

THE SATURN PROJECT

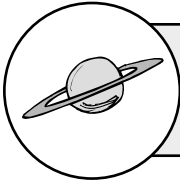
ADAPTED BY SUZANNE CHIPPINDALE

From “Model Saturn Decoration” from NASA’s *The Space Place* web site at: http://spaceplace.nasa.gov/en/kids/cassini_make1.shtml



An Activity for the Whole Family from Project ASTRO

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390 Ashton Ave., San Francisco, CA 94112 ■ www.astrosociety.org/education.html



- **Type of Activity:** Facilitated
- **Time to Do:** 30 minutes
- **Set-up Time:** 10 minutes (not including pre-event preparation)

WHAT’S THIS ABOUT?

Many scientists use models to represent something they are studying. But models are often a challenging concept for some families. In this activity, families do a fun arts and crafts project of creating a model of the planet Saturn, but are challenged to make some aspects of Saturn as realistic as possible. Along the way, they will be asked to compare the differences between Saturn and the Earth-Moon system. There are also two open-ended aspects to this Saturn model that you can leave to the creativity of each family. The first is the colors used for decorating the model; the second is how to include the Earth and Moon in the model. (We recommend this activity as a good addition or alternative for the Family ASTRO *Race to the Planets* kit.)

CAUTION: THIS ACTIVITY CAN BE MESSY AND REQUIRES SOME INVESTMENT IN CRAFT MATERIALS

While most of the activities in Family ASTRO include low cost, easy to find materials, this one is a slight exception. Also, because of the messy nature of the craft supplies used here, this can be a high-maintenance activity. Nevertheless, it was so popular with our “test families,” that we are happy to include it here.

MATERIALS INCLUDED

- “Amazing Facts About Saturn” master

MATERIALS YOU’LL NEED TO GET

- Compact Disks (CDs), at least one per family (this is a good way to recycle those unwanted disks most of us get in the mail!)
- Glitter: gold and silver (recommended) plus any variety of other colors you care to choose and make available to your families
- Small plastic cups to hold glitter
- Fishing line (at least 12” per family to make a loop to hang the model Saturn by)
- 2 examples of children’s toys that are “scaled models” (optional) **Note:** We used a Hot Wheels™ car at 1/64 scale and a Barbie™ doll at approx. 1/6 scale.

- Floral Wire (the type used for making floral arrangements), 8 inches per family
- Table coverings (e.g, plastic table cloths)
- Paperclips (regular size, not jumbo)
- Size 7 removable, split-shot sinkers (for fishing) to represent the Earth (at least one per family)
- Glass “seed” beads (11/0) to represent the Moon (at least one per family)
- 2-inch Styrofoam™ balls: the soft, perforated (**non-smooth**) and compressible type (at least one per family)
- White Glue, e.g., Elmer’s® (note: Tacky® glue is good for holding the foam balls together, but difficult to spread when putting on the glitter)
- Knife (for cutting Styrofoam™ balls)
- Thick, black permanent markers (enough of them to let families share easily)
- Paint brushes for spreading glue (sponges also work) (at least one per family)

SETTING UP THE ACTIVITY

Pre-Event Preparation:

You’ll probably have to do some shopping at your local craft store for floral wire, glitter, glue, brushes, Styrofoam™ balls, and beads; and at a drug store or sporting goods store for the fishing weights and line.

- Cut the 2-inch Styrofoam™ balls in half. Be sure not to use the smooth balls, but the softer, perforated ones from craft stores, as they are much easier to cut with a simple serrated blade.
- Cut fishing line and floral wire to desired lengths (see Materials List above)
- Make sure you have glue containers for each family. If you have a single large bottle of glue, you need to collect small containers (e.g., “buddy cups” from a craft store or small yogurt containers) and fill.
- Copy the “Amazing Facts About Saturn” sheets using the master on page 33 (so that there is at least one for each family).

At the Event Location Preparation:

- Cover tables to protect them from glue and glitter.
- Put various types of glitter in plastic cups for easy access.
- Fill individual family glue containers.
- Set up family tables as desired (e.g., distribute paint brushes, glitter, etc.). Note: You can also keep supplies at a central table in the room and have families come and get items themselves as needed.

SUGGESTIONS FOR INTRODUCING THE ACTIVITY

Begin by exploring the notion of models. Ask if there are any model builders at the event. If so, ask what scale they work in (most model builders will know this). For those who don’t build models for a hobby, ask if anyone has dolls or toy cars at home. Alternatively, ask if anyone has ever built a skyscraper out of Legos™? All of these are examples of models.

For some baby dolls, the scaling factor is nearly 1:1. That means that dolls of babies are about the size of a real baby. Some are bigger than others, but that’s true with babies.

Other dolls are created at different scales. For example, the scaling factor for a Barbie™ doll is about 1:6. At just under a foot tall, she would represent a woman somewhere between 5 feet 6 inches and 6 feet tall. And with a 3-inch Barbie waist, the corresponding life-sized person would have an 18-inch waist. (*So maybe Barbie is not the best example!*)

According to the web site for Hot Wheels™ cars, “These highly detailed 1:64 scale vehicles are produced with multiple pieces and authentic decorations.” So for families who have one, they could go home, measure their own cars, and check if the Hot Wheels people are right.

And what about a tall building to the same scale as the car? The Empire State Building in New York is 1,250 feet tall, so to match the Hot Wheels model, you’d have to build a 19.5-foot model out of Legos. You probably don’t even want to think about how many Legos that would take, but your Hot Wheels would be right at home driving around it.

DOING THE ACTIVITY

Tell your families that today they’re going to build a model of one of the most beautiful planets in the solar system: Saturn. It is the planet with the largest system of rings. But, because it is such a giant planet, they won’t be able to use the same kind of scale that toy makers or architects typically use.

Introduce and show the two major model building materials as follows: The 2” Styrofoam™ balls will be the model planet, and those CD’s that no one has the heart to toss out will represent the rings.

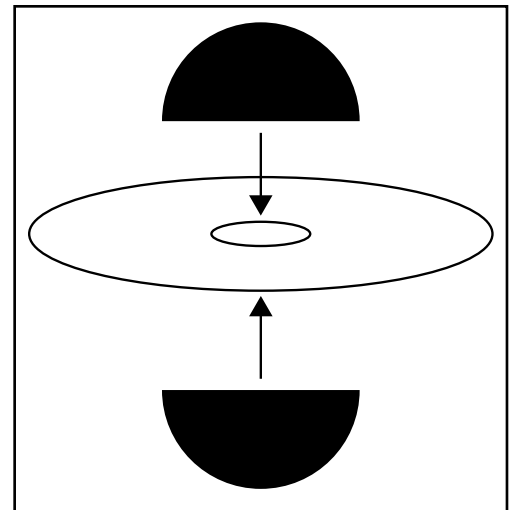
The real Saturn is 120,660 kilometers (km) across (that’s almost 75,000 miles! — *not including the ring system*). The Styrofoam ball on the other hand is just 2 inches, or 5 centimeters (cm) across. This means that for our model, 1 cm is equal to 24,132 km on Saturn. And, if you have families that are “unafraid” of math, you can tell them that since there are 100,000 cm in 1 km, this is roughly a 1:2,413,200,000 model (1 to 2 and a half billion). And yes, the ring system represented by the CD is also to scale (not including Saturn’s F, G, & E rings).

Now briefly introduce the other materials that will be used to complete the Saturn models: e.g., paperclips, glue, glitter, paint brushes (to spread the glue), permanent markers, fishing line, wire, etc. Let them know that, after they finish their Saturn models, they can, if they wish, also make a model of the Earth and Moon to the same scale to put the enormous size of Saturn in perspective.

Briefly demonstrate the assembly of the Saturn model as follows before your families get started on their own:

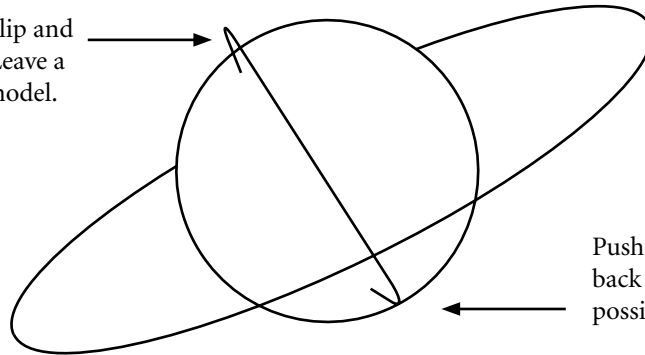
I. Saturn:

- The basic construction is to glue the two halves of the Styrofoam ball on either side of the CD, smack-dab in the middle (so that the two halves are exactly opposite of each other).
- Explain to your families that they will need to continue to hold the two halves of the ball together firmly (with the CD in the middle) until the glue has a chance to take hold (and this can take up to 10 minutes, depending on the type of glue used). Note that they can continue working on their model while they are doing this (e.g., a parent can hold the balls together while a child adds glitter, etc.).
- Now tell the families that we want to hang the Saturn model for easy viewing. Ask them to unbend and straighten half of the paperclip so it looks like a long skinny “J”. Push the straight side through the center of the Styrofoam ball (and so it goes through the hole in the CD) and at an angle so Saturn is tilted when hung. At this point, some members of your audience (if they’re thinking about the Earth) will probably ask, “What should the angle of the paperclip be?” This is when you can pass out the “Amazing Facts About Saturn” sheet and encourage them to research a few of the details that they can include in their models.



- Once the straight end of the paperclip is all the way through, families should bend a small portion of it at the top back to form another “hook.” Now push both hooked ends of the paperclip into the ball, but leave a bit out at the top so that a small loop is sticking up to attach the fishing line for hanging. (The paperclip is now serving double duty as both a hanger and as extra reinforcement to hold the model together.)

Bend straight end of paperclip and insert back into foam ball. Leave a small portion out to hang model.

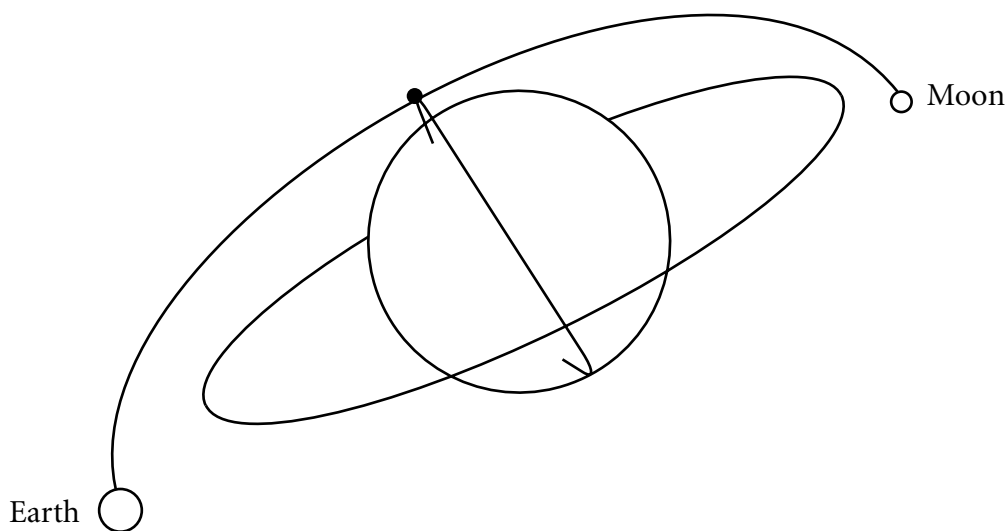


Push the curved end of paperclip back into foam ball (as far in as possible).

- Now introduce a fun part of the project — decorating Saturn. As your families begin to add the glitter to their Saturn models, remind them about the handout sheet of fun facts about Saturn and encourage them to use it for inspiration to build more realistic models. You can also challenge them to pick out as many fun facts as possible to incorporate into their model. Feel free to discuss other facts about Saturn as they are working. NASA’s Cassini-Huygens mission (which reached Saturn in 2004) is one good topic. See the web site at <http://saturn.jpl.nasa.gov/home/index.cfm> for more information.

2. Incorporating the Earth-Moon System:

- Now (if you have time) it’s good to add something familiar — the Earth and the Moon — to the scale model. Point out the scale on the bottom of the Saturn fact sheet that compares Saturn to the Earth–Moon system. Let your families know that you have objects available that represent the Earth (split-shot sinkers) and Moon (glass seed beads).
- Note: To encourage creativity, the method of adding the Earth and Moon to the Saturn model is up to each family, but one suggested method is to attach each to the top of the model using the floral wire so that the Earth and Moon dangle opposite each other and “outside” the ring system at approximately the appropriate scale.



Debrief:

After 15 minutes of model building, check in to see how everyone is doing and ask for voluntary reports of the details that have been built into the family models. One detail that is often overlooked is in the comparison of the materials used for Earth and Saturn. Styrofoam was used for Saturn not only because it is easy to cut, but because it is **less dense** and even floats, as would Saturn (if you had a container of water big enough to hold it!). Lead shot was thus used for the Earth because it is denser (like the Earth is compared to Saturn).

For additional talking points, below is a list of the fun facts on the family handout and a discussion of how most are (or could be) included in the model:

1. **Mass of Earth = 6 million billion billion kg; Mass of Saturn = 100 times Earth's Mass.** Because we didn't give them a choice of materials or a scale, this is not something they can adjust.
2. **Diameter of Earth = 12,756 km; Diameter of Saturn = almost 10 times Earth's diameter.** The lead split-shot is .5 cm and the Styrofoam ball is 5 cm.
3. **Tilt of Saturn's Axis = 26.7 degrees.** Did they stick the paperclip in at an angle to simulate this tilt?
4. **Saturn's Rings are 270,000 km in Diameter, but only a few hundred meters thick.** At this scale, the CD is the correct diameter, but way too thick. A thin piece of acetate might be more accurate, but not stiff enough to make a sturdy model.
5. **Saturn and its Brightest Rings would fit neatly in-between the Earth and Moon (the distance to the Moon = 384,400 km).** Did anyone add the Earth and Moon in a manner that represents this?
6. **Cassini Division and other gaps in the Rings.** Did any families use the permanent markers to draw-in "gaps" in their ring system?
7. **Bonus Fact:** Saturn's Rings are composed of icy material ranging in size from a few millimeters to the size of a school bus. Glitter is highly reflective, like ice, and so makes a better representation of the rings than simply painting them would. Saturn is also so far from the Sun that it would not be nearly so beautiful in the night sky (only a dim point lost amongst the stars) if it were not for the highly reflective cloud tops of its outer atmosphere.

*For more on this topic, and the other topics raised in this guide, please visit the web at:
<http://www.astrosociety.org/education/family/resources/spl.html>

The Saturn Project Family Handout

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AMAZING FACTS ABOUT SATURN ... that Make it Oh So Different from Home.

Mass of Earth "o" = 6 million billion billion kg
Mass of Saturn = almost 100 times Earth's Mass

Diameter of Earth "o"
= 12,756 km
Diameter of Saturn
= Almost 10 times
Earth's Diameter

Tilt of Saturn's Axis = 26.7 degrees
Tilt of Earth's Axis = 23.5 degrees

Density of Earth is 5.5 times that of water
Density of Saturn is less than water
(i.e., it could float in water!)

Image Credit: NASA

Earth's surface materials:
basaltic and granitic rock.
Saturn: no solid surface
(just gas and liquid).

Saturn's rings are 270,000 km
in diameter, but only a few
hundred meters thick.
Saturn and its brightest
rings would fit neatly in
between the Earth and
Moon (Distance to Moon:
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