# Look Out Michael Jordan, Here Comes . . .

*Karen Campbell, WVPT*

## Overview

**Topic:** Spreadsheets, Solar System. In this lesson, students will compare the gravitational pull of the various planets and examine the effect of gravity on the height of a jump. Students will collect data on their vertical jump on Earth, then create a spreadsheet to calculate how high they could jump on other planets. Students should already have a basic understanding of the differences in the planets, and therefore, the differences in gravitational pull. A basic knowledge of spreadsheets is helpful, but not necessary.

## Length of Lesson

2 45-minute class periods

## Instructional Video/Technology

***Computer Skills for the Classroom and Beyond #5,*** Introduction to Spreadsheets, Part I
*Microsoft Works* or other spreadsheet software
1 computer with a presentation device (LCD panel, projector, or large-screen television/monitor)
World Wide Web
Internet Site: Windows to the Universe <http://www.windows.umich.edu/>

## Learning Objectives

The student will be able to:
- compare the gravitational pull of the planets in our solar system
- describe how the differences in gravitational pull of the planets would affect a person's activities
- collect, record, organize and analyze data
- create a spreadsheet to organize data and perform calculations
- use worldwide network communication systems
- retrieve information from teacher-selected World Wide Web site

(The lesson addresses Va. SOLs Science SOL 6.1, 6.10, PS.1; Computer/Technology SOL 8.1, 8.2, 8.4; Math SOL 6.10, 6.18)

## Materials

Per class:
- 1 tape measure (at least 4 feet long)
- masking tape

## Pre-Viewing Activities

**1.** Ask: How high can you jump? Give the students the opportunity to jump up and down as high as possible as an energizing activity.

**2.** Say: I saw some great jumps out there. How many of you can slam dunk a basketball? Allow student response, then ask why not? What factors affect how high you can jump? (Students should eventually come up with "gravity.") Is there anywhere you could go where you could slam dunk? Allow for student ideas. (Students should already understand that the gravitational pull is different on different planets.)

**3.** Have students predict whether or not they could slam dunk on each of the planets.

## Focus for Viewing

Ask: How could we go about finding out if we actually could slam dunk on any other planet? Allow student response, then say: Today we are going to meet two students, Alisha and Rachel, in a video who will help us to accomplish this task. As we watch the video, be looking for the steps that we will need to take to answer our question. Be on the lookout for a special tool that will make our job easier.

### Time Cues

To synchronize your VCR with the time cues that are included with this lesson, zero/reset your time counter at the very beginning of the program, before the introduction and titles. Time cues are expressed as "minutes:seconds;" for example, 3:15 means three minutes and fifteen seconds.

## Viewing Activities

**1.** Say: Let's meet Alisha and Rachel and find out what our first step should be. **START** at the beginning of ***Computers for the Classroom and Beyond #5.*** **PAUSE** 2:04 into the video when Alisha says "I think you know where we're going with this, right?" Ask: What is the first thing we will need to do? (Calculate how high we can jump—our vertical jump). Ask: How do you think they are going to calculate Alisha's vertical jump (subtract jump height from standing height). **REWIND** and **REPLAY** the section where Alisha is jumping if students did not get the numbers the first time.

**2.** Let's see if Alisha and Rachel came up with the same answer. Also, look for the tool that is going to help us find out if we can slam dunk on the other planets. **RESUME** video. **PAUSE** at 3:04 when Rachel says "This is the perfect time for us to learn about spreadsheets." Ask: What tool can we use? (a spreadsheet) What is a spreadsheet? Allow student response, then ask what a spreadsheet is used for. Discuss student ideas.

**3.** Say: Let's see how Alisha and Rachel set up their spreadsheet. **RESUME**. **PAUSE** at 3:34 when Alisha says "And that would be that." Ask: What column headings did Alisha and Rachel use in their spreadsheet? Do you see any problems with the way that they set up their spreadsheet?

### NOTE TO THE TEACHER
### Pause vs. Stop

When using a video interactively with students, teachers need to decide when to use **PAUSE** and when to use **STOP**. **PAUSE** the video when the anticipated discussion or activity will take less than two minutes. **STOP** for longer periods. Pausing for too long at one time can cause video heads on the VCR to become clogged which may require cleaning to correct.

**4.** Say: Mr. Einstein has some suggestions for them. Look for the changes that he suggests. **RESUME** video. **STOP** at 5:34 when Rachel says "That's why recording all the data is so important." Ask: What change did Mr. Einstein suggest. (Record all data.) Why? (Less likely to make mistakes; will account for Alisha's change in height over time) Discuss the importance of accurate collection and recording of scientific data in research.

**5.** Ask the students if they would like the opportunity to collect and record some data on their own. Say: We are going to recreate the experiment that Alisha and Rachel performed, except we are going to collect data on all of the students in the class. (Explain to the students that we will not use the chalk since so many people are jumping at one time and it would get very messy!)

**6.** Work together to set up the spreadsheet on paper. It should include a column for student names, height 2 (jump), height 1 (standing), and vertical jump.

**7.** Take students to the gym or outside. You need a wall that is tall enough to fasten a tape measure to beginning at 6 feet and extending upward. Use the masking tape to fasten the tape measure to the wall. (Depending on the height of the students, you may need to begin at 5 feet.)

**8.** Measure each student's standing reach flat-footed, then have each student jump as high as they can and record the height, rounding to the nearest inch. (Explain to students that you are using customary measurement instead of metric measurement because a basketball jump would be measured that way).

**9.** When all students have recorded their information, return to the classroom and continue.

**10.** Say: Now we know how high we can jump on Earth. What's the next step to finding out if there's anywhere we can slam dunk a basketball? (Calculate how high we can jump on the other planets.) Let's continue with our video to find out what tool Mr. Einstein suggests that we use for this task. **FAST FORWARD** to 6:29 to the picture of the marker on the spreadsheet. **PLAY**. **PAUSE** at 7:25 when Rachel says "Don't forget to label your rows and columns." Ask: What tool did Mr. Einstein suggest? (A computer spreadsheet) Why do you think he suggested using a computer spreadsheet instead of a paper spreadsheet? What advantages would that have? Allow student response. (Depending on students' exposure to spreadsheets, they may or may not understand that spreadsheets can do the calculations for them. This idea will be developed later.) Work together on the board to decide on column labels. (Names, Height 2, Height 1, Earth, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto)

**11.** Say: Before we continue, it would be helpful for us to have some background information on computer spreadsheets. If students have used spreadsheets, this is a good review; if not, this will help them to understand the terminology of spreadsheet. Say: As you watch the video, find the three parts of a spreadsheet. **RESUME** video. **PAUSE** at 8:43 when Alisha says "Then I can type in numbers and letters." Ask: What are the three parts of a spreadsheet. (Column, row, cell)

**12.** Open your spreadsheet software on the classroom computer connected to a presentation device so all students can see. Review the terms: column, row, and cell. Have students come up and point out Row 5, Column C, Cell B-2. Move cursor to several different cells and have students give their location.

**13.** Say: As you watch the next segment, find out the big advantage of a computer spreadsheet over a paper spreadsheet. **RESUME** video. When Rachel quizzes the students on the computer coordinate system, **PAUSE** after each question to allow students to respond. Then **PAUSE** at 10:18 when Rachel gives the location of the jump heights for April 5. Ask: What is the advantage of computer spreadsheets? (They can do the calculations for us.)

**14.** Say: Before we can make the computer do the calculations, we are missing an important piece of information. What is it? (The gravitational pull of the different planets.) Why do different planets have different gravitational pulls? (The planets have different masses.) You may need to discuss the difference between size and mass if students have not already learned this since students may respond that larger planets have a greater gravitational pull. Ask: Where can we go to find out this information? (Textbooks, encyclopedias) What computer tool could we use? (Electronic encyclopedias, the Internet)

**15.** Open an Internet connection. As you go online, ask: What is the Internet? (A world-wide network of millions of computers) Open the site: Windows to the Universe at <http://www.windows.umich.edu/> As the site is coming up, use the opportunity to discuss the type of information that is available on the Internet and its validity. Students should understand that anyone can put information on the Internet, so not everything they find is true. Once you are in the site, you can go to "Table of Contents," then "About the Project" and show the students that this project is funded by NASA and conducted by the University of Michigan. Ask: Should this be reliable information? (Yes) Return to the homepage and enter the site. Once in the site, click on the planet name, then select Planetary Facts. Have students record mass and surface gravity for each planet on the worksheet. There is a great deal of information as well as

**NOTE TO THE TEACHER**

The information is available on the video if the Internet is not available in your school. See #16 in viewing activities.

images on this site that you could explore with the students depending on the amount of time you have available. As students record the mass and gravitation for each planet, discuss the relationship between the two. Discuss how the gravitational pull would affect their daily lives on each planet - difficulty running and jumping, doing work, lifting things, etc. Close the Internet connection and return to the video.

**16.** Say: The video also gives the information on the gravitational pull of each planet. Let's compare what we found on the Internet to what's on the video. **RESUME** video. **PAUSE** when the chart showing the gravitational pull of each planet is on screen. Compare. (There are minor discrepancies.) Ask: Why are there differences in the two? (Newer information, these numbers are estimates.) **STOP** video. Ask: Which planet's gravitational pull is closest to that of Earth? (Uranus) Which has the strongest pull? (Jupiter) Which has the weakest? (Pluto) Discuss the differences. Say: We know our vertical jump on Earth and we know the gravitational pull of the planets. How can we use these numbers to calculate vertical jump? (Divide)

**NOTE TO THE TEACHER**

The site gives the following gravity for each planet:

| | | |
|---|---|---|
| Mercury 0.38 | Venus 0.90 | Mars 0.38 |
| Jupiter 2.64 | Saturn 1.2 | Uranus 0.93 |
| Neptune 1.2 | Pluto 0.03 | |

Students may note a discrepancy on this page when they are investigating the relationship between mass and gravity. Uranus has a mass 14 times that of Earth, but less gravity 0.93. Other sites give the planetary gravity of Uranus as 1.12 and 1.04. You will want to discuss these differences.

**17.** Say: Let's watch the video to find the formula for calculating our jump on the other planets and how we can enter the formula to make the spreadsheet do the calculations. **RESUME** video. **PAUSE** at 11:56 when Rachel says "Where do you think the formula F6/2.65 comes from?" Allow for student response. (2.65 is the gravitation pull of Jupiter, F6 is the cell location of vertical jump on Earth.) What is the formula for finding our vertical jump on the other planets? (Earth vertical jump divided by planetary gravity) What symbol do we use to show the computer that we are entering a formula instead of data? (Equals sign for Microsoft Works)

**18.** Say: Let's see how all of this comes together to find out how high Alisha can jump on Jupiter. **RESUME** video. **STOP** at 12:51 when Rachel says "Why don't you pick a favorite planet and give it a try." Ask: Can Alisha slam dunk on Jupiter? (No) How high can she jump? (6.8 inches) Do you understand how we can combine the information that we have gathered and our knowledge about spreadsheets to find out if we can slam dunk on any of the other planets?

## Post Viewing Activities

**1.** Open your spreadsheet software on the classroom computer connected to a presentation device so all students can see. Work with students to enter the column headings into the spreadsheet.

| | | | | | |
|---|---|---|---|---|---|
| A-1 | Names | E-1 | Mercury | I-1 | Saturn |
| B-1 | Height 2 | F-1 | Venus | J-1 | Uranus |
| C-1 | Height 1 | G-1 | Mars | K-1 | Neptune |
| D-1 | Earth | H-1 | Jupiter | L-1 | Pluto |

**2.** Ask: How can we make these column headings stand out? (Bold) Highlight column names and use toolbar to center align and bold.

**3.** Have each student enter their name, height 2, and height 1.

**4.** Work with students to develop formulas and enter into the spreadsheet (on row 2). Ask: What will happen if you do not enter the = first? (Students should understand that the formula must begin with the equals sign to show the computer that it is a formula being entered.) Ask: What formula did we use the calculate the vertical jump on Earth. (Height 2 minus height 1) Move the cursor to cell D2, then type =B2-C2, then enter. Students should see the calculation being made.

**5.** Ask: What formula would we use to calculate the vertical jump on Mercury? (Earth vertical jump divided by planetary gravity or D2/.73. Move cursor to cell E2, then type =D2/.73. Continue in this manner for each planet.

| | |
|---|---|
| E-2 | =D2/.38 to calculate the vertical jump on Mercury |
| F-2 | =D2/.90 to calculate the vertical jump on Venus |
| G-2 | =D2/.38 to calculate the vertical jump on Mars |
| H-2 | =D2/2.64 to calculate the vertical jump on Jupiter |
| I-2 | =D2/1.2 to calculate the vertical jump on Saturn |
| J-2 | =D2/0.93 to calculate the vertical jump on Uranus |
| K-2 | =D2/1.2 to calculate the vertical jump on Neptune |
| L-2 | =D2/.03 to calculate the vertical jump on Pluto |

**6.** Say: We want to calculate the height of the jumps for all of the students. How can we do that? (We need the formula in all of the cells in that column.) Is there an easy way to accomplish that? (Copy and paste) Highlight cell D2, then copy the formula. Highlight the remainder of the column, then paste the formula. Be sure to show students how the formula changes to accommodate the different rows. Continue for each column.

**7.** Ask: Do we really need to show our vertical jumps to the nearest ten-thousandths? (No) Discuss significant digits, then ask: How many decimal places do we really need? (No more than tenths) Click on D to highlight column, then drag across to highlight columns D through L. Click on Format, then Number and select Fixed with 1 decimal place.

**8.** Once the spreadsheet is complete, select one student. (One with a high vertical jump.) Click on cell D* and highlight cells D* - L*. Use the graphing tool on the toolbar to graph this data. Ask: How can we use this data to tell whether he/she could slam dunk on each planet? (We would have to add their vertical jump to their reaching height.) What is the height of a basketball goal? (10 feet) Students should realize that their reaching height (Height 1) plus their vertical jump would have to be 120 inches or greater to be able to slam dunk.

**9.** Each student may graph and print their data. Compare results to predictions.

## Assessment

**1.** Have students set up individual spreadsheets with the same data.

**2.** Give students the data (planet name, mass, gravitational pull) for a set of imaginary planets. They should add that data to their spreadsheets and determine whether or not they could slam dunk on those planets based on their information.

## Action Plan

**1.** Research how scientists use spreadsheets.

**2.** Find out if their parents use spreadsheets in their jobs. Explain the purpose.

**3.** Invite a business partner into the class to demonstrate how they use spreadsheets in their business.

## Extensions

**Language Arts/Technology:** Have students use a word processor to write a creative story describing life on an imaginary planet that has a great deal or very little gravity. (Va. SOLs English 6.7, 7.8, 8.5; C/T 8.1)

**Math/Technology:**

- Have students create a spreadsheet that would convert the customary measurements that they gathered to metric measurements. (Va. SOLs Math 6.9; C/T 8.1)
- Have students add a column to their spreadsheet to calculate whether they could slam dunk for each planet. (Height1 + Vertical Jump). Graph results (Va. SOLs C/T 8.1)

**Science/Technology:**

- Have students use electronic resources such as electronic encyclopedias or the Internet to gather data on the planets, then build a database and enter collected data. (Va. SOLs Science 6.10; C/T SOL 8.1, 8.3)

**Some related Web sites:**

*Welcome to the Planets: California Institute of Technology*
<http://pds.jpl.nasa.gov/planets/>
This is a collection of many images from NASA's planetary exploration program by the California Institute of Technology.

*Browse the Solar System USGS*
<http://wwwflag.wr.usgs.gov/USGSFlag/Space/wall/wall.html>
This site contains information about the Solar System and products created by the USGS.

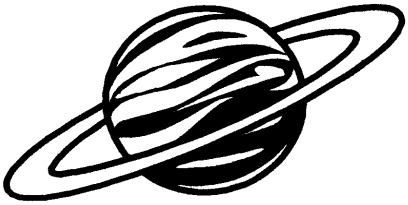
*The Nine Planets — A Multimedia Tour of the Solar System*
<http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html>
This site provides an overview of the history, mythology, and current scientific knowledge of each of the planets and moons in our solar system by the SEDS at the Lunar and Planetary Laboratory, University of Arizona.

*Regional Planetary Image Facility*
<http://www.nasm.edu/ceps/rpif.html>
The Planetary Image Facility, at the National Air and Space Museum Smithsonian Institute, houses over 300,000 photographs and images of the planets and their satellites obtained from planetary missions.

*Windows to the Universe*
<http://www.windows.umich.edu/>
Windows to the Universe provides information and graphics about the Earth and Space Sciences by NASA and the University of Michigan. It includes not only scientific content, but also information about the artistic, historical, and cultural connections between science and our lives.

*The Weighing Station*
<http://www.tcsn.net/afiner/convert2.html>
This site provides a description of the relationship between gravity and mass, as well as a "Gravity Calculating Machine" that will automatically calculate your weight on the other planets.

*A publication of the 1998-99 NTTI—Virginia*



# Planet Data

| Planet | Mass | Gravity |
|---|---|---|
| Mercury | | |
| Venus | | |
| Earth | | |
| Mars | | |
| Jupiter | | |
| Saturn | | |
| Uranus | | |
| Neptune | | |
| Pluto | | |