3D Models of Minerals and More!

INTRODUCTION

Mineral ores like chromite and magnesite are used to produce the critical minerals chromium and magnesium. Chromium is key for producing stainless steel and magnesium is essential for structural parts of automobiles and electronics. Learn more about these minerals by exploring three-dimensional (3D) models. With 3D scans of actual mineral-containing samples, you can manipulate samples on-screen, carefully observing their properties. With an augmented reality program like a MERGE cube, you can hold a projected sample in your hand as you observe its properties. Start your journey exploring Minerals and More in 3D!

MATERIALS

- Computer, tablet, or phone with Internet access and a camera
- Paper MERGE Cube
    - scissors
    - glue or tape
    - paper or cardstock
    - printed MERGE Cube template

PROCEDURE

Part 1 – Exploring Minerals with Sketchfab

1. According to the United States Geological Survey (USGS), critical minerals are essential for manufacturing products and without them, there could be serious economic or national security consequences for the U.S. The USGS releases a list of critical minerals, with the most recent being from 2025.
    a. Explore the list from the USGS (https://bit.ly/4xi05Cj)
    b. Do you recognize any of these critical minerals? Click on the name of a mineral to learn more about it.

2. Now read about chromium by clicking its name on the USGS list of critical minerals. As you read, note that a **feedstock** is a raw material used to make other products. What mineral is chromium recovered from?

3. Many geoscientists use 3D imaging to create 3D models of minerals. These interactive models can be published on Sketchfab to freely share with others. This allows researchers to study many different samples from all over the world in many different locations.
    a. The Alexandru Ioan Cuza University (UAIC) in Iași, Romania has put together a large 3D collection of rock and mineral specimens from its Museum of Mineralogy and Petrography. To search for a critical mineral in this collection, go to Sketchfab (http://sketchfab.com/), and in the Search box at the top of the page, enter the name of the mineral followed by Museum of Mineralogy and Petrography.
    b. Try entering "chromite Museum of Mineralogy and Petrography", and you should see 27 models.
    c. Click on a couple of the models to explore them. Zoom in and out. Move them in all directions. Clicking on the "?" lets you reset the camera view. Carefully observe each model. How do they look similar and different?

4. Be sure to investigate these two chromite 3D models and read the description associated with each one.
    a. Specimen 1: Black nodular Chromite (https://bit.ly/Sketchfab-nodular-chromite)
    b. Specimen 2: Chromite with Uvarovite (https://bit.ly/Sketchfab-chromite-uvarovite)

ANALYSIS FOR PART 1

1. As you interact with each of the two chromite-containing specimens above, write at least three observations about each one.
    a. You might describe the colors you see, the shape that the chromite within the specimen takes, the texture of the specimen, the luster of the specimen, how it might break (Would it cleave into sheets or fracture into pieces?), or something else you noticed.
    b. Which properties are easiest to observe using these models?
    c. What else might you want to know about the specimens?
2. How is each specimen similar to something you are already familiar with?
3. Where did each specimen come from? Why do you think it is important to know where it was collected?
4. Sometimes exact locations are not provided for certain specimens. Why do you think that is?

5. Minerals in specimens provide clues to how they were formed. Based on your observations, do you think the chromite in these specimens formed by igneous, metamorphic, or sedimentary processes? Conduct brief research to find out how chromite forms and where you are likely to find it.
6. According to the USGS information on chromium, how is it used? What properties did you identify that might make chromium suited for this use?

FURTHER STEPS

Copper is a mineral that you are probably very familiar with as it is found in cookware, wiring, and other products. You may not be aware that some copper specimens are collected simply for their beauty and art-like 3D shape and not their utility. Explore this Sculptural and Aesthetic Native Copper specimen (https://bit.ly/Sketchfab-sculptural-copper) – this is a naturally formed piece of pure copper. Carefully observe its rare crystal structure.

Search for and explore other mineral specimens from the UAIC Museum of Mineralogy and Petrography in the Sketchfab collection by entering the name of the mineral followed by Museum of Mineralogy and Petrography, such as "copper Museum of Mineralogy and Petrography."

Part 2 – Exploring Minerals with MERGE Augmented Reality Cubes

1. In addition to interacting with 3D models online, with an augmented reality program like a MERGE cube, you can hold a projected sample in your hand as you observe its properties.

2. First, you will need to make a paper MERGE cube by following these instructions: https://bit.ly/make-merge-cube.

3. Go to the Paleontological Research Institution's (PRI's) MERGE web collection: https://viewer.merge3d.ai/open/pri?page=1. Click on the minerals collection. Then select the chromite specimen.

4. A message may appear inviting you to sign up to unlock the full experience of MERGE 3D with a free trial. You do not need to Sign Up. The PRI collection is offered at no charge and with no sign up. Click "Maybe Later" to continue through to the model space. Next, click the cube icon in the upper left to activate the MERGE online application.

5. Hold the MERGE cube up to the camera and investigate your specimen. To truly feel like you are holding the specimen in your hands, view it using a tablet or a phone with the camera on the back.
    a. When the website first loads on your phone or tablet, it will point the camera view toward you. Click the circular arrows icon in the upper left of your screen to flip the camera to the back.
    b. Hold the MERGE cube in one hand and the phone in the other. Having a classmate hold the phone or using a self-standing tablet works even better so you can hold the MERGE cube in one hand, carefully rotating and observing it, freeing up the other hand.

ANALYSIS FOR PART 2

1. As you interact with the chromite-containing specimen, write at least three observations about it. You might describe the colors you see, the shape that the chromite within the specimen takes, the texture of the specimen, the luster of the specimen, how it might break (Would it cleave into sheets or fracture into pieces?), or something else you noticed.
2. How does holding the specimen virtually in your hand compare to moving one around on screen?

FURTHER STEPS

Read about how a genetically engineered bacterium is helping to increase the rate of breakdown of minerals high in magnesium and iron, releasing two critical minerals (cobalt and nickel) while also capturing CO_2. (https://bit.ly/microbes-critical-minerals)

Reflect on the impact of how new scientific research can help with critical mineral shortages while also using approaches that can benefit society.

AND THERE'S MORE!!

In support of AGI's Earth Science Week Fossil Day, explore PRI's MERGE fossil collections: https://viewer.merge3d.ai/open/pri?page=1

For each fossil you investigate, answer the following:

1. What kind of fossil is it? Trace or body? If trace, what type of trace fossil is it? If body, is it altered or unaltered? Mold or cast? For help, see The Nature of the Fossil Record at the Digital Atlas of Ancient Life: https://bit.ly/PRI-digital-atlas.
2. Can you identify what biological kingdom it belongs to? What makes you think so?
3. What do the characteristics of the fossil indicate about the environment when and where it formed?