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| **Lesson Plan for Grades:** 10+**Length of Lesson:** 90 min |
| **Authored by:** UT Environmental Science Institute**Date created:** 2/12/2024 |
| **Subject area/course:*** Astronomy
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| **Materials:*** Student devices (with internet connection)
* Post-It Notes
* Universe Builders Card Sort
* Slide Deck
* “Look Back” Work Sheet (physical or digital copy)
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| **TEKS/SEs:****§112.33. Astronomy**(10) Science concepts. The student knows how astronomical tools collect and record information about celestial objects. The student is expected to:* (C) analyze the importance and limitations of optical, infrared, and radio telescopes, gravitational wave detectors, and other ground‐based technology; and
* (D) analyze the importance and limitations of space telescopes in the collection of astronomical data across the electromagnetic spectrum.

(15) Science concepts. The student knows the scientific theories of cosmology. The student is expected to:* A) describe and evaluate the historical development of evidence supporting the Big Bang Theory;
* D) describe the current scientific understanding of the evolution of the universe, including estimates for the age of the universe;
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| **Lesson objective(s):*** Student will be able to...
	+ Students will be able to describe the Big Bang theory as the prevailing theory for the origin of the universe.
	+ Students will understand how galaxies form and evolve.
	+ Students will explain the concept of "looking back in time" through telescopes.
	+ Students will analyze data to explore limitations of current technology in observing the universe.
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| **Differentiation strategies to meet diverse learner needs:*** The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.
* ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.
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| **ENGAGEMENT (15 minutes)*** During this portion, the instructor will begin by asking students: “What do you think the universe looked like at its very beginning?”
	+ Have students write their responses down on a post-it note and collect each student’s note by having them post it somewhere in the room. Together, create a class idea of what the early universe looked like.
* Hold a discussion of student responses and introduce the concept of the Big Bang and a hot dense soup of particles that existed then via the slide deck.
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| **EXPLORATION (20 minutes)*** Distribute the universe builders card sort. There should be two bundles of six cards each for every group of students containing the name/image depicting a phase of universal development, and a description.
* Challenge students to match the names and image with the correct descriptions and to place the phases in order: cosmic inflation, the big bang, the dark ages, the first stars, galaxies, and present day/future.
	+ If students are done early....
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| **EXPLANATION (20 minutes)*** Bring the class back together. Have each group be responsible for placing one phase in correct sequence for the class.
	+ Students should explain how they arrived at this answer for that stage, why they think they are correct, and how their phase developed from the stage that came before.
* Present the further explanation of galaxy formation and facilitate the discussion of how galaxies are like cities in that they tell us a lot about how the “area” (the universe) has developed.
* Higher-Order Thinking Questions:
	+ How did the conditions from one phase of the universe’s development create the necessary conditions for the next phase? (example, how did cosmic inflation set up for the big bang?)
	+ Given the current state of the universe, where are we headed? What potential future phases might be in store? What evidence would we need to look for to confirm or disprove these theories?
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| **ELABORATION (35 minutes)*** Using the slide deck:
	+ Introduce the concept of telescopes as time machines due to the finite speed of light. Explain that when we look at distant objects, particularly galaxies, we are seeing them as they were in the past because the light takes time to reach us .
	+ Explain the purpose of the James Webb Space telescope—to see further “back in time” than ever before, to the Dark Ages of the universe when the first stars and galaxies were forming:
		- Play the clip from Dr. Casey’s talk (<https://www.youtube.com/watch?v=jsqu6qduw7U> ) in which she discusses and explains why the JWST was created and what it’s being used to study.
	+ Distribute the “look-back” work sheet, which expands on the idea of looking back on different objects in our universe. Students can complete this sheet in groups or individually and should be allowed access to devices that can connect to the internet or textbooks/articles that have information on different cosmic objects including their distance from the earth.
		- Follow with a discussion:
			* Was there anything that surprised anyone during the activity?
			* What was the furthest object that was researched?
			* How far away is the oldest observable object in the known universe to us?
	+ As a class, show students images of the “little red dots” – extremely bright galaxies formed shortly after the Big Bang. Using the skills students exercised on the worksheet, hold a discussion about what the students think the “little red dots” are, and how they came to be.
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| **EVALUATION (throughout entire lesson)*** Post-it, class discussion, card sorts
* Instructors may also collect the “look back” handout from students.
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| **SOURCES AND RESOURCES*** **Dr. Caitlin Casey’s *Hot Science – Cool Talks #129,* “Breaking the Universe: Discoveries from the Beginning of Time”,** <https://www.esi.utexas.edu/talk/discoveries-from-jwst/>
* [Slide Deck](file:///C%3A%5CUsers%5CNewt%5CDownloads%5CAstronomyLPFinalPres.pptx)
* [Universe Builders Card Sort](file:///C%3A%5CUsers%5CNewt%5CDownloads%5CUniverse%20Builders%20Final.pdf)
* [“Look Back” Hand Out](file:///C%3A%5CUsers%5CNewt%5CDownloads%5CJourney_Through_Time-4.pdf)
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Additional resources

* <https://www.seattleschools.org/wp-content/uploads/2022/03/AVID_Instructional_Strats.pdf>