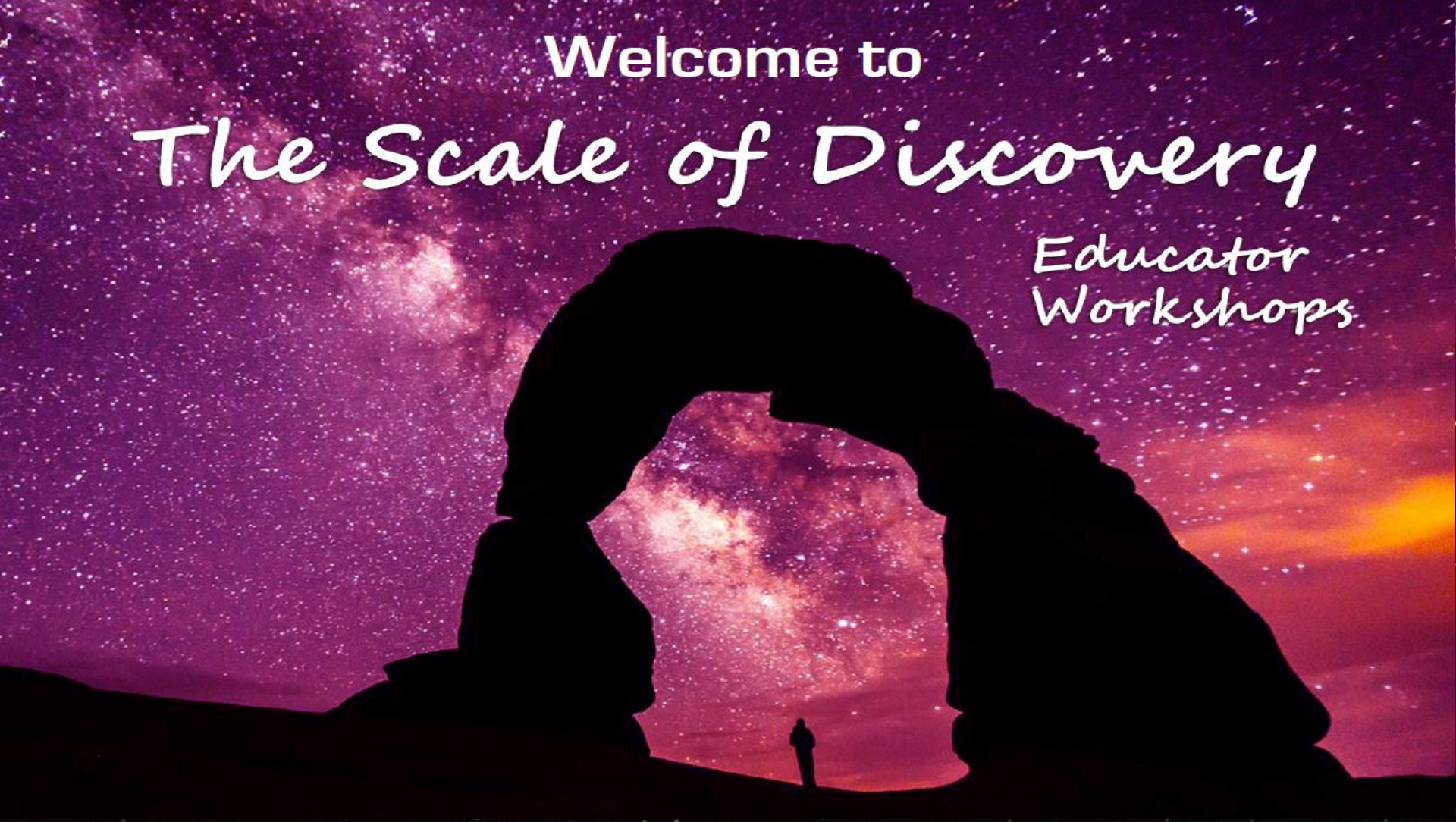


Barbara Buckner, PhD
Armstrong Flight Research Center
EPD Education Specialist
661-276-2966
Barbara.R.Buckner@nasa.gov

Cosmic Scale

TIME

SIZE

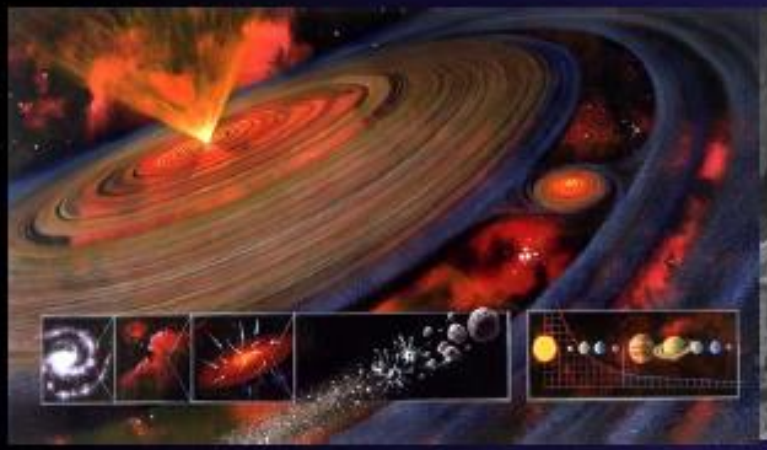
DISTANCE

Planetary Science – Driven by Questions

Where do we come from?

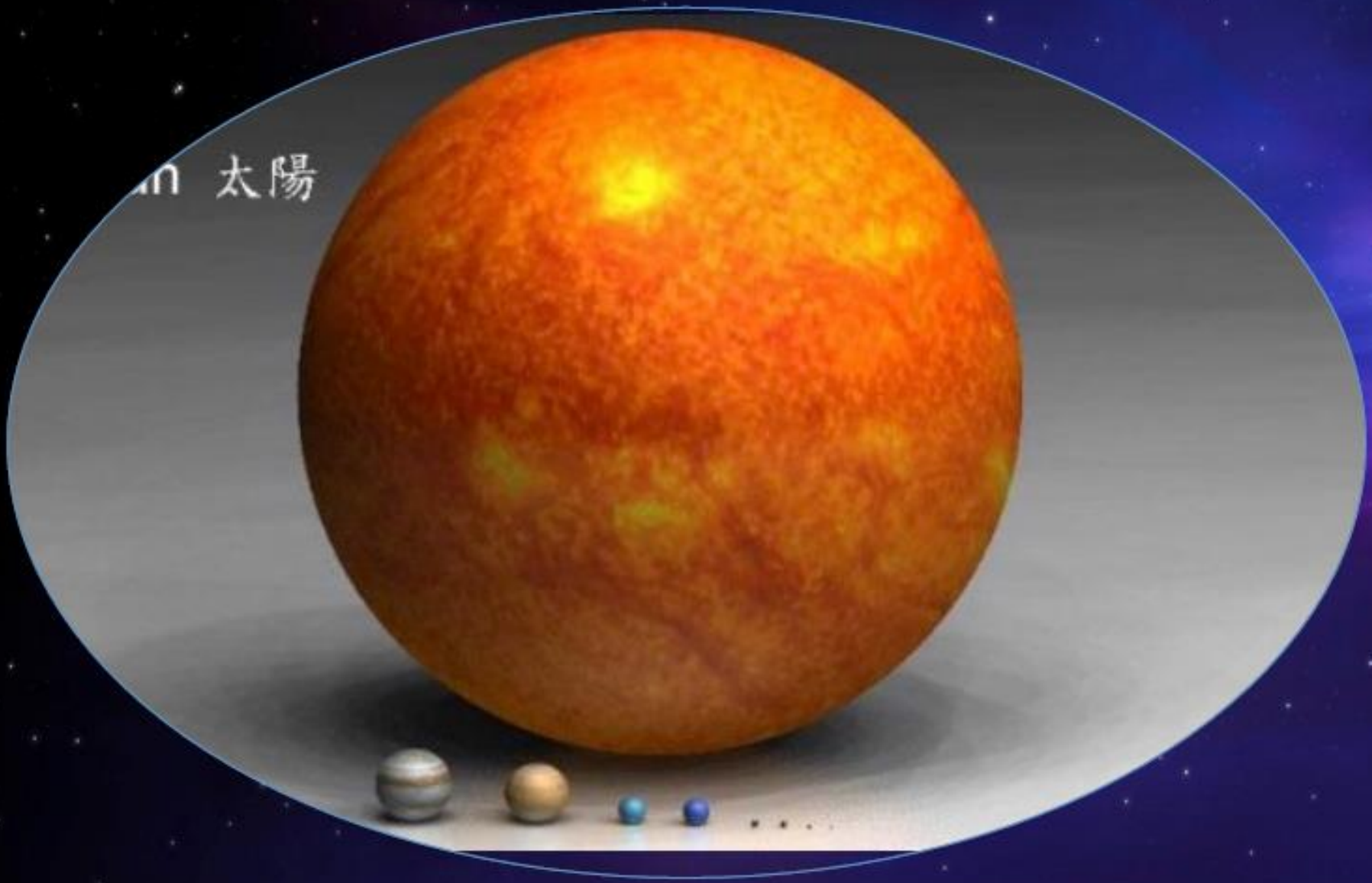
Where are we going?

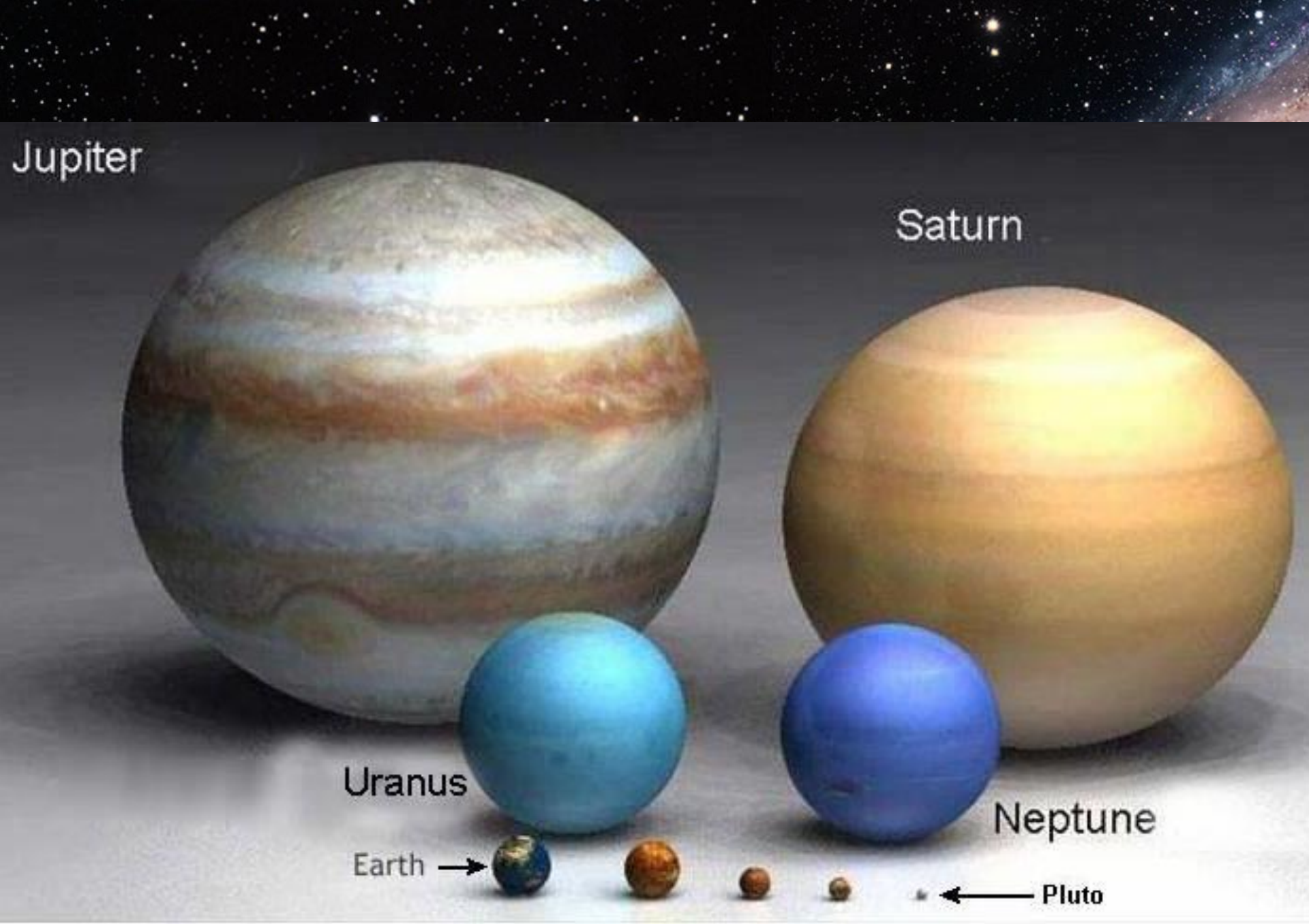
Are we alone?



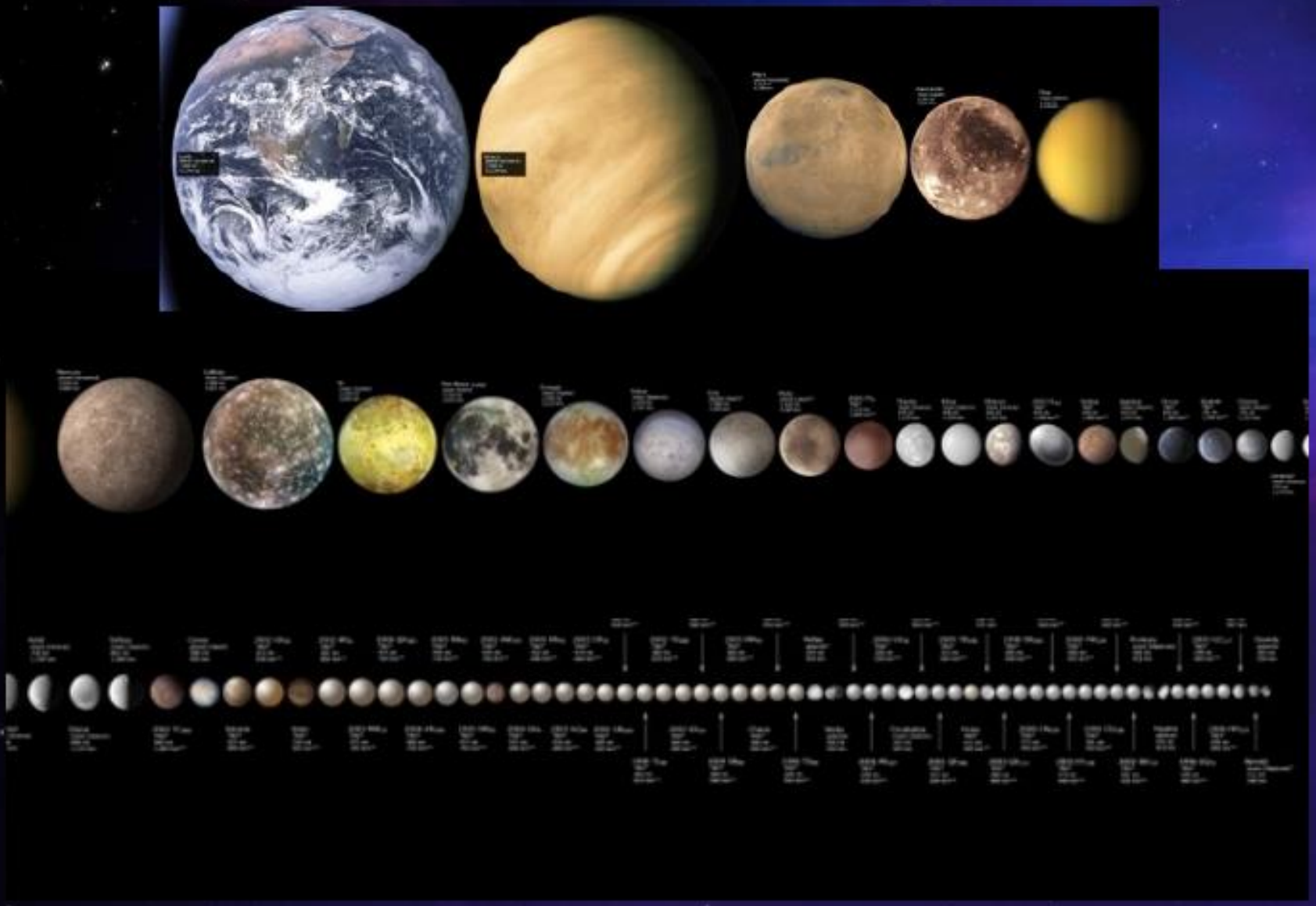
Going Back in Time to Understand our Solar System through the Study of Materials from Space

Size Matters




Jupiter
Saturn
Uranus
Neptune
Earth
Pluto

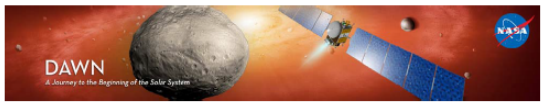
Size is Relative



Planet - Star Size Comparison


Where Are You?
Scale of Planetary Bodies

Where Are You?



Where Are You? Teacher Guide

MATERIALS
For each team of four
- Activity, "Where Are You?" (for each student)
- Assortment of food items, particularly fruits and vegetables, from which students can select four food items to represent the following solar system bodies:
  - Earth: melon (roughly 25.5 centimeters in diameter)
  - Mars: grapefruit (approximately 13.6 centimeters diameter)
  - Vesta: raisin (1 centimeter)
  - Ceres: grape (approximately 2 centimeters)

  Note: The raisin and grape provid[e] other interes[t] [i]n Vesta and Ceres in that Vesta is believed to be d[ry] [l]ike raisins.
- Meter sticks

Setting: To model the [s]ize of planets an[d] [a]steroids, students will need to work in a [l]arge open space su[ch] as a [g]ym, field, r[e]cium, cafeteria, or hallway.

CE[R]ES
[A]sk students w[h]o have seen the flashback "What CAN You See With a Telescope?": "If a [1]9th century astronomer observed an asteroid through the most powerful telescope [a]vailable during that time period, what would this asteroid look like?" Stud[e]nts recall that asteroids appear as tiny points of light.

Ask the students who read "I Can See You More Clearly Now" what [t]elescopic surface features of Vesta the Hubble Telescope r[e]vealed that [e]ven (ex[c]ept for the, ancient lava flows, impact basins and a [l]ar[g]e on Ve[s]ta). Why do they think that Ceres' s[u]rface [a]ppears [s]mooth in Hubble im[a]ges? (It [i]s not [s]mooth, [t]he Hubble a[l]ti[t]ude that it was being viewed.)

2. Now [s]how th[e] im[a]ges of asteroi[d]s within star fields available at: http://[w]ww.[j]pl.[n]asa.gov/[p]lanetgallery/INDEX.html#Minor_planets (images captured [i]n 1996 to 2[0]00) or http://neo.jpl.nasa.gov/images/1999an10.html (taken in 1[9]99). Point out to students that these asteroid images were captured fairly recently using much more sophisticated technology than was available during the 19th century.

3. Mention to students that even two of the largest and brightest asteroids, Vesta and Ceres, only appeared as points of light in the sky when using early Earth-based telescopes. Introduce the activity by explaining that Vesta is actually similar in size to the state of Arizona, while Ceres is comparable to the size of Texas. Explain that the model they will create in class will help them to visualize the size and distance of these two asteroids in relation to Earth.

4. Distribute the activity "Where Are You?" to each student.

5. Have a variety of food items of different sizes displayed in class. Some should fit the scaled-down diameters (25.5 cm, 13.6 cm, 2 cm, and 1 cm). Be sure to have other sizes as well so that students must do the calculations to select the most appropriate food

Teacher Version

History and Discovery of Asteroids **Where Are You?**

STUDENT ACTIVITY—SCALE MODELING OF VESTA AND CERES IN THE SOLAR SYSTEM

If you were to look through the most powerful telescope from the 19th century on a clear, cloudless night, an asteroid such as Ceres or Vesta would appear only as a tiny point of light.[1] You may wonder: *How big are these asteroids really? How far away are they from Earth? And how can I get a better view of these points of light?* In this activity, you will create a model to help you answer these questions. This model will help you to develop an understanding of both the size and distance of Ceres and Vesta relative to Earth.

Part 1: Size to Scale

1. Using food items, you will create a scaled-down model of a portion of our Solar System. The table below lists several planets and asteroids along with their approximate diameters measured in kilometers. Your job will be to convert the diameter to the scale of **1 centimeter (cm) = 500 kilometers** (km) Then based on your calculations, assign foods to represent the Solar System objects. Mercury has been completed for you as an example.

Solar System Bodies	Diameter in km	Convert to Scale 1 cm = 500 km	Scaled-down Size in cm	Food Item
Mercury	*4, 880*	$\frac{1\ cm}{500\ km}\left(\frac{4,880\ km}{1}\right) = \frac{4,880\ cm}{500} = 9.76\ cm$	*9.76*	*Orange*
Earth	*12,756*	[ ]	[ ]	[ ]
Mars	*6,794*	[ ]	[ ]	[ ]

[1] See vignette "What Can You See with a Telescope?"

STUDENT ACTIVITY: Where Are You? DAWN 1

Food Item

[ ] [ ]

[ ] [ ]

and Ceres.

ferences can

STUDENT ACTIVITY: Where Are You? DAWN 2

Scale of Planetary Bodies

Solar System Bodies	Diameter in km	Convert to Scale 1 cm = 500 km	Scaled-down Size in cm	Food Item
Mercury	*4, 880*	$\frac{1\ cm}{500\ \cancel{km}}\left(\frac{4{,}880\ \cancel{km}}{1}\right)$ $= \frac{4{,}880\ cm}{500}$ $= 9.76\ cm$	*9.76*	*Orange*
Earth	**12,756**			
Mars	**6,794**			
Vesta	**525**			
Ceres	**933**			

Solar System Bodies	Diameter in km	Convert to Scale 1 cm = 500 km	Scaled-down Size in cm	Food Item
Mercury	*4, 880*	$\frac{1\ cm}{500\ \cancel{km}}\left(\frac{4{,}880\ \cancel{km}}{1}\right)$ $= \frac{4{,}880\ cm}{500}$ $= 9.76\ cm$	*9.76*	*Orange*
Earth	**12,756**		**25.518**	
Mars	**6,794**		**13.588**	
Vesta	**525**		**1.05**	
Ceres	**933**		**1.866**	

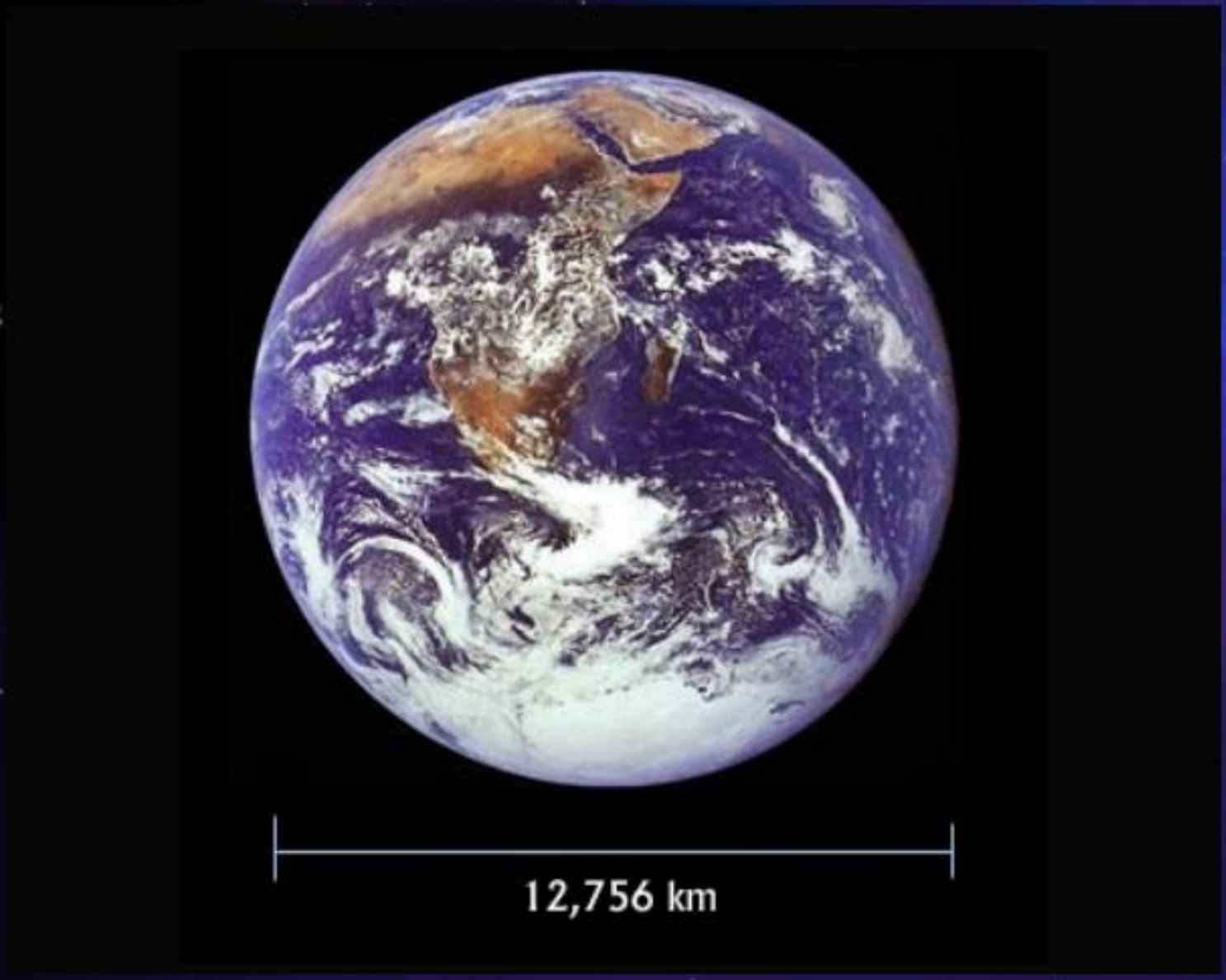
What is a Dwarf Planet?

SPACE STATS

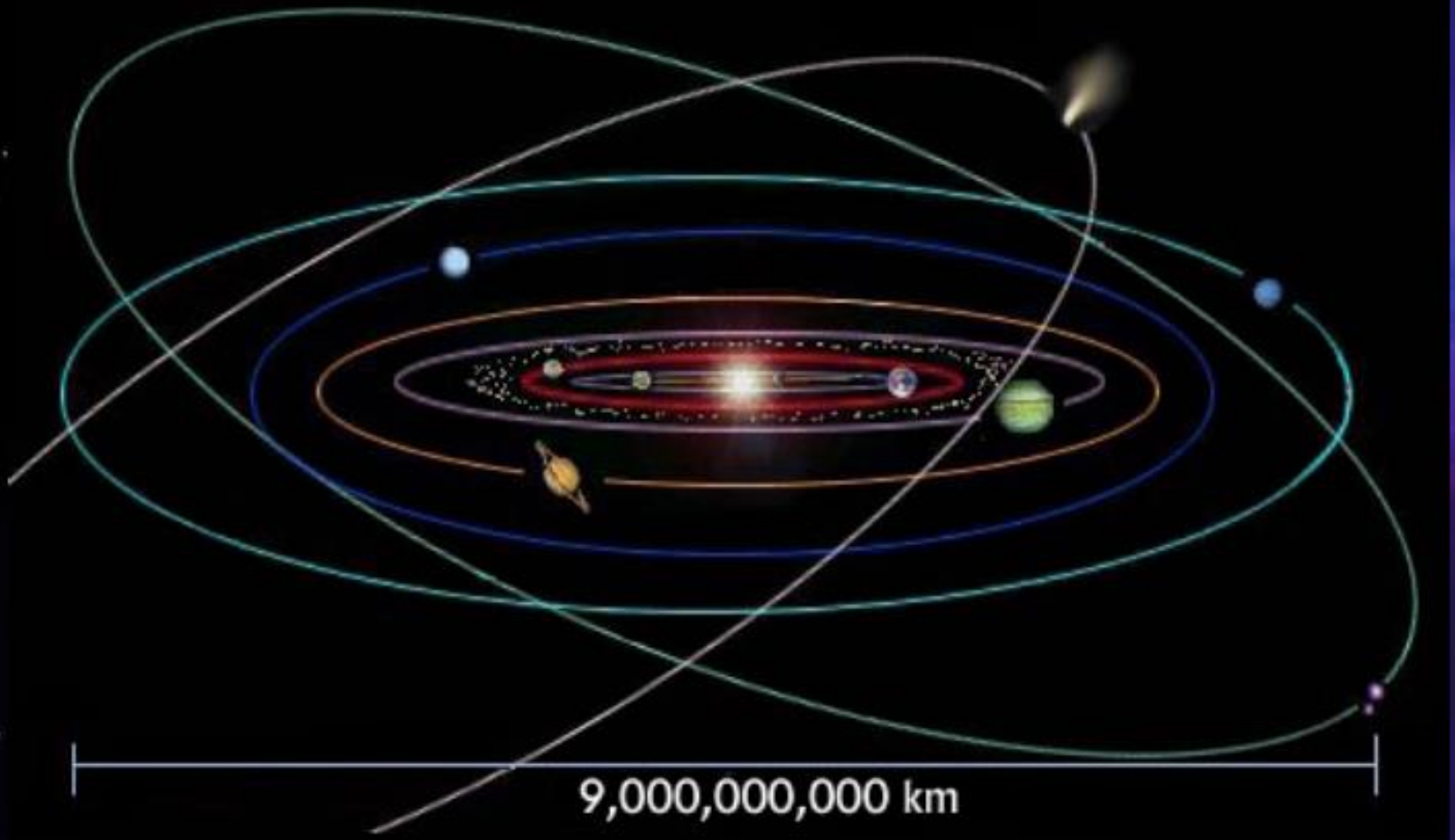
HOW BIG ARE THE PLANETS?

Here are the relative sizes of the planets in our Solar System. The Sun is so enormous that you could fit over one million Earths inside it – which is why we couldn't fit it on this page!

Distance



The Solar System



The Milky Way Galaxy

Solar System Scroll

Scale of Universe

Solar System Scroll

www.davinciclub.org

DA VINCI CLUB

SOLAR SYSTEM SCROLL

Exploring the scale of the solar system with a new artistic twist!

THE ACTIVITY

This lesson is ideal outdoors in a large space, or down a long hallway. Students will create a scale model of the solar system using adding machine tape (sketdi-able, roll-able, affordable). Making comparisons to the distance between solar system objects with their own bodies will help make the lesson personally relevant. Use a long tape measure or mark with steps.

In this activity, one Astronomical Unit (AU), the distance between the Sun and the Earth (~150,000,000 km) equals 10 centimeters: 1 AU = 10 cm

- This activity illustrates scale of distance between Solar System bodies, but not their size relative to each other—Dawn mission's Where Are You? activity helps illustrate both.
- Students can use different sized circles to symbolize relative size, though they will not be able to illustrate that comparison fully within the width of the adding tape.

SUPPLIES

-Adding machine tape (~10 students/roll)
-Craft glue or hot glue or Two sided tape
-Rulers or measuring tape
-Fine tip sharpies or markers
-NASA Global planet images
-Wooden skewers
-Meter measuring tape
-Small circle templates (coins or lids)
-Colored pencils
-Ribbon or Yarn

Material preparation

1. Cut adding machine tape to 4.2 meters (14 ft.) lengths
   a. One/student or team (though kids love to take home their own SS model)
2. Cut wooden cooking skewers to 14 cm length.

Student Activity

1. Glue wooden skewers to the ends of the adding machine tape by putting a small bead of glue, or a strip of two sided tape,
   a. Roll the paper around the skewer a little to secure.
   b. Tape wooden ends of scroll to long tables or floor with blue, painter's tape or masking tape (tape that holds yet comes up easily)

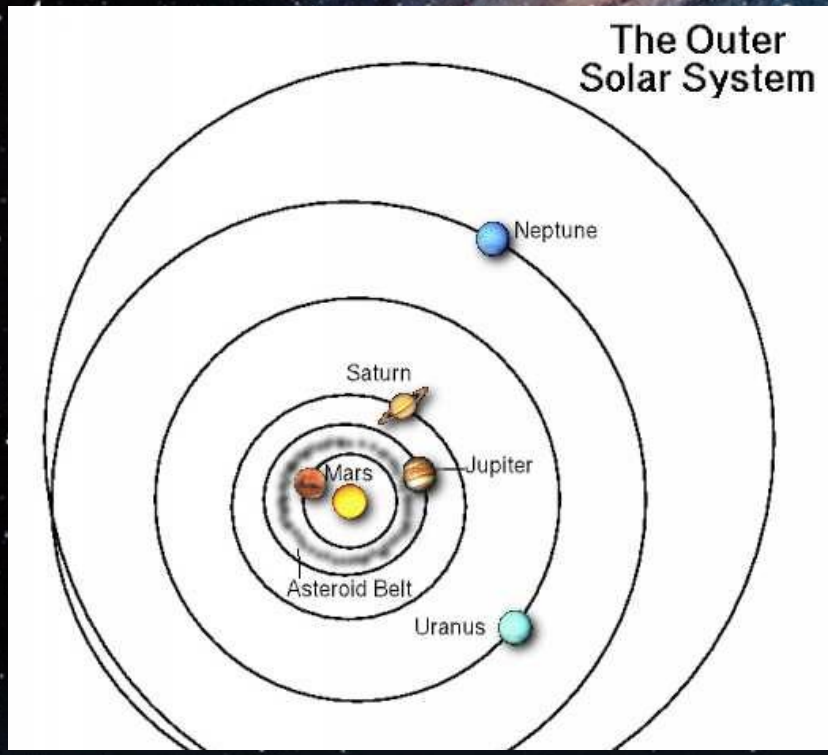
near the base of the scroll.
s 0 AU.
e to mark 10 cm increments with their pencil, recording the
om the Sun:
AU, etc.
the distance in cm for the outer solar system
ke a mark for Earth
ts make marks for the other planets, asteroids and dwarf
ale
and cm
udents to research and develop their own conversions

race their planets
4 cm work great
an 4 cm in diameter to ensure Mercury and Venus can be
Earth on the scroll.
draw and color the planets, asteroids and dwarf planets.
nage searches to research what the worlds look like
ds and distance in both AU and cm
m details: NASA missions at different bodies, even major

gs and look at other projects and discuss their observations,
scale of the solar system.
h reflects upon and synthesizes their discoveries
ish on sticky notes can be an effective protocol to foster a
er-peer critiquing process
n or yarn to take home a space keep sake.

SOLAR SYSTEM SCROLL CONVERSION CHART

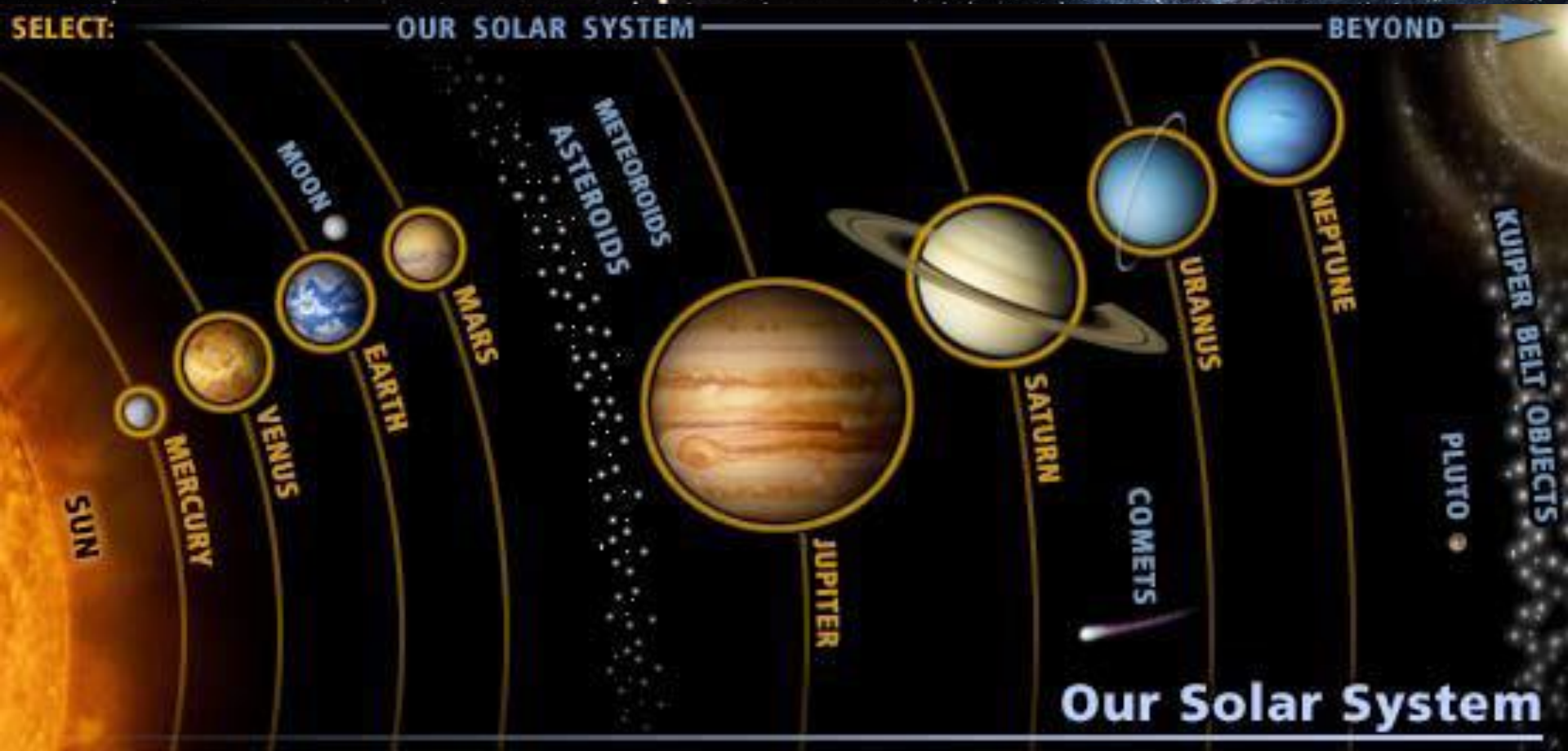
AVE DISTANCE From Sun In Miles	SCALE FOR SCROLL Metric in cm 1 AU = 10 cm	SCALE FOR SCROLL in inches 1AU = 3"
	0 cm	0"
36,000,000	4 cm	2"
67,200,000	7 cm	3"
93,000,000	**10 cm**	**4"**
141,600,000	15 cm	6"
	18 - 45 cm	7-18"
219,000,000	24 cm	9.5"
257,000,000	27 cm	11"
483,600,000	52 cm	20"
886,700,000	95 cm	37"
1,784,000,000	192 cm	75"
2,794,400,000	301 cm	118"
Pluto 39.5 AU	3,674,500,000	395 cm	155"

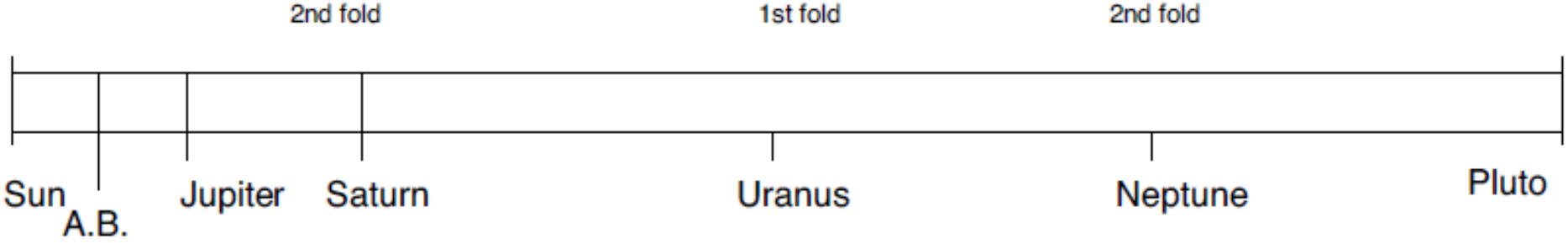


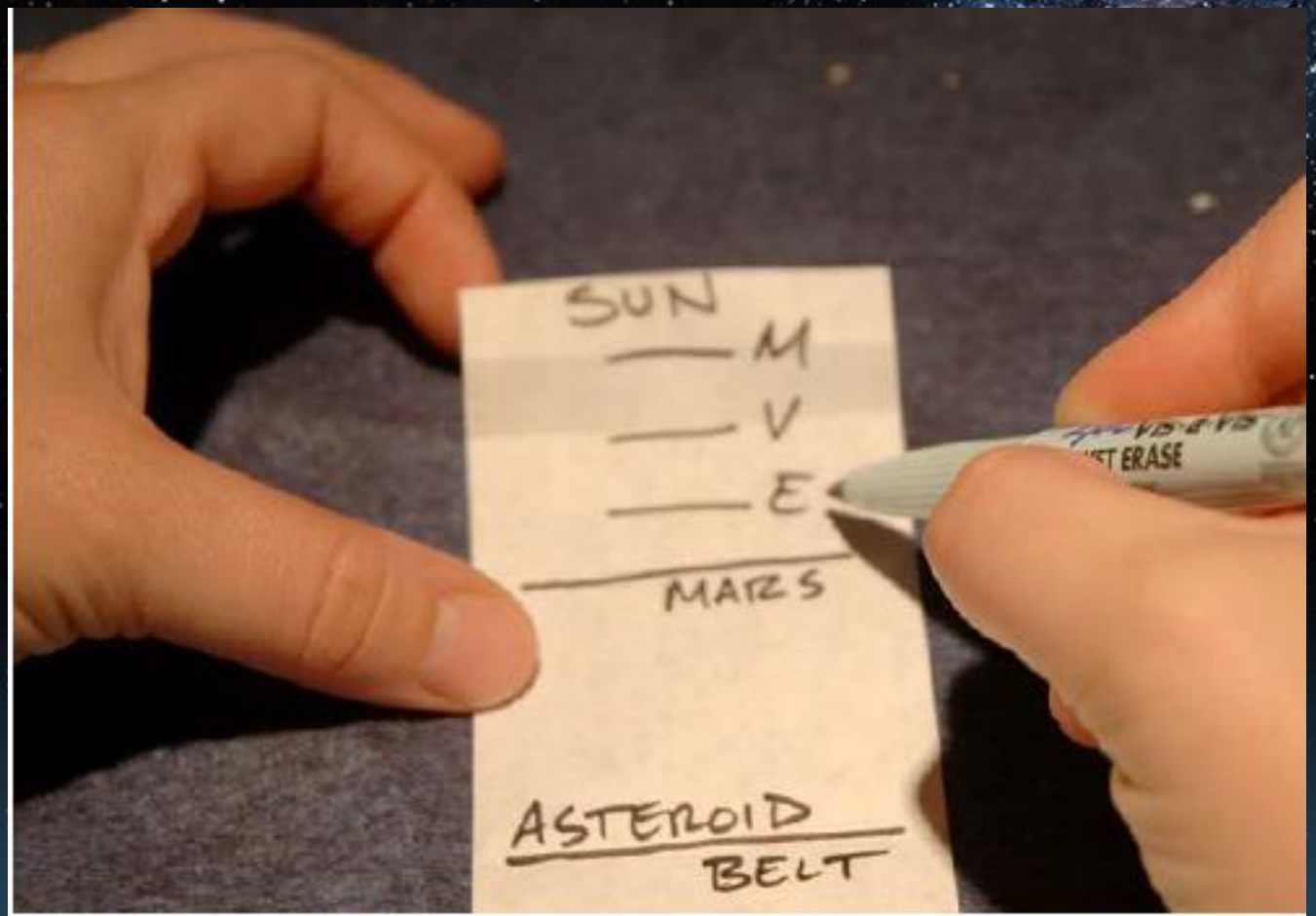
Scale of Universe

PLANETS & SMALL BODIES	AVE DISTANCE FROM SUN In Astronomica Units (AU) rounded to tenths	SCALE FOR SCROLL *in inches* *1AU = 3"*
Sun	0 AU	0"
Mercury	0.4 AU	2"
Venus	0.7 AU	3"
Earth	**1 AU**	**4"**
Mars	1.5 AU	6"
Asteroid Belt	1.8 - 4.5 AU	7-18"
Vesta	2.4 AU	9.5"
Ceres	2.7 AU	11"
Jupiter	5.2 AU	20"
Saturn	9.5 AU	37"
Uranus	19.2 AU	75"
Neptune	30.1 AU	118"
Pluto	39.5 AU	155"

Pocket Solar System




2nd fold
1st fold
2nd fold
Sun
A.B.
Jupiter
Saturn
Uranus
Neptune
Pluto

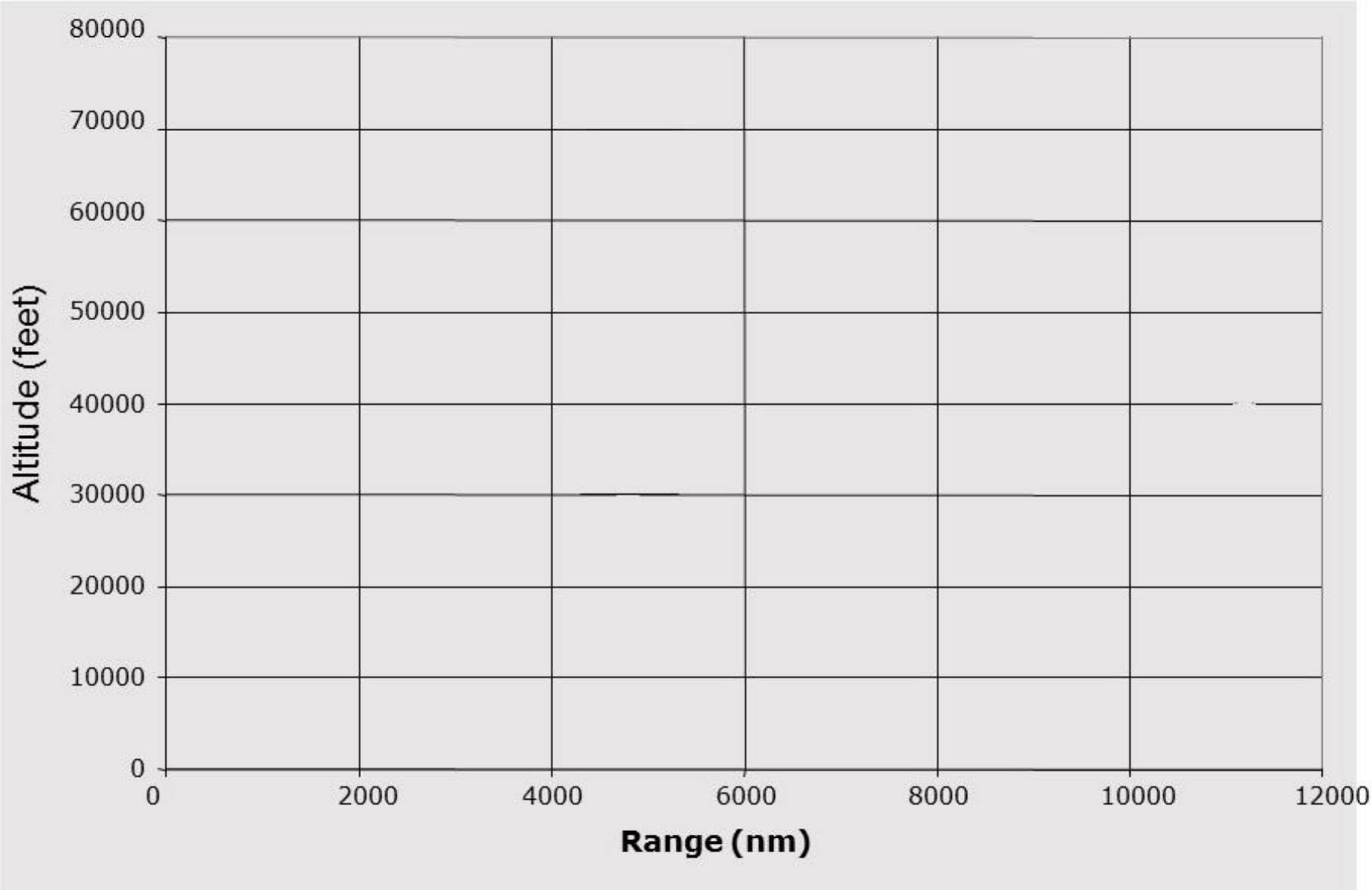

SUN
M
V
E
MARS
ASTEROID
BELT


Range vs Altitude
AFRC Airborne Science Aircraft

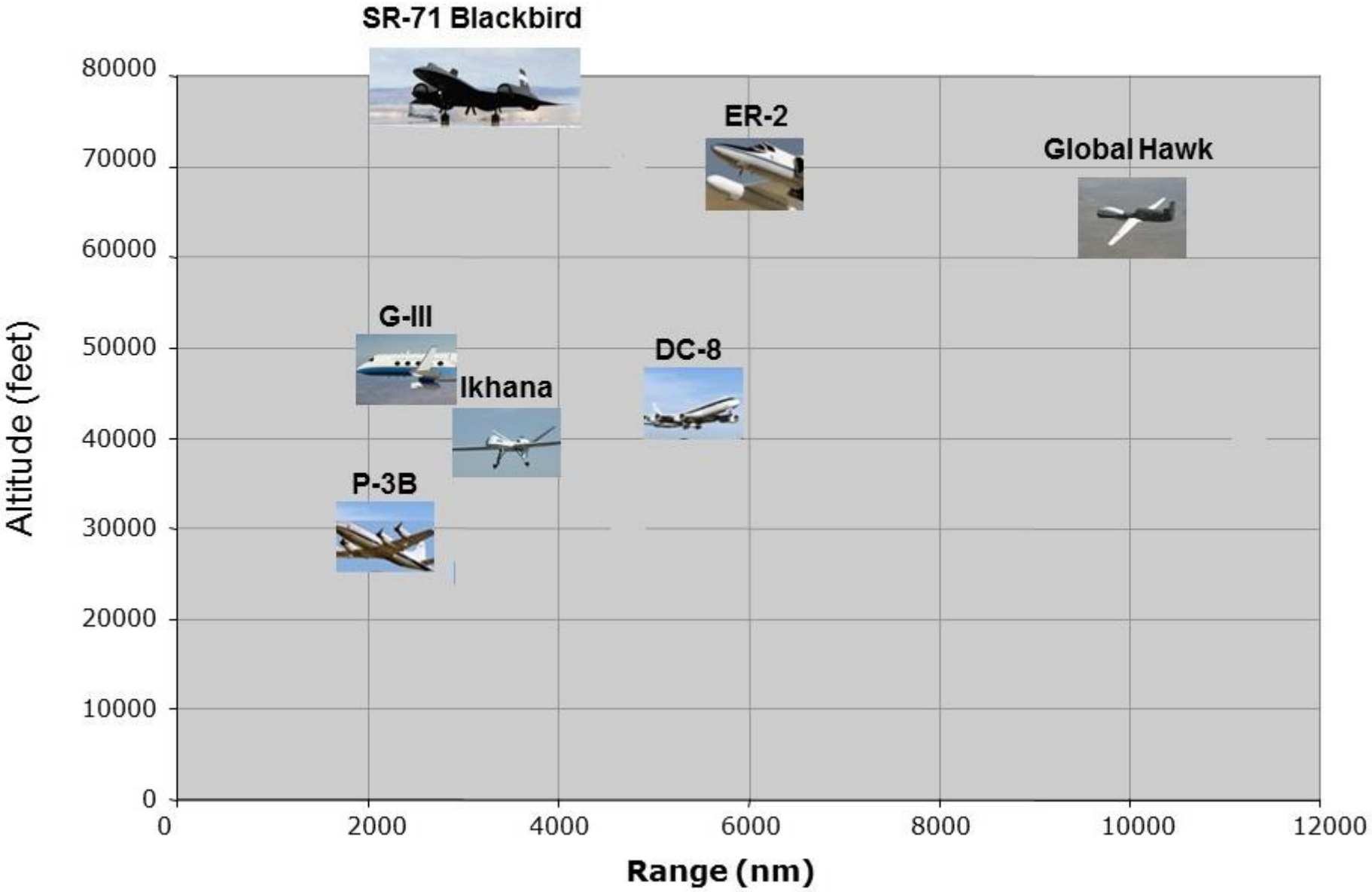
AFRC Science Aircraft

Plane	Range (nm)	Altitude (ft)
DC-8	5400	42000
ER-2	6000	70000
G-III	2712	45000
Global Hawk	10000	65000
Ikhana	3500	40000
P-3	2380	28300
SR-71 Blackbird	3200	80000

NASA Airborne Science Aircraft



NASA Airborne Science Aircraft



Learn More...

about all these missions that are visiting
New Worlds and making **New Discoveries**

discovery.nasa.gov
newfrontiers.nasa.gov

YOUR STUDENTS can be part of
NASA's exciting work!