Planet Properties (Part 1 of 3):

What is it?

Our Solar System is vast and diverse. The planets are as different and unique as people are! All three of these activities focus on three main topics: size, distance and composition. Each is designed to expand our minds when thinking about the Solar System.

In this first activity, students will explore the vast differences in the sizes of the planets.

This activity discusses topics related to National Science Education Standards:

MS-ESS1-3: *Analyze and interpret data to determine scale properties of objects in the Solar System.*

- This activity helps students visualize the relative sizes of Solar System planets.

Materials (per team of 7):

Equipment, provided by NASA:

- 1 3lb tub of craft dough (4 are included in the kit)
- Plastic knife

Printables:

- Planet Boxes sheets

Materials (per student):

Printables:

- Scaling the Solar System Worksheet

Artifact included in this kit:

- Meteorite Sample and Information Sheet

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit http://speakers.grc.nasa.gov.

Margarita Marinova (Planetary Science and Exploration, Mars)

Jeffery Hollingsworth (Planetary Atmospheric Dynamic and Circulation of Mars)

Set-Up Recommendations:

- Print out copies of **Planet Boxes** (we recommend that they be laminated, but it is not essential)
- Prepare copies of **Scaling the Solar System Worksheet** for students
- Set out supplies for each team (1 tub of craft dough, 1 set of **Planet Boxes**)

Procedure:

1. Introduce the activity to students with a discussion. Ask students how much the Moon and Earth differ in size. You could use this opportunity to show images of Earth and the Moon, if you would like. After some time to think, inform them that if we think of the Earth as the size of a basketball, the Moon would be the size of a tennis ball. Discuss how all of the planets in the Solar System are quite different in size, and in this activity we will build a model of the relative sizes of the planets.
2. Split the class into teams of 7 (this can be varied, but 7 works best). Pass out copies of the **Scaling the Solar System Worksheet**. Have them answer questions 1 and 2.
3. Explain to students that they will be taking turns through each step of the activity. One turn consists of rolling the dough out into a tube shape, dividing it into as many pieces as instructed, and putting those pieces into the different planet boxes. Tell them that you will be leading them through the different steps. You may want to demonstrate one "turn" before beginning.
4. Use the following steps to divide the craft dough. As a student is working with the dough, you may want to ask the non-working students some trivia questions about planets (some facts can be found from the resources listed in **Helpful Resources**).
    i. Divide the entire ball of dough into 10 equal parts:
        - Combine 6 parts together into a ball and put them into the Jupiter box.
        - Combine 3 parts into a ball and put them into the Saturn box.

    ii. Divide the remaining part into 10 equal parts:
        - Take 5 parts and combine them with the ball in the Saturn box.
        - Combine 2 parts into a ball and put into the Neptune box.
        - Combine 2 parts into a ball and put into the Uranus box.

    iii. Divide the remaining part into 4 equal parts:
        - Take 3 parts and combine them with the ball in the Saturn box.

    iv. Divide the remaining part into 10 equal parts:
        - Combine 2 parts into a ball and put into the Earth box.
        - Combine 2 parts into a ball and put into the Venus box.
        - Take 4 parts and combine them with the ball in the Uranus box.

    v. Combine the remaining 2 parts and divide into 10 equal parts:
        - Roll 1 part into a ball and put into the Mars box.
        - Take 4 parts and combine them with the ball in the Neptune box.

- Take 4 parts and combine them with the ball in the Uranus box.

vi. Divide the remaining part into 10 equal parts:
- Combine 7 parts into a ball and place in the Mercury box.
- Take 2 parts and combine them with the ball in the Uranus box.

vii. Divide the remaining part into 10 equal parts:
- Take 9 parts and combine them with the ball in the Uranus box.
- Roll the last part into a ball and place in the Pluto box.

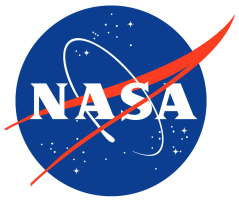
5. After dividing up the dough, have students take a moment to absorb what they have learned. You may want to ask questions like, “Which is bigger, Saturn or Uranus?” or, “Is Mars as big as the Earth?” Have students fill out the questions on their **Scaling the Solar System Worksheet**.

Helpful Resources:

NASA Solar System:
http://solarsystem.nasa.gov/planets/

Planetary Fact Sheets:
http://nssdc.gsfc.nasa.gov/planetary/planetfact.html

National Aeronautics and Space Administration



Name: _____

Scaling the Solar System Worksheet

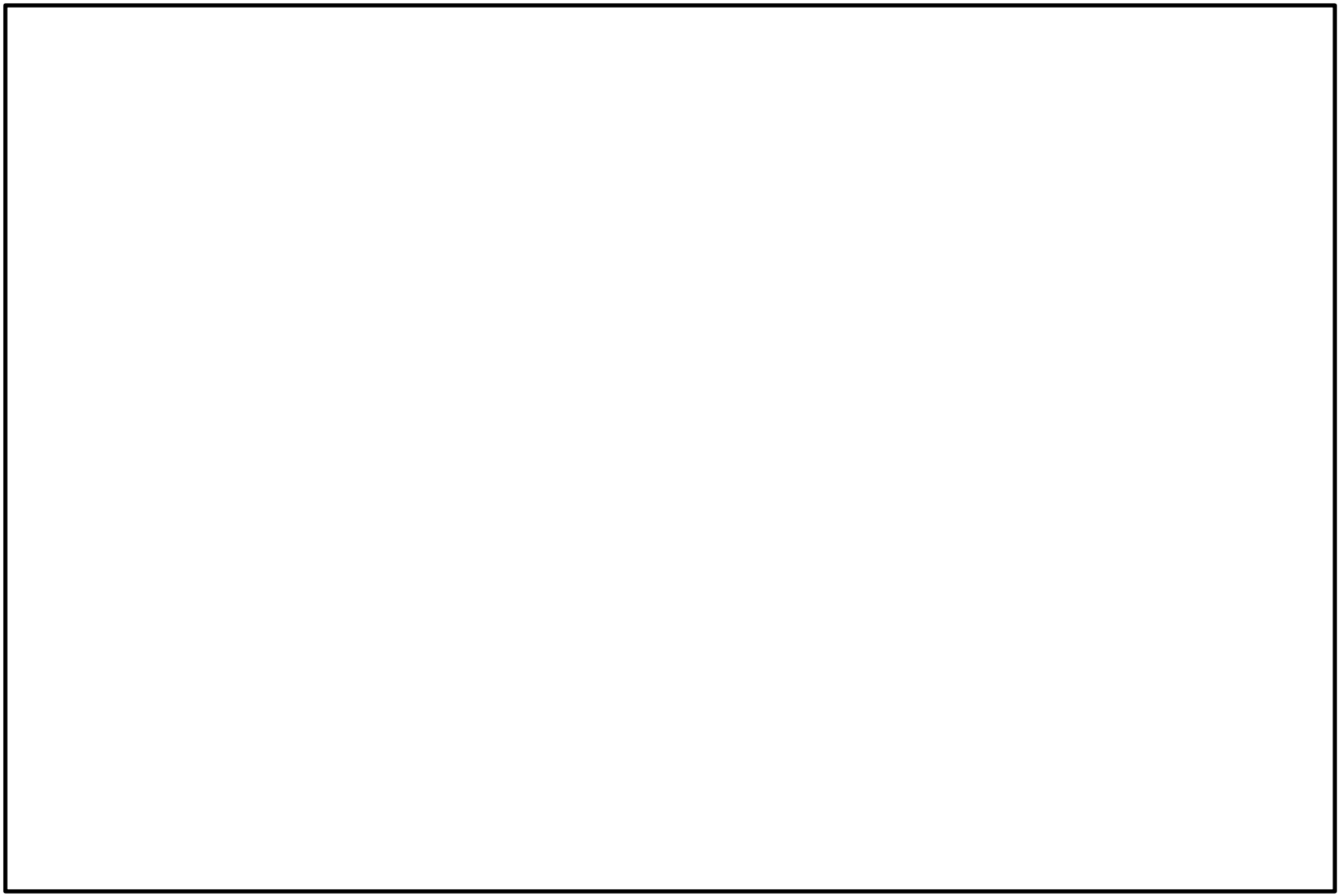
1. Which planet do you think is the largest in the Solar System?

2. Which planet do you think is the smallest?

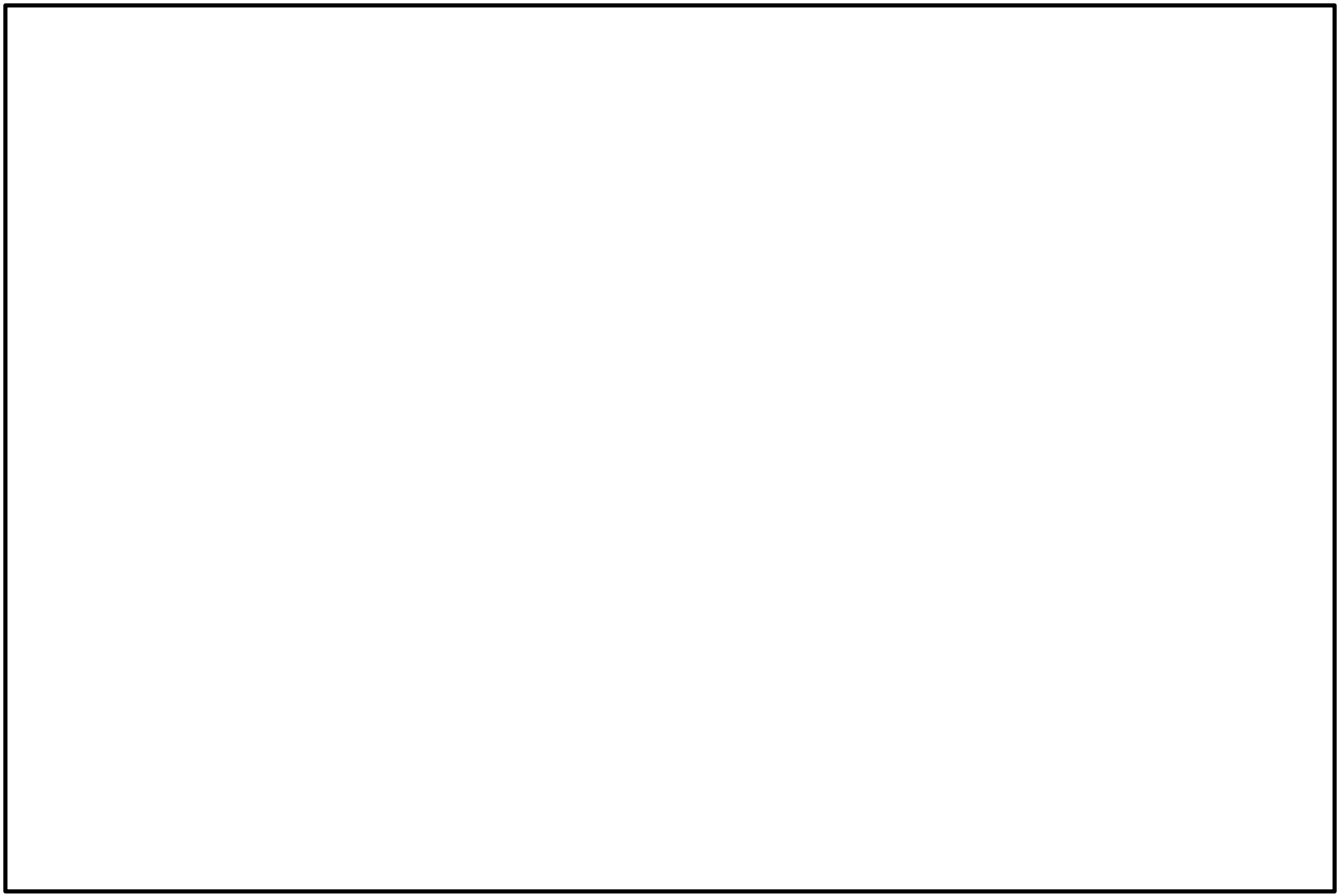
3. After completing your model, were you surprised to see the results? Why or why not?

4. We used a model to represent the relative sizes of the planets. What are other features of the Solar System that we could represent with models? Name two different examples.

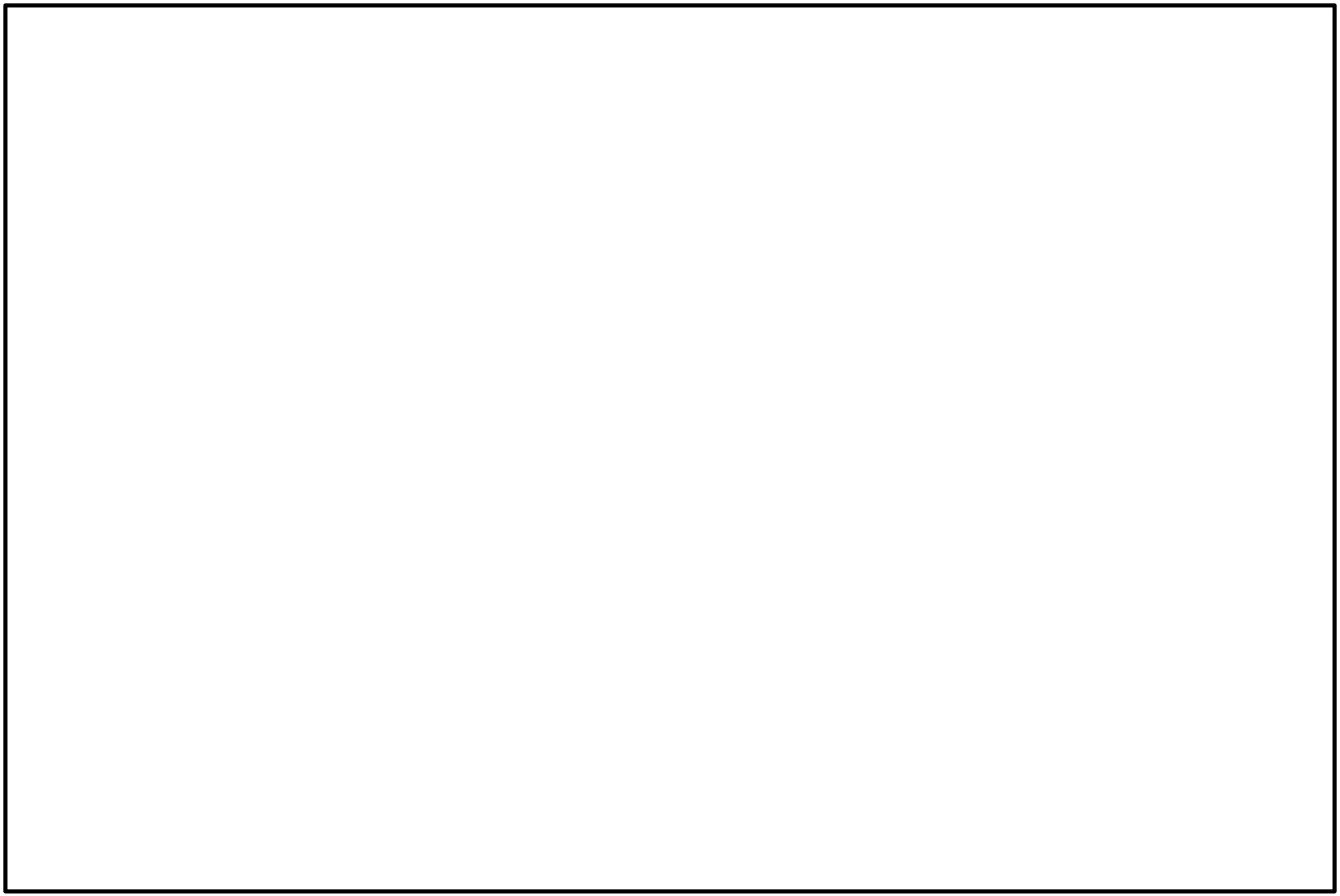
Mercury



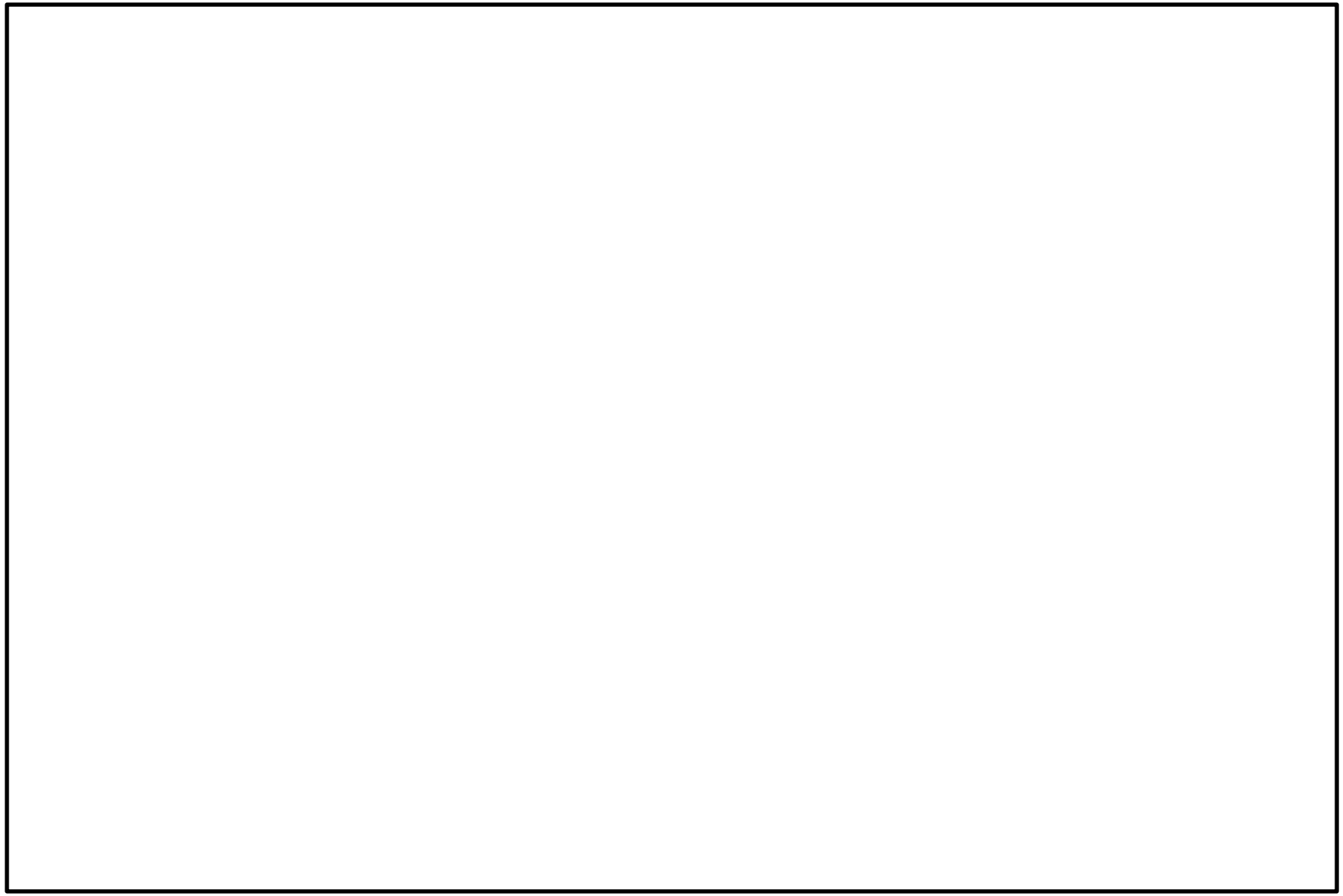
Venus



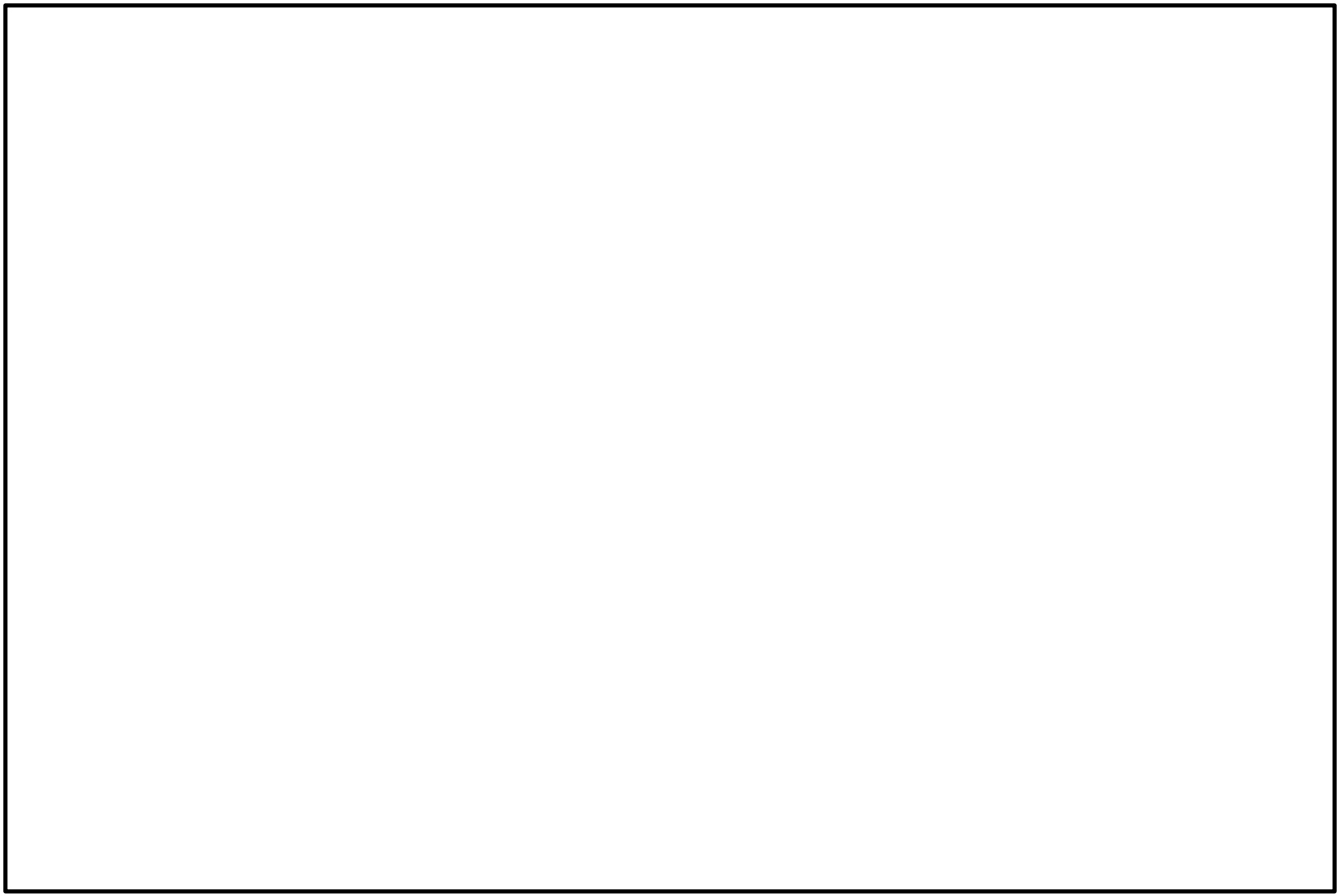
Earth



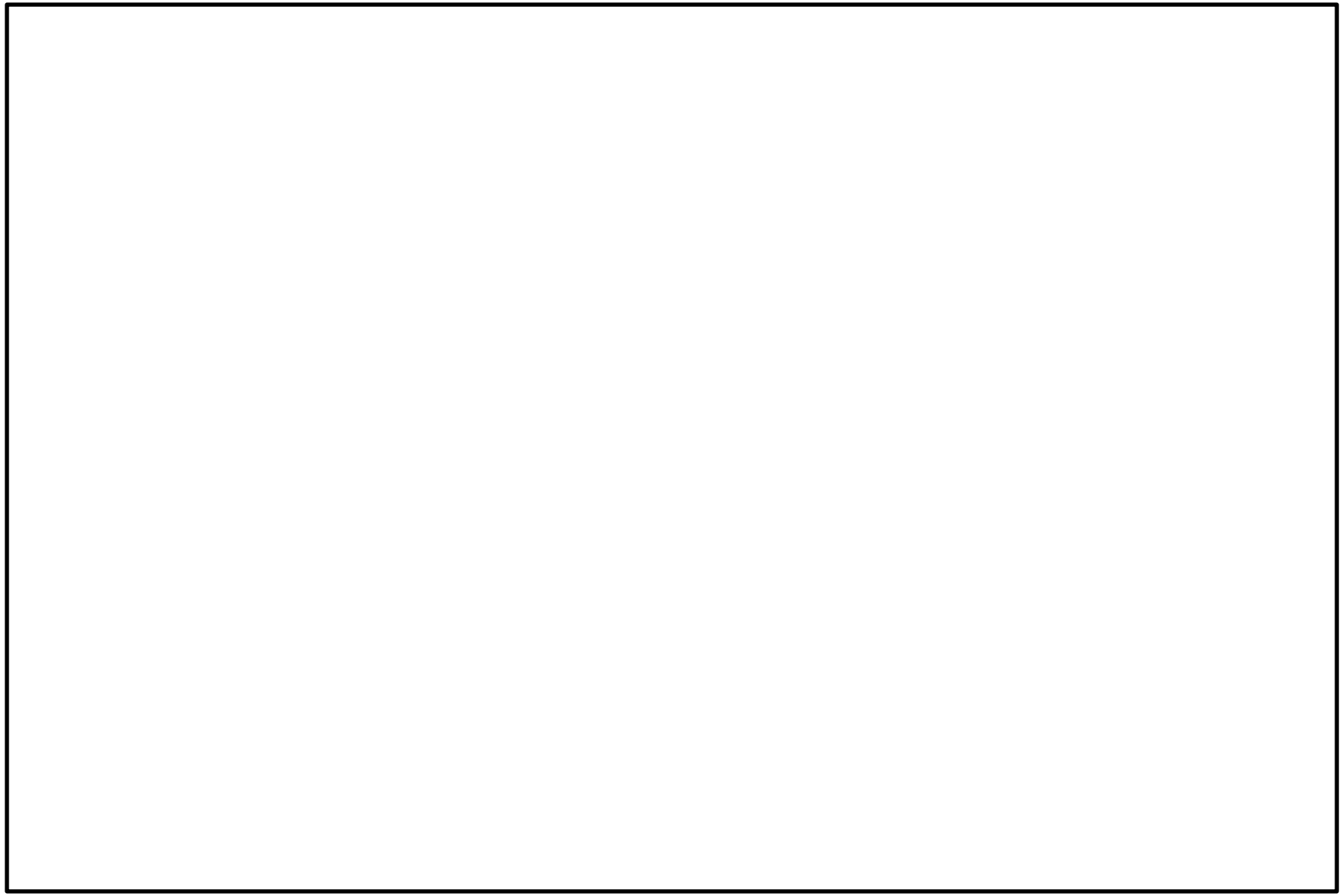
Mars



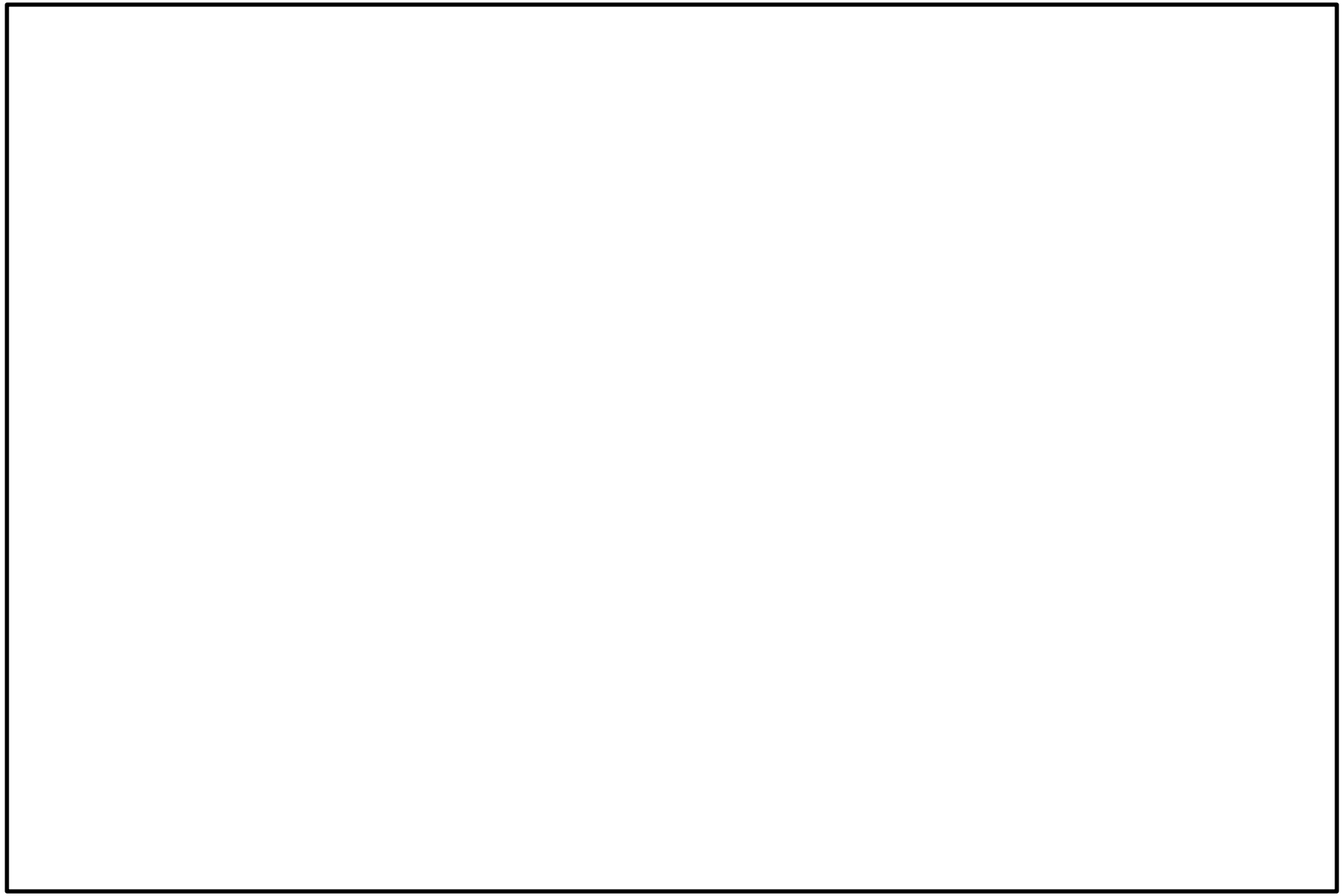
Jupiter



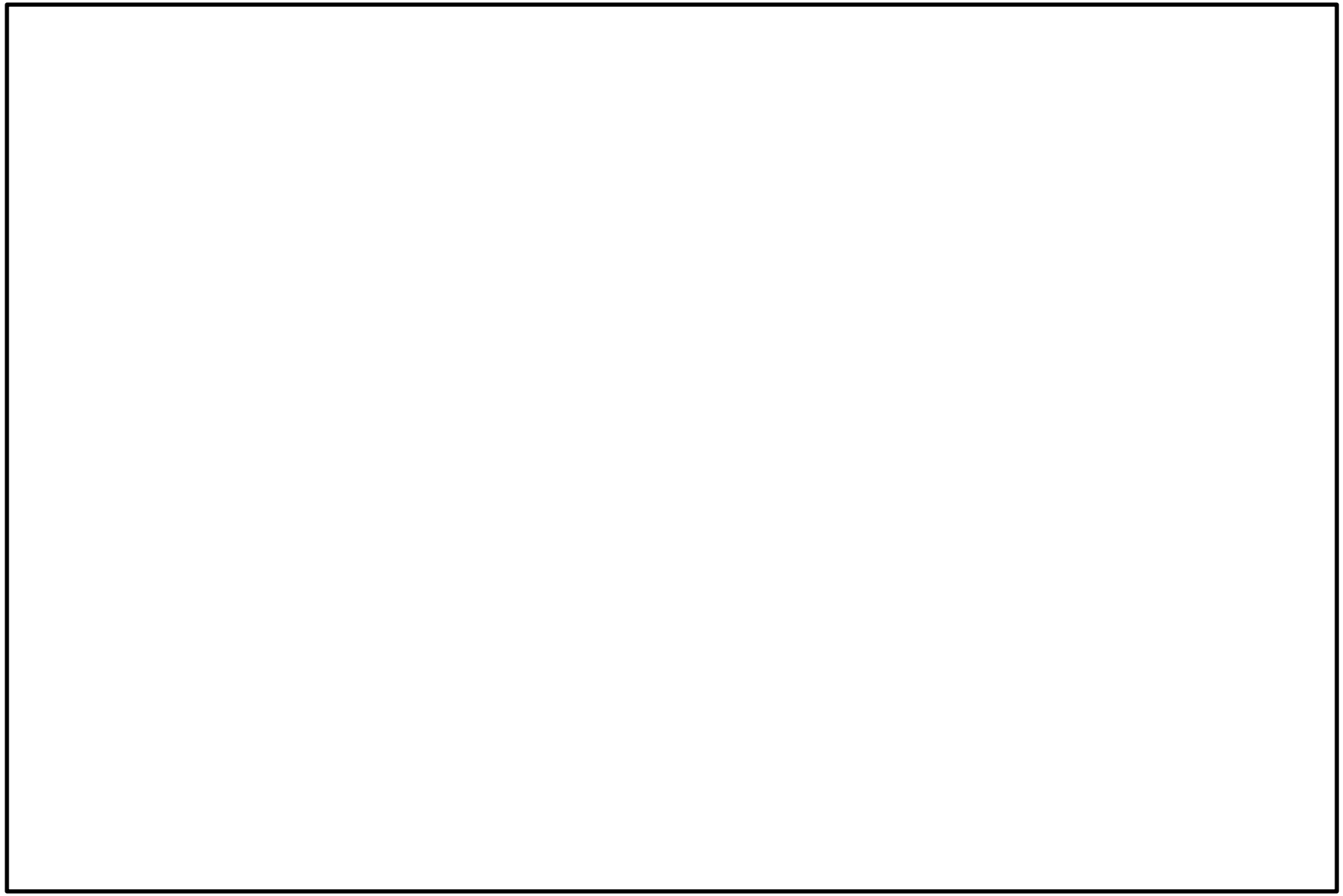
Saturn



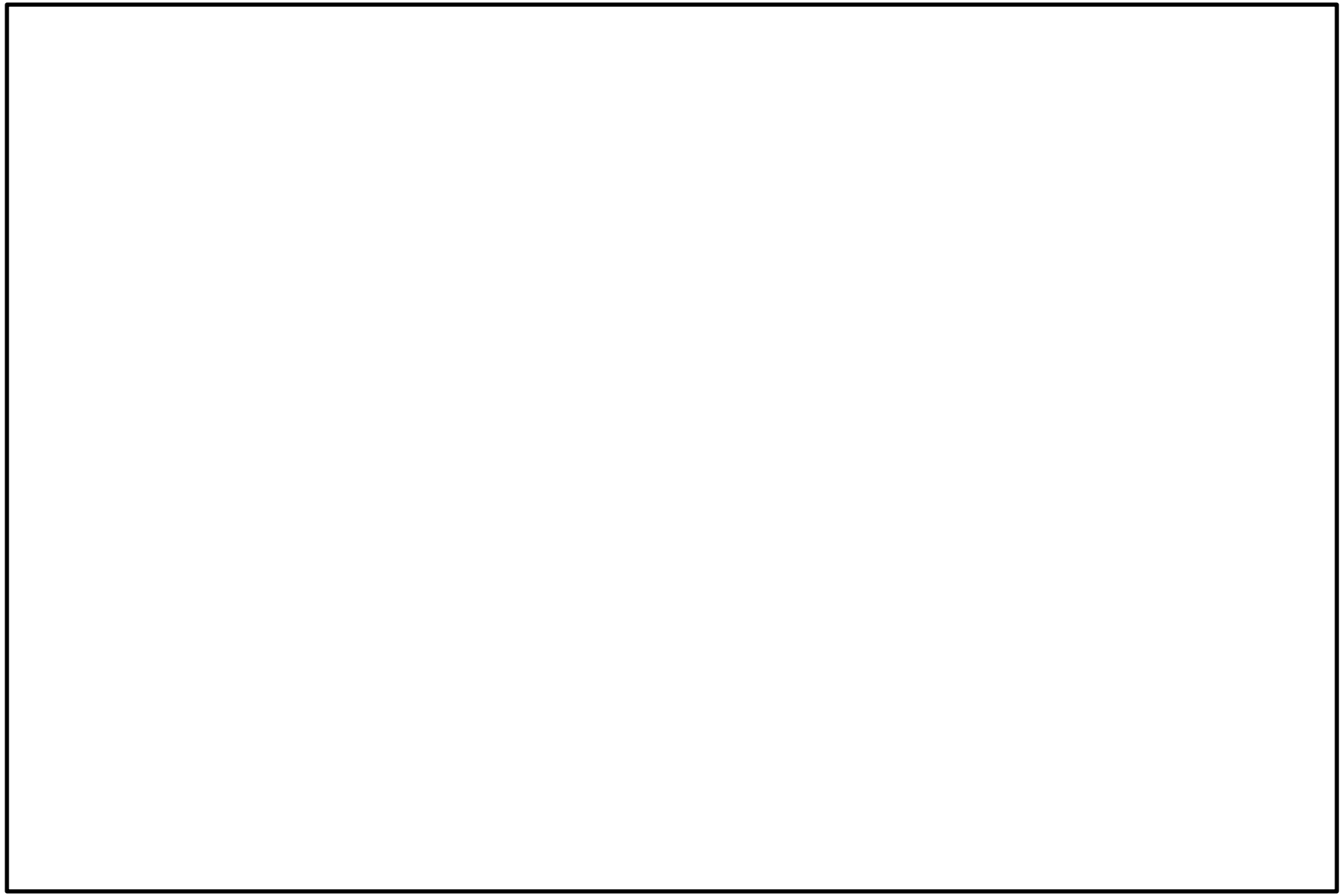
Uranus

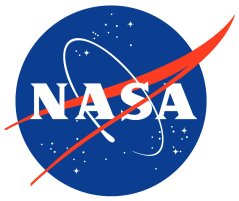


Neptune



Pluto





Planet Properties (Part 2 of 3):

What is it?

Our Solar System is vast and diverse. The planets are as different and unique as people are! All three of these activities focus on three main topics: size, distance and composition. Each is designed to expand our minds when thinking about the Solar System.

Interplanetary travel is extremely difficult considering the distance between bodies in outer space. In this activity, students will explore the relative distances between the planets in our Solar System.

This activity discusses topics related to National Science Education Standards:

MS-ESS1-3: *Analyze and interpret data to determine scale properties of objects in the Solar System.*

- This activity helps students visualize the relative distances between planets.

Materials (per class):

Equipment, provided by NASA:

- Models to represent Earth and Moon (inflatable Earth and Moon stress ball)

Equipment, not provided by NASA:

- Toilet Paper (one roll per team)

Materials (per student):

Printables:

- Distances in the Solar System Worksheet

Artifact included in this kit:

- Meteorite Sample and Information Sheet

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit http://speakers.grc.nasa.gov.

Margarita Marinova (Planetary Science and Exploration, Mars)

William Clancy (Planetary Science Mission, Mars Analogue Missions, Human Robotics Systems)

Jeffery Hollingsworth (Planetary Atmospheric Dynamic and Circulation of Mars)

Set-Up Recommendations:

- Prepare copies of **Distances in the Solar System Worksheet** for students
- Set out one roll of toilet paper for each team
- Move as much furniture out of way as possible (like desks and chairs) or, if possible, host this activity outside. A lot of space is needed to get to the edge of the Solar System.

Procedure:

1. Introduce the activity to students with a discussion. Remind students that they have learned how different in size the planets are, but do they know how far apart they are. Using the inflatable globe and Moon stress ball, tell the students that these are the relative sizes of the planets.
2. Pass out copies of the **Distances in the Solar System Worksheet**.
3. Ask for a volunteer to be the "Earth" and hand them the inflatable globe. Now ask for a second volunteer to be the "Moon." Ask the "Moon" how far they should be from the "Earth." Ask for the class to participate by guessing whether the "Moon" should be closer or further away.
4. After a few moments of discussion, show them how far the "Moon" should be from the "Earth" (about 20 feet in this model). Have them answer questions 1 and 2 on their **Distances in the Solar System Worksheet**.
5. Explain to students that they will be using the toilet paper to see the relative distances between the planets.
6. Use the following steps to model the relative distances in the classroom. You will be measuring out the distances using sheets of toilet paper. One sheet represents 1,000,000 miles! One way to conduct this activity is to ask the class to answer a trivia question about the next planet in the sequence and the student with the correct answer can represent that planet by holding that section of the toilet paper train.

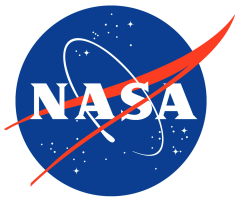
Celestial Object	# of Sheets from Sun	# of Sheets from Previous Object
Sun	0.0	0.0
Mercury	3.6	3.6
Venus	6.7	3.1
Earth	9.3	2.6
Mars	14.1	4.8
Jupiter	48.4	34.3
Saturn	88.7	40.3
Uranus	178.6	90
Neptune	280.0	101.0

7. After reaching the last planet, ask students if they learned anything interesting about the relative distances between the planets. Have students fill out the rest of the questions on their **Distances in the Solar System Worksheet**.

Helpful Resources:

NASA Solar System:
http://solarsystem.nasa.gov/planets/

Planetary Fact Sheets:
http://nssdc.gsfc.nasa.gov/planetary/planetfact.html



Name: _____

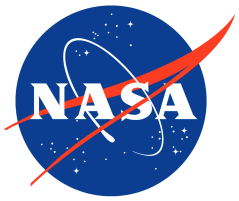
Distances in the Solar System Worksheet

1. When you learned how far the Moon is from the Earth, were you surprised? Why or why not?

2. What can you conclude from the distances between the rocky planets (Mercury, Venus, Earth and Mars) as compared to the gaseous planets (Jupiter, Saturn, Uranus and Neptune)?

3. Knowing that Neptune is very, very far away from the Sun, do you think humans could travel to Neptune? Why or why not?

4. Do you think humans might be able to travel into deep space in the future? What are some things that you think they would need to think about for deep space travel?



Planet Properties (Part 3 of 3):

[Adapted from *NASA's Planets in a Bottle*]

What is it?

Our Solar System is vast and diverse. The planets are as different and unique as people are! All three of these activities focus on three main topics: size, distance and composition. Each is designed to expand our minds when thinking about the Solar System.

In this final activity, students will explore the different characteristics of the planets. Not only will they explore what makes the planets different, but using simple baker's yeast, they will explore whether or not these environments are habitable.

This activity discusses topics related to National Science Education Standards:

MS-LS2-2: *Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems*

- This activity encourages students to think about the (simplified) properties of our planetary neighbors and whether or not their ecosystems could support organisms.

Materials (per student or team of 2):

Equipment, provided by NASA:

- Cloth measuring tape
- Funnel

Consumables, provided by NASA:

- 1 Balloon

Consumables, not provided by NASA:

- Lukewarm water
- Sugar
- Quarter-ounce package of yeast
- Half-liter plastic bottle (empty)
- *[Optional] Additional items to represent different planets (see list below in **Procedure**)*

Materials (per student):

Printables:

- Planet in a Bottle Worksheet

Artifact included in this kit:

- Meteorite Sample and Information Sheet

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit http://speakers.grc.nasa.gov.

Margarita Marinova (Planetary Science and Exploration, Mars)

William Clancy (Planetary Science Mission, Mars Analogue Missions, Human Robotics Systems)

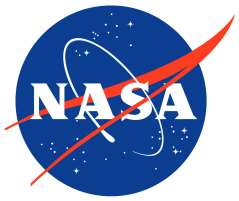
Jeffery Hollingsworth (Planetary Atmospheric Dynamic and Circulation of Mars)

Set-Up Recommendations:

- Prepare copies of **Planet in a Bottle Worksheet** for students
- Set out supplies for each student/team
- *Optional: Write the title "What Earth is like" on the board to help lead the discussion in **Procedure** step 1.*

Procedure:

1. Introduce the activity to students with a discussion. Ask students what they think it's like for life to live on Earth. You may want to write their opinions on the board.
2. Split the class into singles or teams of 2. Pass out copies of the **Planet in a Bottle Worksheet**. Have them answer question 1.
3. Explain to students the activity they will be doing. We know that the Earth is a warm, healthy environment for life with plenty of nutrients for things to grow. To represent this, we would use lukewarm water and plenty of sugar (3 cubes).
4. Ask the student to pick a planet they want to represent and come up with how to represent that planet using the ingredients at hand (sugar, water, yeast, etc.) or make up one of their own. Each bottle will have to contain some form of liquid and sugar for any possible reaction with the yeast. In the section below, you will find a list of possible combinations for different planets.
5. Mix together the sugar and liquid (water) inside the bottle until the sugar dissolves.
6. Using the funnel, pour in the yeast and gently swirl the mixture.
7. Cap the bottle with a balloon.
8. Every 15 minutes or so, have students measure their balloon with their cloth measuring tape and mark down on their **Planet in a Bottle Worksheet**. During that time, you may also want students to visit each other to learn about what planet they have and how they represented it.



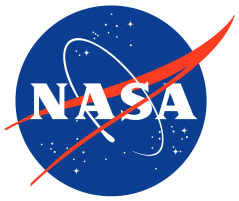
9. At the end of class, have the students share with each other the results of their planet in a bottle. Did their balloon expand? If so, how much? If not, why not? What do they think their planet needs to be better suitable for life? Have students finish the questions on their **Planet in a Bottle Worksheet**.

   Possible Planet Representations:
   - Mercury: Mercury's surface is very hot. Boiling the water could represent Mercury.
   - Venus: Venus is very hot and has an acidic atmosphere. You could boil orange juice, vinegar, or lemon juice (which have an acidic nature) to represent Venus.
   - Moon: The Moon has very little atmosphere that doesn't protect its surface. You could represent the Moon by using a hand pump to vacuum out the majority of air, or expose the yeast to UV light.
   - Mars: Mars is cold and has a thin atmosphere. You could represent Mars by freezing the yeast beforehand or exposing the yeast to UV light (like the Moon).
   - See if you can come up with other representations for other planets!

Helpful Resources:

NASA Solar System:
http://solarsystem.nasa.gov/planets/

Planetary Fact Sheets:
http://nssdc.gsfc.nasa.gov/planetary/planetfact.html



Name: _____

Planet in a Bottle Worksheet

1. What were some of the main characteristics of Earth that you and your class came up with? List 4 or 5 examples below.

2. Fill out the below chart with your balloon measurements:

Time of Measurement	Circumference of Balloon

3. Did your balloon expand? If so, how much? If not, why do you think that is?

4. What do you think a planet needs to be most suitable for life?