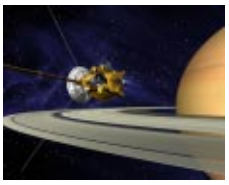
# My Spacecraft Model

*An illustration of Cassini at Saturn.*



LESSON TIME
*May be carried out over two days. There are four activities; total time 2 hours.*

PREPARATION TIME
*30 minutes*

MATERIALS CHECKLIST
- *Miniature marshmallows, 30 per student*
- *Round toothpicks, 30 per student*
- *Sandwich bags, 1 per student*
- *Copies of "Cassini Spacecraft Design" and "Cassini Spacecraft Design Review Summary" worksheets*
- *Science Notebooks*

STUDENT PREREQUISITES
*No prerequisites are required, but students need some background information to understand the Cassini spacecraft challenges — see Procedure, Day One, first part.*

**LESSON NO. 5**

*Language Arts Focus — Written Reporting and Oral Peer Presentations*
*Science Focus — Planning, Building, and Explaining a Spacecraft Model*

OVERVIEW

Students will engage in basic problem-solving as they design and construct their own small model of a spacecraft. Through writing and illustration, students will document their work and will complete a Design Review Summary. Like scientists and engineers, students will make presentations to show and explain their models and design summaries to their peers.

BACKGROUND

Scientists and engineers developing and designing the Cassini spacecraft faced a number of complex and challenging issues. The spacecraft has many unique requirements.

Cassini has to:
- Hold all the fuel and equipment required for extended space travel
- Be durable for long-term space travel
- Be small enough to maintain the speed needed to travel a long distance quickly
- Have enough power to run all the equipment for at least 10 years

This hands-on activity introduces students to basics of the design process. The following website details the requirements of the Cassini spacecraft in terms that young students can follow:

*http://eis.jpl.nasa.gov/~skientz/cassini/spacecraft.html*

Other ideas for building models of the Cassini spacecraft can be found at:

*http://saturn.jpl.nasa.gov/kids/activities.cfm*

## Objectives

Students will:
1. Design spacecraft models.
2. Learn that design is an iterative process.
3. Build spacecraft models based on their designs.
4. Document their designs using scientific labels.
5. Practice communication skills as they make a presentation to their peers.

## Teacher Preparation

Prepare material for model building and collect materials for writing activities. You will need enough miniature marshmallows and enough round toothpicks so that each student gets 30 of each item. Make a copy for each student of the "Cassini Spacecraft Design" worksheet and "Spacecraft Design Review Summary" worksheet.

## Procedure

### Day One

*Introduction to Saturn and the Cassini–Huygens mission — 20 minutes*

1. Background knowledge about Saturn and the Cassini–Huygens mission is needed so that students understand the problems of size, distance, and durability that need to be overcome so the spacecraft can complete its voyage to Saturn.
2. The following are good sources for background information on Saturn and the mission for classroom read-alouds:
   - *Saturn: The Sixth Planet* by Michael D. Cole
   - *Saturn* by Elaine Landau
3. The website *http://eis.jpl.nasa.gov/~skientz/cassini/spacecraft.html* provides a good introduction to the spacecraft.

*Planning and Starting the Model — 40 minutes*

1. Explain to students that they will be designing and building a spacecraft model.
2. Tell students that they will each receive 30 marshmallows and 30 toothpicks for model building.
3. Explain that they will need to do some planning before starting to build the model.
4. Remind students that their spacecraft should be:
   - Lightweight and small
   - Able to carry enough fuel for the mission as well as equipment for collecting new information
5. Explain that students will make three "planning" designs, but will have to decide on one final design.
6. Explain that they will receive a spacecraft design worksheet that contains space for drawing and labeling their designs. Model how to draw a simple design.
7. Explain to students that the drawings will help them construct the model. Model putting together some of the basic parts of your spacecraft. Be sure to remind students not to use your design, but to create a design of their very own!
8. Distribute a "Cassini Spacecraft Design" worksheet to each student.

teacher TIP

Some students may need a little help from you in order to get started with this activity; other students will do the designing with ease. Some students will not be developmentally ready to construct in three dimensions. Encourage those students to construct their models in two dimensions. Either format works!

9. When each student has illustrated what he/she wants to construct, distribute marshmallows and toothpicks for model building. You may want to "approve" each design before they begin.
10. To keep materials organized, ask students to put their worksheets together and place their models on top of the worksheet in an undisturbed area of the classroom. The models should remain out for another day to completely air dry.

### Day Two

*Completing and Documenting the Final Design — 15 minutes*

1. Have students gather their worksheets and models together.
2. Distribute the "Cassini Spacecraft Design Review Summary" worksheet.
3. Explain to students that they will draw and label their finished spacecraft.
4. Have students complete their drawings and answer the questions on the bottom of the worksheet.

*Peer Reporting — 45 minutes*

1. Each student will make an oral presentation to show and explain his/her final drawings.
2. Begin the presentations by asking each student to explain how their model works and what they like best about their model.
3. Encourage students to ask questions of the presenters. To prompt student-generated questions, you may begin the discussion with some of the following questions:
   a. What was the hardest part of designing your model?
   b. What was the hardest part of building your model?
   c. What are the parts of your model called? What do they do?
   d. Why did you choose this version of your design to be your final model?
   e. Would you change anything?
   f. Does your model have a name?
4. When finished, students can display their models in the classroom and add their worksheets to their portfolios.

### Using Science Notebooks

Writing prompts for this lesson:

1. Focus question: What makes your spacecraft model a good model?
2. Process questions: What did you do to build your model? What did your classmates think of your model? Do you agree with them?

## Why This Works

This hands-on activity provides students with an opportunity to experience some of the challenges that engineers and scientists encounter when working on space missions. Teachers who have done this activity reported that their students were so engrossed in their work that the classroom was silent for 20 to 30 minutes — that's concentration!

This activity not only allows students to create their own designs and give them a concrete presence in the classroom, but it gives them an important opportunity to share their work with their peers. Peer presentations, in which students show their models and explain how they arrived at their model designs, encourages higher-level thinking and increased learning. Teachers reported that young students enjoyed naming their designs and relished the opportunity to tell others how they worked.

Lastly, students learn that modification is an important step in the process of making a final product. In this lesson, students make multiple versions of their final plans — an iterative thought process that also serves students in language arts as they work though multiple drafts before finalizing their writing.

## Assessment

The students' oral presentations, spacecraft designs, and writing will allow you to assess their work. Their oral explanations and drawings will show how well the students completed the tasks. Entries in students' Science Notebooks will also help you to evaluate their learning.

### Standards

*NCTE Standards for the English Language Arts*

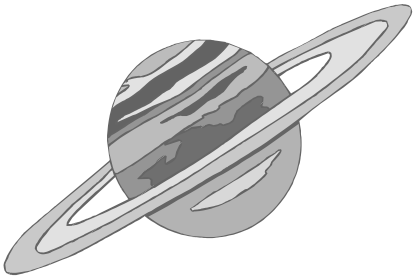
- Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), and genre to create, critique, and discuss print and nonprint texts.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.
- Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

*National Science and Mathematics Education Standards*
Earth and Space Sciences

- Objects in the sky

*ITEA National Technology Standards*
Students will develop an understanding of design. This includes knowing about:

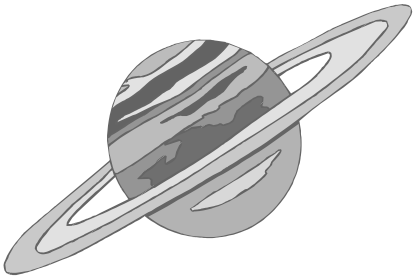
- The attributes of design
- The role of troubleshooting, invention, innovation, and experimentation in problem solving



# Cassini Spacecraft Design Worksheet

**Name**_____

| | |
|---|---|
| 1. First Idea | 2. Second Idea |
| 3. Third Idea | 4. Final Plan |



# Cassini Spacecraft Design Review Summary

**Name**_____

Draw your finished spacecraft.

1. What is the name of your spacecraft? _____

_____

2. What was the easiest part of building your spacecraft?

_____

3. What was the hardest part of building your spacecraft?

_____

4. What changes did you make?

_____