

## THE FINAL FRONTIER: TEACHER GUIDE

**Subject:** Earth Science

**Grade Level:** Middle School

**Last Updated:** December 12, 2008

### Case Summary

The future is here: it's 2206, and humanity will soon begin colonizing new planets in the solar system. However, the government has only given NASA enough money to colonize one planet. Which planet should we colonize first? How will we go about doing it? Who should be part of the colonies? As NASA's top scientists, it falls on you to figure it out.

### Credits

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This case was adapted from *Know Your Galactic Address* (Dixon, 2008).

Dixon, D. (2008). Know your galactic address. Retrieved December 11, 2008 from <http://dixon8science.okaloosaschools.wikispaces.net/file/view/Know+your+Galactic+Address+Davidson.pdf>

### Learning Objectives

At the end of the case, students will be able to:

1. Describe in detail the physical characteristics of the eight other planets in our solar system, including distance from the sun and from Earth, size, atmosphere, terrain, climate, etc. and when applicable, evidence of possible life on other planets in the solar system.
2. Explain the characteristics of one planet (elaborated above) to the rest of the class in a clear and comprehensible way and using self-constructed visual aids.
3. Diagram at least one other planet in the solar system, scaled to Earth and the sun.
4. List the various hazards to account for in colonizing a given planet, including protection from heat, cold, low or excess gravity, toxic atmosphere, inadequate or excess solar radiation, transportation, delivery of water and deliver and/or production of food.
5. Compare and contrast the nine planets, including Earth, based on all of these characteristics.
6. Discuss the possibility and logistics of colonizing planets in other solar systems.

### Georgia Performance Standards

*S6CS1.* Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

*S6CS5.* Students will use the ideas of system model, change, and scale in exploring scientific and technological matters.

S6E1. Students will explore current scientific views of the universe and how those views evolved.

- b. Describe the position of the solar system in the Milky Way galaxy and the universe.
- c. Compare and contrast the planets in terms of
  - Size relative to the earth
  - Surface and atmospheric features
  - Relative distance from the sun
  - Ability to support life

### Assessment

At the end of the case, students will pass in their box charts, which will be graded based on completeness and clarity. Even though we go over these periodically in class, knowing that they will be passing the box charts encourages students to listen and efficiently take notes.

For their final assessment, students create either handouts or posters to use in presenting an argument for or against colonization of their planet to the rest of the class. These must include both written and illustrated components, based on a sample poster/handout guide (See Student Materials for this case).

Overall grading for the case is based on their combined grades for their box charts and products. Grading will be based on a 5-point scale (5=excellent, 4=very good, 3=good, 2=fair, 1=poor) that will be converted into a percentage and from there into total points depending on the weight of the assignment, for each of three criteria:

- Accuracy and depth of product components; attention to grammar and mechanics
- Individual contribution/participation within the team
- Individual research ability and effort – online, print, investigative questioning

The second and third criteria (participation, individual effort) will be judged not only by facilitator observations, but by student evaluations to be completed at the end of the case (See sample **Evaluation** in Student Materials).

### Implementation Strategy

This case is designed to take place over two 60-minute and three 120-minute class sessions. It consists of a mock letter from the current president of NASA and a “Planetary Colonization Criteria” handout. The handout can be found at <http://dixon8science.okaloosaschools.wikispaces.net/file/view/Know+your+Galactic+Address+Davidson.ppt>. This case can be facilitated by two facilitators or even a single teacher, because rather than placing a facilitator with every group, the students spend time brainstorming with their group and then as a whole class.

Implementation for this case differs from that of our others in the respect that students will work in pairs, trios or groups of four (really, whatever combination) so that there are eight groups per class. Each group will draw a planet from a hat in which all of the planets, minus Earth, are written on slips of paper, and they will be responsible for the planet that they draw.

All groups will be responsible for completing a “Planetary Colonization Criteria” handout for Earth to use as a basis for comparison when examining the colonization potential of their selected planet.

Dixon, D. (2008). Know your galactic address. Retrieved December 11, 2008 from <http://dixon8science.okaloosaschools.wikispaces.net/file/view/Know+your+Galactic+Address+D+avidson.ppt>

Students typically read, discuss and take notes in their groups in 15-20 minute blocks, then reconvene as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their questions, and/or test their hypotheses) at the end of every 10-minute block. However, because this case only has one “scene,” i.e. the letter, they will spend the shortened class period on Monday reading the letter, brainstorming within their group, and will reconvene to share as a class the next day. While the students brainstorm, facilitators should float from group to group, checking progress and helping students think through questions or mental roadblocks.

### *Implementation Schedule*

Day 1 (60 minutes total)

- Read letter; brainstorm and construct box chart
- Go over box charts; divide learning issues

Day 2 (120 minutes total)

- Pass out “Planetary Colonization Criteria” handout

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- “Textbook lab:” Prior to online or any other research, utilize textbook (REF) as a primary resource for answering learning issues

Day 3 (120 minutes total)

- Computer lab: Finish researching learning issues (~30 minutes)
- Reconvene and discuss findings in groups (20 min.), then as a class (~40 min.)
- In groups, plan out the presentation and divide up presentation components (30 min.)

Homework: Work on individual presentation components

Day 4 (60 minutes total)

- Work on presentations during class (~60 min.)

Day 5 (120 minutes total)

- Each group presents their planet and takes questions from the rest of the class
- Case evaluation, wrap-up

## Case Notes

*This case was written prior to scheduling changes at our school and consequently has never been implemented. However, our team has produced and implemented several other cases using this “official letter” format, including I Spy Lots of Lights, Walkin’ on the Moon, and Tsunami Disaster. We recommend referring to those case notes (available through CASES online) for tips. Also, web resources are available for this case on the PRISM Columbia Middle website (See **Resources**).*

## Facilitator Guide:

*NASA Letter with key concepts underlined:*



From the desk of

**Michael Griffin, PhD**

Head Administrator

**INTERNAL MEMO**

May 5, 2206

**Attention:** Drs. \_\_\_\_\_

I have recently received a notice from the federal government confirming that NASA will be given funding to develop and execute a plan to colonize one of the other planets in our solar system. However, since the amount that we are being given is only enough to colonize one planet, we must decide which one we are to focus our efforts on. I am therefore forming a Planetary Colonization Task Force, which you will lead. I will need detailed reports on each of the planets in our solar system before I can make a decision. To help ensure that all members of the task force gather all needed information, I have included Planetary Colonization Criteria forms with this memo; please use these forms to guide you in developing your presentations.

I have scheduled a meeting to take place five days from now, where we will discuss the findings that you present and decide which planet is best suited for colonization.

Mike

## Resources

We found that assembling the most useful of the following online sources as links on a website that the students can access in the computer lab or at home is a very efficient way to structure group or independent research. Also, the students should be encouraged to utilize their textbooks or other resources. These are some helpful resources; a selection of these was included on the “The Final Frontier” page of the PRISM website under 8<sup>th</sup> grade Cases ([www.prism.emory.edu/columbia](http://www.prism.emory.edu/columbia)).

### *Textbook*

Padilla MJ, Miaoulis M, Cyr M (2004) Prentice Hall Earth Science (Science Explorer). Prentice Hall Publishers.

### *Web Resources*

Kidsmemory.com. (2006). Solar system. Retrieved December 12, 2008 from [http://www.kidsastronomy.com/solar\\_system.htm](http://www.kidsastronomy.com/solar_system.htm)

Finer, A. and Arnett, B. (2006). The nine planets – For kids! Retrieved December 12, 2008 from <http://kids.nineplanets.org/>

National Aeronautics and Space Administration. (2006). Moons of the solar system scaled to Earth’s moon. Retrieved December 12, 2008 from [http://solarsystem.nasa.gov/multimedia/gallery/Many\\_Moons.jpg](http://solarsystem.nasa.gov/multimedia/gallery/Many_Moons.jpg)

Russel, R. (2005) Windows to the universe: Our solar system. Retrieved December 12, 2008 from [http://www.windows.ucar.edu/tour/link=/our\\_solar\\_system/solar\\_system.html](http://www.windows.ucar.edu/tour/link=/our_solar_system/solar_system.html)

British Broadcasting Company. (2006). Science and nature: Space. Retrieved December 12, 2008 from <http://www.bbc.co.uk/science/space/solarsystem/>