



To the teacher:

The issues that face humans are steeped in numbers: exponential population growth; possible global warming; our exploration of space. The math and science skills that are necessary to deal with these issues have become an integral part of daily life. The Defying Gravity Thinking Big Module aims to teach students how to work with the astronomical numbers used in planning space journeys. By using the engaging backdrop of space exploration, students will learn how to manipulate, represent, use and feel comfortable with very large numbers.

The module consists of pre-lesson activities, a lesson plan with vivid PowerPoint-based presentation, follow-up activities and a full laboratory exercise. The lesson and the laboratory are designed to be separate, single period activities (approximately 45 minutes); the pre-lesson and follow-up lesson activities have been planned as homework assignments. However, all these components can be molded to fit your schedule.

The pre-lesson activities are meant to familiarize the student with these terms and concepts and how to use them.

The classroom lesson can be greatly enhanced by using the PowerPoint presentation materials (or the corresponding transparencies)- however it is not necessary to use these items. If the technology is not available, or if you are so inclined, the ideas can just as easily be worked out with chalk and slate.

This lesson plan covers a variance of uses for Powers of Ten. Each topic is headlined with a multi-step problem that involves, among other appropriate mathematical techniques, using Powers of Ten. Each topic is backed by computational problems to be disseminated for student practice and to promote self-directed learning.

The content within has been specifically chosen to meet the following National Science Education Standards. (2)

Content Standard A: Science as Inquiry

Content Standard E: Science and Technology

Content Standard F: Science in Personal and Social Perspectives

Content Standard G: History and Nature of Science

Good luck with these lessons. And remember,

“A mind once stretched by a new idea never regains its original dimensions.”

-Oliver Wendell Holmes (1809-1894)
Celebrated physician and professor of anatomy
and physiology at Harvard

Lesson Plan by David Blattberg

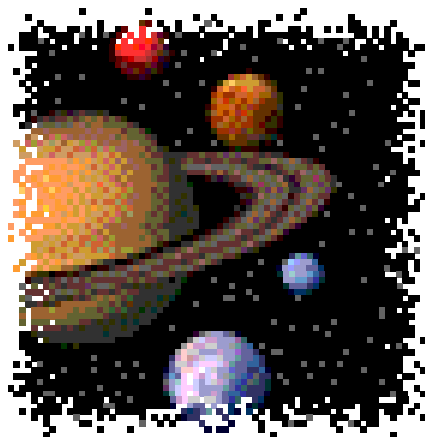
Pre-lesson Activity: Our Solar System

Draft Example: Students are to fill in blanks using either website (given) or NASA data document (given).

Pre-Lesson Activity #2: Our Solar System

Instructions: Please convert all the distances into powers of ten notation.

PLANET	DISTANCE TO THE SUN (km)	POWERS OF TEN
MERCURY	_____	_____
VENUS	_____	_____
EARTH	_____	_____
MARS	_____	_____
JUPITER	_____	_____
SATURN	_____	_____
URANUS	_____	_____
NEPTUNE	_____	_____
PLUTO	_____	_____



Pre-Lesson Activity: Powers-of-Ten Notation

Getting familiar with Powers of Ten

In writing very large numbers, it is convenient to use the following system of notation:

$$10^1 = 10$$

$$10^2 = 10 \times 10 = 100$$

$$10^3 = 10 \times 10 \times 10 = 1000$$

$$10^4 = 10 \times 10 \times 10 \times 10 = 10,000$$

Following this pattern:

$$10^{12} = 1,000,000,000,000$$

A light-year is approximately equivalent to 6,000,000,000,000 miles. This number could be written as $6 \times 1,000,000,000,000$ miles, or 6×10^{12} miles—a much simpler notation.

Shortcut:

If given 7.0×10^8 , move the decimal eight places to the right, which produces 700,000,000.

Commonly used Powers of Ten:

$$\text{Million} = 10^6 \quad (1 \times 10^6)$$

Therefore, 4 million can be written as 4.0×10^6 .

$$\text{Billion} = 10^9 \quad (1 \times 10^9)$$

Therefore, 7 billion can be written as 7.0×10^9

Exercises: Convert the following numbers into powers of ten notation.

a) 7,000,000

b) 4,000

c) 85,000,000

d) 2 million

e) 9 billion

f) 6,000,000,000,000

g) 1,500,000,000,000,000

h) 400 billion

Appendices 1 & 2

Sizes of the Planets:

<u>Planet</u>	<u>Actual Diameter</u>
Mercury	4,880 km
Venus	12,100 km
Earth	12,800 km
Mars	6,800 km
Jupiter	142,000 km
Saturn	120,000 km
Uranus	51,200 km
Neptune	48,600 km
Pluto	2,200 km
Sun	1,392,000 km

Distances from the Sun

<u>Planet</u>	<u>Distance</u>
Mercury	58,000,000 km
Venus	108,000,000 km
Earth	150,000,000 km
Mars	228,000,000 km
Jupiter	778,000,000 km
Saturn	1,424,000,000 km
Uranus	2,867,000,000 km
Neptune	4,488,000,000 km
Pluto	5,910,000,000 km