theory | Concisely describe whether Big Bang Theory seeks to explain the origin or the development of the Universe. Support your answer. |
| 2.14 | Confidence in Big Bang Theory | Given the predictions of Big Bang Theory that have been observed, describe the level of confidence that humanity should have in the Big Bang theory. |
| 2.14 | Nature of galactic/universal order | Describe the nature (i.e., what the order is) and origin (i.e., why the order exists) of order in the Universe, e.g., ordered distribution of matter, Cosmic Microwave Background radiation, ordered nature of galaxies, ordered ages of stars and galaxies, ordered development of galaxies. |

## Description of the Test

This test consists of ~40 questions and is worth ~130 points. As always, we encourage you to learn the material throughout the unit, rather than cramming for the test; but the choice is yours. The test consists of:

* ~16 questions identical to those asked in pre-class quizzes (i.e., matching questions about terms & their definitions or T/F questions about concepts). These questions are worth 2 points each. The terms & concepts you will be tested on are listed above. Definitions and concepts are from readings & class.
* ~18 concept/skill-application questions worth 3 points each. These are multiple select—T/F questions similar to those from in-class quizzes and focus on applying the terms, concepts, and skills listed above Answering these questions requires that you understand how to use the concepts & skills (and their interrelationships) from this unit. The Concept Mastery tools for this unit (located in iLearn) contain all the in-class quiz question (which illustrate how the concepts you must master are tested); as such, they are useful study aids.
* 2 short-answer (i.e., short essay) analysis question worth 10 points. This question comes from the skills listed in the study guide, requires deep understanding of the system in question, and focuses on the origin of a system (e.g., “describe how our solar/system formed”), nature of a persistently-ordered state (e.g., a ‘normal star’), and/or nature of a transition between persistently-ordered states (e.g., from ‘giant star’ to ‘mini star’). The question typically provides a list of terms/concepts that students should use in their description/analysis (e.g., “use the terms gravity, fusion, temperature, nebula, normal star, … in your description”). ‘A’ answers will be correct & complete (9 points) and well-organized & grammatically/stylistically correct (1 points).
* 1 short-answer, exploration question worth 5 points. This question asks you to describe your perspective on an issue relating to discovered and revealed truth. ‘A’ answers will correctly describe each type of truth (4 points), clearly articulate what you believe about each type of truth—including examples or other details (0.5 point), and will be well-organized and use good grammar & style (0.5 point). The question on this test reads something like this:

Describe your perspective on how Gods create/created order in the Universe (e.g., formation of stars, planetary systems, galaxies, and the large scale structure of the Universe; origin of persistent states in stars and galaxies—and the transitions between them). Support your position using God’s words and His works.