Educator Guide for the James Webb Telescope Challenge

Overview

This guide provides a detailed lesson plan and instructional steps for teachers and students to use the JWST Minecraft Education Map. It incorporates Universal Design for Learning (UDL) principles and aligns with relevant learning standards from the NGSS (USA), UK, Canada, and Australia (NSW).

Have you ever gazed up at the night sky and wondered what secrets the universe holds? Now you can introduce your students to the wonders of space with the new James Webb Space Telescope Challenge. Developed in collaboration with NASA and aligned with global science curricula for ages 8-14, this immersive lesson offers a hands-on journey through space exploration. Students will learn about the telescope's mission, star formation, planets, galaxies, and exoplanets, as well as participate in a creative solar system-building challenge.

As students embark on their cosmic adventure, they will tackle **essential questions** that drive real astronomers:

- What exactly is the James Webb Space Telescope, and what can it do?
- How do stars and planets differ?
- And how can we model the vast structures of our universe?

Learning Objectives

1. Students will develop and use models to explain the function of the James Webb Space Telescope and its role in gathering data about the universe.
2. Students will analyze and interpret data about the solar system to identify patterns and differences in the characteristics of stars and planets, including size, composition, and temperature.
3. Students will design and build models of solar systems in Minecraft, demonstrating the relationships between planets, orbits, and their central star.
4. Students will investigate the structure and function of galaxies and celestial objects, such as black holes, and explain how their properties influence their behavior and interactions.
5. Students will design exoplanets and simulate star formation to explain the cause-and-effect relationships between planetary characteristics, stellar evolution, and the potential for life.

Materials

- Minecraft Education Edition
- JWST Minecraft Education Map
- Computers or tablets with Minecraft Education Edition installed
- Research resources on exoplanets, star formation, galaxy types, and astrophysical phenomena
  - NASA JWST Website
  - European Space Agency - JWST

Duration

Total: 2 hours
- Introduction and Tutorial: 15 minutes
- Learning Module: 30 minutes
- Build Challenge: 1 hour
- Extension Activities: 15 minutes

Step-by-Step Instructions

1. Starting the Game

- Launch Minecraft Education Edition.
- Load the JWST Minecraft Education Map.
- Follow the on-screen prompts to begin the tutorial.

2. Navigating the Intro

- Interact with NPC Dr. Ceres to get an introduction to the JWST Build Challenge.
- Choose whether to complete the Minecraft tutorial if you are new to the game or skip if you are experienced.

3. Exploring the rooms in the James Webb Telescope

- Solar System Room:

- Interact with the solar system diorama:
  - Approach the diorama and right-click (or press the action button) to learn about different planets and stars.
  - Stars and Star Size: Read about different classes of stars (O, B, A, F, G, K, M) and their characteristics.
  - Planet Sizes and Types: Understand the differences between dwarf planets, terrestrial planets, gas giants, and ice giants.
  - Planet Colors and Rotation: Learn why planets have different colors and how their rotation speeds vary.
  - Exoplanets: Discover the significance of exoplanets and what the JWST can learn about them.
- Use the camera to take screenshots of the diorama and important information.
- Write notes using the book and quill for future reference.

- Star Formation and Types:

- Learn about various star classes: Approach each star model or information board and interact with them to learn about O, B, A, F, G, K, and M class stars.

- Use interactive buttons to cycle through star information and get details on examples of each star type, such as Zeta Ophiuchi (O class) and Procyon (F class).

- Planet Characteristics:

- Interact with planet displays: Approach models or information boards that describe planet sizes, compositions, and colors.
  - Planet Sizes: Learn about dwarf planets, terrestrial planets, gas giants, and ice giants.
  - Planet Types: Understand the compositions of different planets, including rocky and gas planets.
  - Planet Colors: Explore why planets like Mars are red or why Uranus appears cyan.
  - Planet Rotation: Understand how different planets rotate and the concept of tidal locking.

- Galaxy Room:

- Interact with NPC Dr. Ceres:
  - Learn about the Milky Way and other galaxies.
  - Explore the information on several types of galaxies and celestial objects within them, such as black holes and nebulae.

4. Participating in the Build Challenge

Starting the Challenge:

- Speak to Dr. Ceres to begin the build challenge.
- Decide the central object of your solar system (star or black hole).

Creating Orbit Rings:

- Choose the number of orbit rings and their contents (planets, asteroid belts).
- Use buttons to add planets or asteroid belts to each orbit ring.

Building Planets:

- Customize each planet by selecting its size, type (terrestrial, coreless, gas), color, rotation speed, and number of rings.
- Use the interactive menus to make your selections.

5. Extending the Build Challenge

- Design Exoplanets: Create exoplanets with unique atmospheres, terrains, and life forms.
- Simulate Star Formation: Visualize and build stages of star formation from nebulae to mature stars.
- Build Galaxies: Design spiral, elliptical, and irregular galaxies.
- Create Alien Ecosystems: Design ecosystems on your exoplanets imagining how life might evolve.
- Model Astrophysical Phenomena: Build models of black holes, neutron stars, and supernovae.
- Design Scientific Missions: Create missions with spacecraft or rovers to explore your new solar systems.
- Develop Interactive Storylines: Create storylines with tasks or challenges to gather data about your planets and stars.

6. Documenting Progress

- Use the camera to take screenshots of your builds and progress.
- Record observations and findings using the book and quill.

7. Presenting and Sharing

- Present your completed solar systems and extended builds to the class.
- Explain the scientific concepts and creative decisions behind your designs.

App Smashing Examples

PowerPoint:

- Export images from Minecraft using the camera feature.
- Insert the images into a PowerPoint presentation. Use PowerPoint's 3D model feature to demonstrate your builds in a dynamic and interactive way.
- Add text and annotations to explain the scientific concepts and creative decisions behind your designs.

Padlet: Create a collaborative board where students can post images and notes from their Minecraft builds and provide feedback on each other's work.

Learning Standards

Australia (NSW) Curriculum for Stages 2-4

- Stage 2 Science (Earth and Space): Investigate the observable properties of stars and planets and how they are related to their distances.
- Stage 4 Science: Investigate the structure and features of the universe, including the solar system.

Canada Curriculum (Ontario) for Grades 3-8

- Grade 6 Science (Earth and Space Systems): Describe the physical characteristics of components of the solar system.
- Grade 8 Science (Earth and Space): Analyze the characteristics and properties of celestial objects visible in the night sky.

NGSS (USA) for Grades 3-8

- 3-PS2-4: Define a simple design problem that can be solved by applying scientific ideas about magnets.
- 5-ESS1-1: Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
- MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

- MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

UK Curriculum for Key Stages 2 and 3

- KS2 Science: Understand the movement of the Earth and other planets relative to the Sun in the solar system.
- KS3 Science: Understand the structure and evolution of the universe, including galaxies, stars, and the solar system.