



modeling the universe

Getting Ready

This is an introductory activity that helps students think about where we fit in the universe, and model the size, shape and relative position of objects in the universe. Students should be familiar with the objects in our solar system and terms for celestial objects beyond our solar system. This activity begins with students brainstorming about objects in the universe and the concepts of models. Students with less experience with these concepts will require more time and teaching in the discussion part of the activity.

Procedure:

Part 1. Discussion

- Facilitate a class discussion of what's in the universe. Ask students "What IS the universe?" Brainstorm a list of objects in the universe that can be viewed with a telescope. As students mention different objects, ask them what they know about them. What is a planet? What is a star? What is a galaxy? How far away are these things, relatively speaking? What do you think they would look like in the telescope? Which ones can we see without the aid of a telescope? How could we group the objects?
- Discuss how scientists use models to suggest how things work and to predict phenomena that might be observed. Ask students to name some familiar models, such as a globe, or a dollhouse. A model is not the real thing. It can always misrepresent certain features of the real thing. Different models may represent only part of what is being modeled.

Part 2. Modeling

- Divide into groups of 3-4 students. Each student can have one or more of the following roles: model maker(s); recorder of model features; spokesperson.
- Challenge students to create a model of the universe in less than 30 minutes. You may wish to have some groups choose just a part of the universe to model (such as the solar system, or a galaxy, or perhaps just the earth-moon system). One person in the group should write down the features of the model as it is built, along with questions that arise.
- Students can use the Universe Model Analysis Worksheet to record the features of their model as they work.

Part 3. Sharing Models with the Class

- As each group presents their model ask them to comment on these 4 questions:
 - What features of the universe does your model represent?
 - What things does your model misrepresent?
 - What things about the universe does your model omit, or not represent at all.
 - What questions came up as your group worked on your model?





Goals:

- To represent earth's physical place in the solar system and universe
- To understand astronomical size and scale
- To understand strengths and weaknesses of models

Overview:

In this activity students are challenged to create a model of the universe in a single class period.

Getting a "big picture" of the universe as a whole is a difficult challenge — for professional astronomers as well as for students — but it's a challenge that has occupied humanity for ages. To understand the vast ranges of scale of cosmic systems, the student of the universe has to create and evaluate a variety of models against the observational evidence.

A model is a simplified imitation of something that we hope can help us explain and understand it better. Models can take different forms, including physical devices or sculptures, drawings or plans, conceptual analogies, mathematical equations, and computer simulations. In this activity, students make a physical model to represent as much of the universe as they can. They will then analyze their own and others' models with regard to what they represent, what they misrepresent, what they leave out, and perhaps most importantly, what questions they raise.

While the idea of creating a physical model of the entire universe in one sitting can seem a bit daunting, this activity quickly elicits student ideas and preconceptions about the contents and organization of the cosmos. Most students will be somewhat familiar with solar system objects, but may be confused about the relationship of stars to planets, and about the relative distances. The scientist's view of the hierarchical "nested" structure of the universe—planet systems, star neighborhoods, galaxies, galaxy clusters—is not second nature to most people.

What You Need:

For the class:

- | | | |
|--|-----------------------------------|--|
| <input type="checkbox"/> modeling clay | <input type="checkbox"/> string | <input type="checkbox"/> other odds and ends that might be useful in creating models |
| <input type="checkbox"/> paper | <input type="checkbox"/> markers | |
| <input type="checkbox"/> balloons | <input type="checkbox"/> scissors | |
| <input type="checkbox"/> different sized balls and marbles | <input type="checkbox"/> straws | |

For each group of students:

- Copy of Universe Model Analysis Worksheet





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Discussion Notes:

The following questions may also provide useful prompts as students share their models:

- Are there any patterns that emerge?
- What parts of the astronomical models do you think represented the “real thing” particularly well? Why?
- What parts of the astronomical model do you think misrepresented the “real thing”? Why?
- Why is representing the whole universe a difficult challenge?
- How can these models be used to make predictions regarding observations of the universe? (E.g. where is Earth in this model and what would observers on Earth see if they lived in this universe?)
- What are some things you need to find out to design a better model?

Assessment:

These discussions will elicit a number of student ideas, both about the universe and the role that models play in developing a scientific understanding of the world. As a guide (or rubric) for creating “good” models, some teachers may wish to use these indicators for evaluating student models:

- Students can describe how their models explain certain features of the universe. This may include labels.
- Students have multiple responses to the questions on the Universe Model Analysis Worksheet.
- Students can describe connections between their models and other (outside) knowledge regarding the universe.
- Students are able to pose questions that relate to their models. (i.e. “where would black holes be located in my model?”)

Going Further:

This activity can be used as an introduction for further exploration about the universe and the role that models play in developing a scientific understanding of the world. A number of follow-up activities can be found at this website:

<http://www.universeforum.org/mtu/>

Activities include explorations regarding the size and scale of the universe, the age of the universe, and a tour of objects in the universe. Additional material on this website include a mapping of national standards, a history of cosmological models, as well as links to a number of other materials that will help students develop their models further.





UNIVERSE MODEL ANALYSIS WORKSHEET

A model is a simplified imitation of something to help us understand it better. Because a model is not the real thing, it can always misrepresent certain features of the real thing. Different models may represent only part of what is being modeled.

After your group creates your model, you will be asked to explain your model to the rest of the class, commenting on these 4 questions:

- What features of the universe does your model represent?
- What things does your model misrepresent?
- What things about the universe does your model omit, or not represent at all.
- What questions came up as your group worked on your model?

Use this chart to record the features of your model as your group is working.

Features Represented	Misrepresented or irrelevant features	Features of real thing omitted by model
Questions we had:		

