

# Lesson 2: Planetary Formation: Mars vs. Earth formation and the Case for Pluto

## Summary

This learning module and related laboratory exercise exposes students to planetary body classification, and planet differentiation. Students will be able to compare and contrast the formation history of Mars and Earth as well as confidently assess the present classification of the planet Pluto.

## Learning Goals

### Students will be able to:

- Explain how planets form using JELL-O 1-2-3 as an analogy.
- Engage in a positive interactive debate regarding the classification of Pluto and in written format express their view competently using current scientific theory and resources.

## Context for Use

This learning module is meant for adaptation in an introductory earth science course and/or planetary science course.

## Description and Teaching Materials

### *In-Class Activity*

In-Class Activity 1- Differentiation of Planets & Jell-O 1-2-3

### *Homework/Lab*

Homework 1- Pluto Debate Write-up

## Teaching Notes and Tips

1. JELLO 1-2-3 Analogy
  - a. Small class size <20: have JELLO ingredients made up and ready for disbursement at end of class.
  - b. Large class size >20: have both ingredients and one pre-made JELLO cup for students

to analyze and develop an analogy for planet differentiation.

2. Pluto debate
  - a. Prior to class assign students to either the Affirmative or Negative team so students have a chance to develop an argument. **OR**
  - b. During class, allow students 10-15min to develop an argument

## Mars for Earthlings

### References and Resources

1. Planetary Differentiation and Planet Comparison Overview:  
<http://nineplanets.org/overview.html>
2. Jello 1-2-3 recipe: <http://gourmetish.blogspot.com/2006/10/jello-1-2-3.html>
3. Mars vs. Earth size research: Brandon, Alan 2011. *Nature* 473, 460–461 (26 May 2011)  
doi:10.1038/473460a
4. Pluto and Planetary Body Classification : <http://www.iau.org/public/pluto/>
5. New Horizon Probe to Pluto NASA Video (see homepage for link) :  
[http://www.nasa.gov/mission\\_pages/newhorizons/main/index.html](http://www.nasa.gov/mission_pages/newhorizons/main/index.html)
6. Kuiper Belt and the Oort Cloud information:  
[http://www.nasa.gov/sites/default/files/files/Kuiper\\_Belt\\_Lithograph.pdf](http://www.nasa.gov/sites/default/files/files/Kuiper_Belt_Lithograph.pdf)



## Mars for Earthlings

### ***In-Class Activity 1***

Planetary Formation MFE

*Differentiation of Planets & Jell-O 1-2-3*

### **Engage**

To engage students, have a brief discussion on the interior of the Earth using the following explore activity as a preliminary analogy.

### **Explore**

To explore the concept of differentiation, try an activity involving jello.

In Class activity 1 – Jello

Jello 1-2-3 recipe: <http://gourmetish.blogspot.com/2006/10/jello-1-2-3.html>

Differentiation is the concept of how different constituents of a planetary body separate out as a consequence of their physical or chemical behavior. The planetary body develops into compositionally distinct layers. Can students come up with any other examples of differentiation (e.g., salad dressing oil and water)?

### **Explain**

To further explain how differentiation occurs in planets, have students examine other references, such as:

Planetary Differentiation and Planet Comparison Overview

Mars vs. Earth size research: Brandon, Alan 2011. *Nature* **473**, 460–461 (26 May 2011)

doi:10.1038/473460a

### **Elaborate**

To distinguish planetary classifications, provide the following reading for further information on Pluto.

Pluto and Planetary Body Classification

<http://www.iau.org/public/pluto/>

### **Evaluate**

The Pluto debate demonstrates the evolution of science as new information becomes available. This is a fundamental component of the Nature of Science. Have a class debate about whether or not Pluto is a planet.

New Horizon Probe to Pluto NASA Video (see homepage for link) :

[http://www.nasa.gov/mission\\_pages/newhorizons/main/index.html](http://www.nasa.gov/mission_pages/newhorizons/main/index.html)

Kuiper Belt and the Oort Cloud information:

[http://www.nasa.gov/sites/default/files/files/Kuiper\\_Belt\\_Lithograph.pdf](http://www.nasa.gov/sites/default/files/files/Kuiper_Belt_Lithograph.pdf)



## Mars for Earthlings

After the in-class debate, students will write up a short 1 page cited discussion paper on their opinion regarding the classification of Pluto (see link for paper guidelines). Make sure students include and discuss the current planetary classification scheme.

Students will develop an analogy, as a class, between JELL-O 1-2-3 and planetary differentiation.

