

## *The Future of the Milky Way: Teacher's Guide*

**Grade Level:** 9-12

**Curriculum Focus:** Astronomy/Space

**Lesson Duration:** Two to three class periods

### **Program Description**

Scientists from around the globe probe to find clues about the origins of our galaxy. See how they attempt to pinpoint the location of a strange and dangerous presence—a massive black hole—hidden at the core of the galaxy. Watch the dramatic animation of the birth and life of the Milky Way Galaxy and learn what the future holds for the cosmos.

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### **Onscreen Questions**

Part I—Before watching the video

- Think about ways in which astronomers from around the globe gather information about our galaxy, the Milky Way. Pay attention to the equipment and the facilities scientists use in their study of the galaxy.
- Share any personal experiences that you might have had observing the night sky.

Part I—After watching the video

- Describe the appearance of the Milky Way. Where is our solar system located within the Milky Way?
- At the center of the Milky Way is a powerful black hole. What is a black hole? What role do black holes play in the galaxy?

Part II—Before watching the video

- For thousands of years, scientists, philosophers, and mystics have made many fascinating predictions about the future of the cosmos. What are your thoughts regarding the future of our planet, our galaxy, and the universe?
- Share the names of any books or films that have helped shape your views.

Part II—After watching the video

- Scientists forecast that Earth's environment will eventually become inhospitable to humans. What is the basis of this prediction? Discuss the conditions necessary for such an event.
  - What would you propose to save the human race from extinction?
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## Lesson Plan

### *Student Objectives*

- Speculate about the changes that are taking place in our galaxy.
- Research the latest ideas on the future of the Milky Way.
- Discuss the consequences of events that may happen in the future.

### *Materials*

- *The Future of the Milky Way* video and VCR
- Computer with Internet access
- Print and pencils

### *Procedures*

1. Begin the lesson by having a brainstorming session on students' ideas about the future of our galaxy the Milky Way. Do they think the galaxy is changing? If so, what do they think is bringing about these changes? What do students think the galaxy will look like billions of years from now?
2. Next, show the video. Have students pay particular attention to the segments on three main events occurring in the Milky Way: the collision of the Milky Way and the Andromeda Galaxy, the destiny of the sun and other stars in the galaxy, and the development.
3. Tell students that scientists predict that these events will occur billions of years from now. To learn more about each of these topics and the relationship among them, tell students that they will have time in class to research one of these topics.
4. Divide the class into three groups. Have one group research the collision of galaxies; the second group, changes in stars; and the third group, the development of black holes. The Web sites below provide appropriate information.

#### **Collision of Galaxies**

- <http://oposite.stsci.edu/pubinfo/pr/97/34/af1.html>
- [http://www.prime-radiant.com/Colliding\\_Galaxies.html](http://www.prime-radiant.com/Colliding_Galaxies.html)
- [http://www.space.com/scienceastronomy/astronomy/big\\_banger\\_990921.html](http://www.space.com/scienceastronomy/astronomy/big_banger_990921.html)

#### **Changes in Stars**

- <http://btc.montana.edu/ceres/html/starsbackground.htm>
- <http://www.enchantedlearning.com/subjects/astronomy/stars/lifecycle/>
- [http://imagine.gsfc.nasa.gov/docs/teachers/lifecycles/LC\\_main\\_p2.html](http://imagine.gsfc.nasa.gov/docs/teachers/lifecycles/LC_main_p2.html)
- [http://www.imsa.edu/edu/astro/astrostudents/96\\_97\\_2/t06p1/](http://www.imsa.edu/edu/astro/astrostudents/96_97_2/t06p1/)
- <http://www.d78st.com/life.html>



## Black Holes

- <http://archive.ncsa.uiuc.edu/Cyberia/NumRel/LIGO.html>
  - [http://www.damtp.cam.ac.uk/user/gr/public/bh\\_intro.html](http://www.damtp.cam.ac.uk/user/gr/public/bh_intro.html)
  - [http://imagine.gsfc.nasa.gov/docs/science/known\\_12/black\\_holes.html](http://imagine.gsfc.nasa.gov/docs/science/known_12/black_holes.html)
  - <http://www.eclipse.net/~cmiller/BH/blkbh.html>
5. After each group has completed its research, have students write a paragraph representing their findings. Tell students to include scientists' latest research, theories, and supporting evidence.
  6. Conclude the lesson by bringing students together for a final class discussion. To begin, ask one person from each group to summarize the group's findings. Why do scientists think that these events will take place? What is the relationship among these events? What will the world look like billions of years from now after these events have taken place?

## Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students participated actively in class discussions; completed their research carefully and thoroughly; wrote well-developed paragraphs summarizing their ideas on the topic.
- **2 points:** Students participated in class discussions; completed their research; completed paragraphs summarizing their ideas on the topic.
- **1 point:** Students participated little in class discussions had difficulty completing their research; did not complete paragraphs summarizing their ideas on the topic.

## Vocabulary

### Andromeda Galaxy

*Definition:* A spiral galaxy (like our galaxy, the Milky Way) that is our closest neighbor, about two million light-years from Earth

*Context:* Scientists predict that the Andromeda Galaxy will collide with the Milky Way, possibly resulting in the end of life as we know it.

### black hole

*Definition:* A region in space with such strong gravitational force that nothing can escape; scientists think that black holes form as a result of the death of one or more massive stars.

*Context:* Astronomers believe that the Milky Way Galaxy has millions of black holes, although pinpointing their locations is extremely difficult.

### gravitational force

*Definition:* The attraction existing between all objects that is responsible for holding together the sun's hot gases, keeping the planets and stars in our galaxy in their orbits

*Context:* The gravitational force between the Andromeda Galaxy and the Milky Way is pulling them together; the result may be a major collision.



**Milky Way**

*Definition:* Our galaxy, which contains the sun; nine planets, including Earth; billions of stars; and numerous other objects

*Context:* The study of the Milky Way with state-of-the-art radio and infrared telescopes has led scientists to believe that a black hole lies at the center of the galaxy.

**red giant**

*Definition:* The time in a star's life cycle when its core is running out of hydrogen and helium; the star cools and becomes less bright.

*Context:* When our sun becomes a red giant, it will be the beginning of the end of life on Earth as we know it.

**stars**

*Definition:* Balls found in space made of hydrogen, helium, oxygen, and carbon. Stars come in many shapes and sizes; the sun is a medium-sized star

*Context:* Stars are born in huge clouds of dust and gas and expand as they grow. Eventually stars explode and collapse, possibly becoming a black hole.

**Academic Standards****National Academy of Sciences**

The National Academy of Sciences provides guidelines for teaching science in grades K-12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following science standards:

- Earth and Space Science: Origin and evolution of the universe

**Mid-continent Research for Education and Learning (McREL)**

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit link:

<http://www.mcrel.org/compendium/browse.asp>

This lesson plan addresses the following national standards:

- Science – Earth and Space Sciences: Understands the composition and structure of the universe and the Earth's place in it
  - Language Arts – Writing: Uses the general skills and strategies of the writing process, Gathers and uses information for research purposes
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## Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>

