

Comet Nucleus Model with Pull-Out Tails

Construction Instructions



Forward - Use in the Planetarium

The comet nucleus model is designed to illustrate the path and orientation of a comet nucleus and its two tails as it orbits the sun. This model was designed to be used with our "Comets & Discovery" planetarium show, though its usefulness is unbound. In a planetarium theater, place the sun model in the center of the room under or near the star projector. To maximize the educational and entertainment value of the activity with a group, ask for and select three volunteers. This activity will work well with most any age.

The instructor will start by describing the nucleus, its composition, and that its coma will grow and stretch away from the sun as the comet approaches the sun. When the nucleus gets close to the sun, the tails will start to form and stretch away from the sun. One volunteer will hold the nucleus model, the other two will hold the rods that are attached to the ends of the two ribbons. The instructor will then inform the one holding the nucleus to slowly go around the sun model. The person holding the white ribbon will represent the dust tail and will be told to always follow the nucleus. The person holding the blue ribbon will represent the ion (gas) tail and will be told that the end of the tail always points away from the sun. Both of the tail volunteers will be asked to slowly pull the tails out as the nucleus first approaches the sun. If all works well, each person will do their job correctly and the length and orientation of the tails will be seen to stretch and splay out. If not, ask the audience what went wrong and what should be done to make it correct. With the audience's suggestions, redo the "orbiting" of the nucleus with the two tails and see if it goes well.

There are a number of educational methods applied in this activity. Since many children and adults have difficulty understanding and thinking in three dimensions (spatial reasoning), they can now see how the tails follow their own orientation in relation to the comet and sun as the comet orbits the sun. The instructor is also used only to introduce the activity, but not to be the participant. This makes for an active learning environment instead of a passive one. Even if a person is still sitting in the audience, they see one of their peers (another audience member) be involved. Those that are literally part of the activity (one of the three volunteers) receive not only hands-on instruction, but are also part of making science fun, which helps alleviate science phobia. If the audience is asked to state what may have gone wrong in the first try, then they are not only being active participants, but are using reasoning skills to evaluate the situation.

We think that you'll have lots of fun with this activity. Your school groups and public program attendees will both enjoy and learn.



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Materials & Tools

- 10" Solid styrofoam ball
- Various knives (I used a drywall saw and an electric knife, but try different ones to see what works best for you.)
- Clay sculpting tools
- Different sized and shaped rasps
- Hot wire scroll table (You can get this from www.hotwirefoamfactory.com)
- Foam Coat (You can get this from www.hotwirefoamfactory.com)
- Bounce (You can get this from www.hotwirefoamfactory.com)
- 1/4" Power magnets (12)
- 7/8" x 1 7/8" x 3/8" Ceramic block magnets (2)
- 3/4" x 1 13/16" Hinges (2)
- Dremel Tool
- 7/16" Dowel
- 1"x2" Wood
- Screws (The lengths will depend on the thickness of the wall of your comet)
- 1 1/2" wide grosgrain ribbon: 7' each - white and blue
- Staples
- Needle and thread
- Sandpaper
- Acrylic paint (black and white)
- Matte clear acrylic coating
- 6" Rubber base board
- Window blind rods (2)
- Eyelet fastener kit
- 16 mm split rings (4)
- 6 mm split rings (2)
- Large lobster clasps (2)

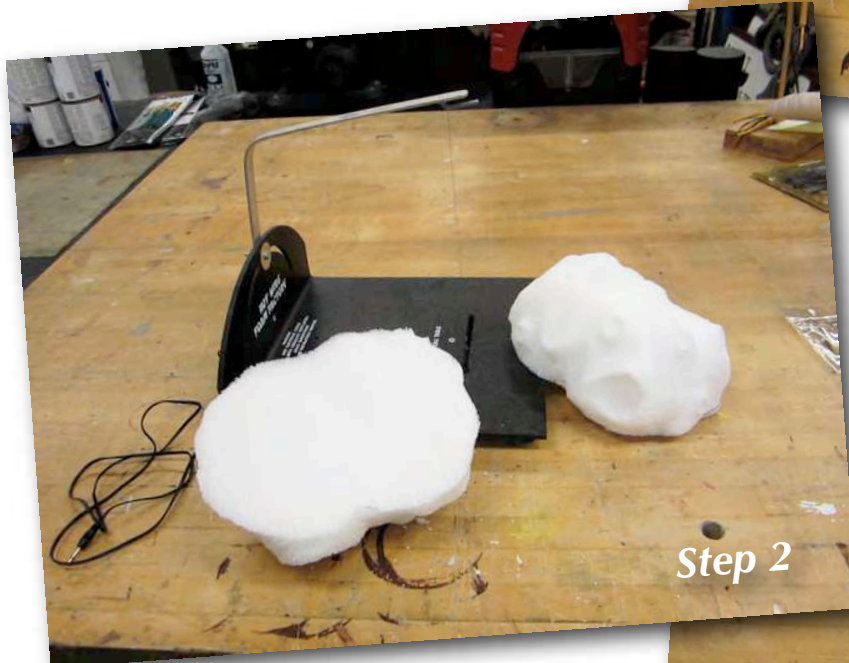


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Instructions

1. Start with a 10" solid styrofoam ball. Use different knives and rasps to carve out desired shape of comet. I also used a clay sculpting tool to gouge out pieces of foam.



2. Use a hot wire foam cutting tool to cut the comet in half. I used a hot wire scroll table from Hot Wire Foam Factory. If needed, draw a line down the center of the comet where you want to cut so you don't go off course.

3. Hollow out the two halves of the comet for your mechanism to fit in.
4. Make indentations for the magnets and hinges on each half of the comet along the inside lip. We added more power magnets around the perimeter to increase the closing force.



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5. Coat both halves in a one-to-one mixture of Foam Coat and Bounce inside and out. I applied two coats.



6. Place the magnets in the indents you made earlier and fill in the holes and cover the magnets with Foam Coat mixed with Bounce. If the holes are not large enough or deep enough for the magnets, drill them out using a



Dremel. I went back later and added more magnets so it would hold more securely. Use the Dremel to grind out holes to add more magnets.

7. Place the hinges in their indents and screw them into the comet being careful so that the screws don't poke out the other side of the comet. I ended up going back and adding a second hinge for more lateral stability. If you need to do this, just use a Dremel and grind out enough material from the comet to accommodate the hinge and screws. Cover the hinge plates and around the screws with Foam Coat and Bounce to secure them in place. Be sure not to get the Foam Coat on the hinge part so the hinges will still operate. After that has dried, close the comet and back fill around the hinges with Foam Coat for more stability. I placed two scraps of paper in between the hinges to keep any stray Foam Coat from sticking the hinges together. Also cover the outside of the moving part of the hinge with tape to prevent any Foam Coat from getting in the moving part of the hinge.



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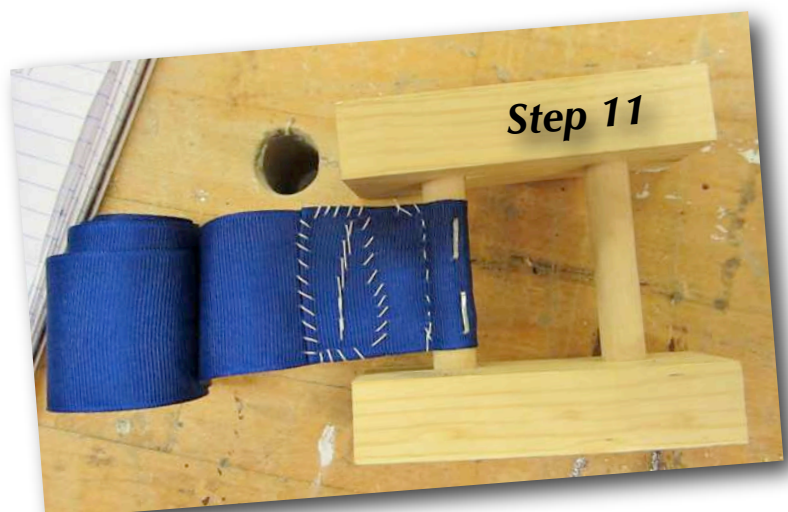
8. Cut 4 pieces of the 1"x2" wood about 3 1/2" long. Cut 4 pieces of dowel about 2 1/2" long. These measurements will differ depending on how large the cavity is of your comet. I also cut off some of the corners of the 1x2s so they would fit more snugly in the cavity of the comet.



9. In each 1x2, drill one 7/16" hole and one 29/64" hole only going about half way through. The 7/16" hole will be for the support dowel and the 29/64" hole will be for the winding dowel that the ribbon will be attached to.

10. Drill pilot holes in the ends of two of the dowels and through the 7/16" holes and screw everything together.

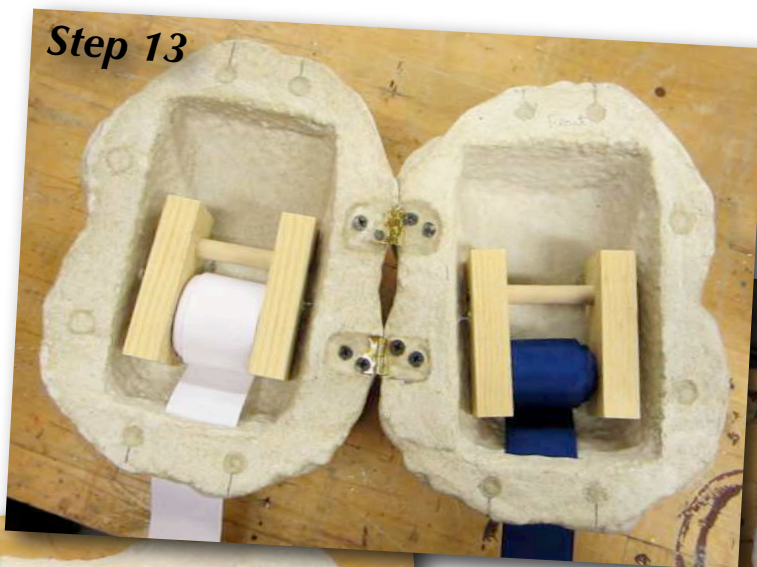
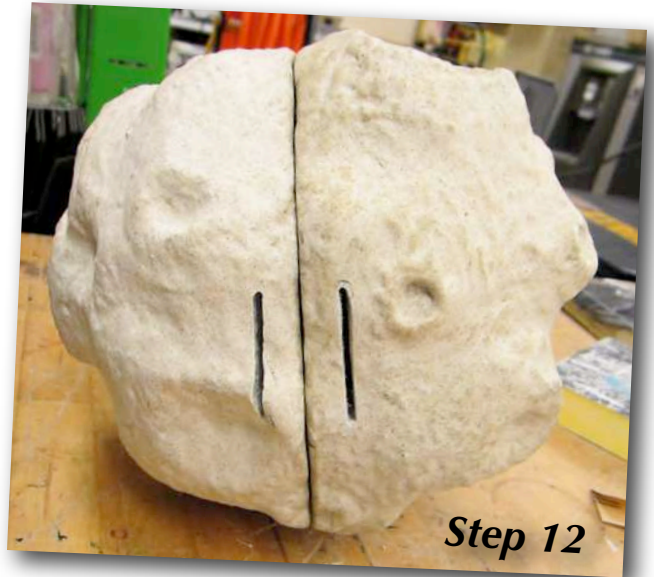
11. Loop a ribbon around each winding dowel and sew it together. Staple the ribbon to the winding dowel.



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12. Dremel out 2 slits on the back of the comet on each half. This should be wide enough for your ribbon. Make sure to go all the way through to the inside. Insert a long, thin piece of sand paper folded in half in the slit and sand until the slit is free of styrofoam and the edges are smooth.
13. Place each winding mechanism in each half of the comet and screw through the outside of the comet into the wooden blocks. Drill pilot holes so nothing splits. Tighten the screws enough so they form a dimple in the surface of the comet and fill in the dimple with Foam Coat and Bounce to smooth out the comet.



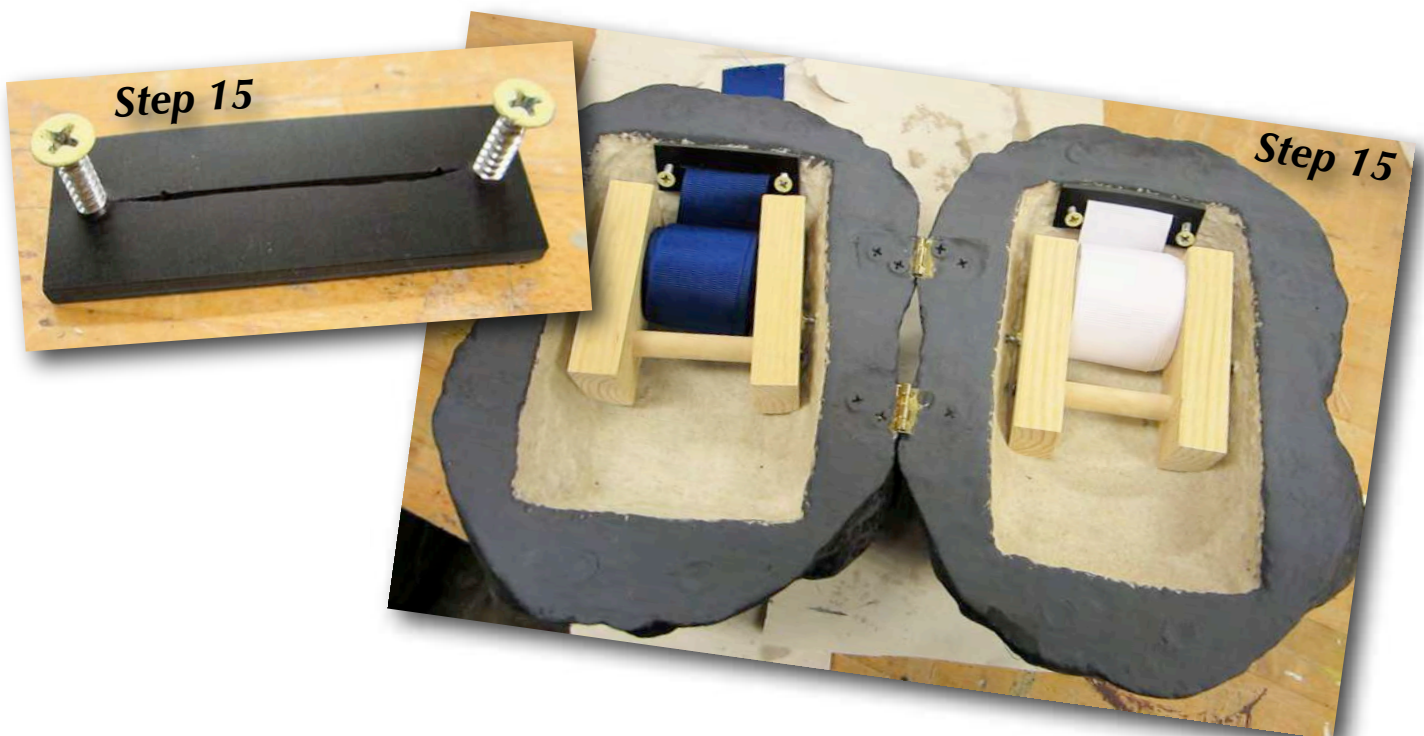
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14. Paint and seal the comet. I used a charcoal-colored paint for the base coat and then did a black wash over it to darken the craters and finally dry brushed over that with a slightly lighter gray for the highlights.



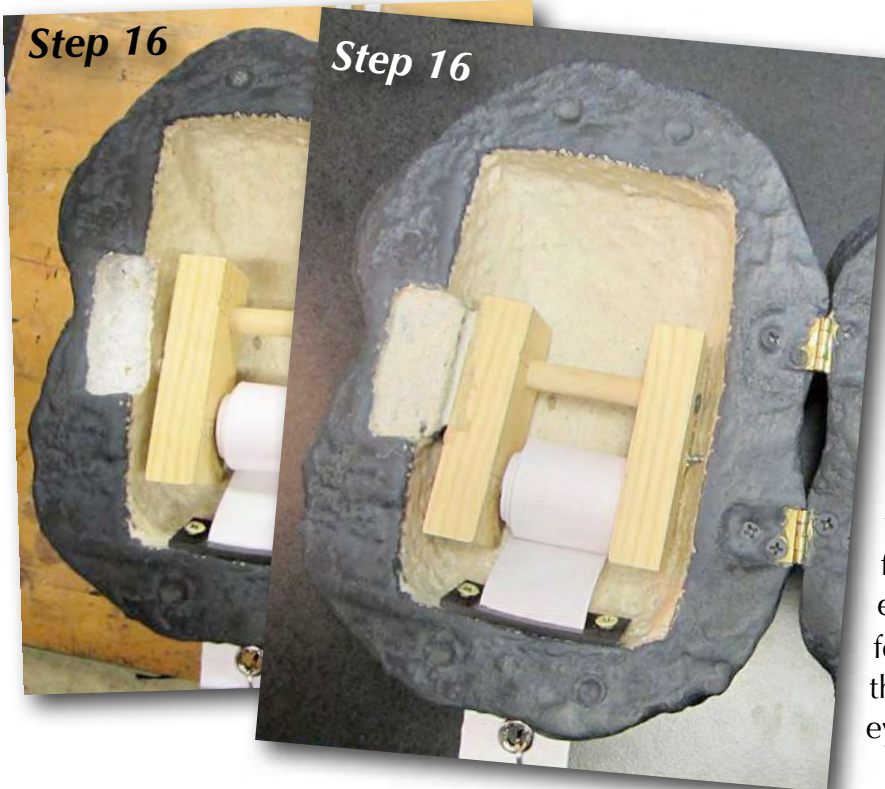
15. Cut a 1" x 2 1/2" piece of rubber base board. Use a sharp blade to make a slit in the center a little wider than your ribbon. This will add tension to the ribbon when it is being pulled out. Drill pilot holes through the rubber on either side of the slit you made. Pull the ribbon through the rubber then the slits in the comet. Use Foam Coat and Bounce as glue and screw the rubber to the inside of the comet.



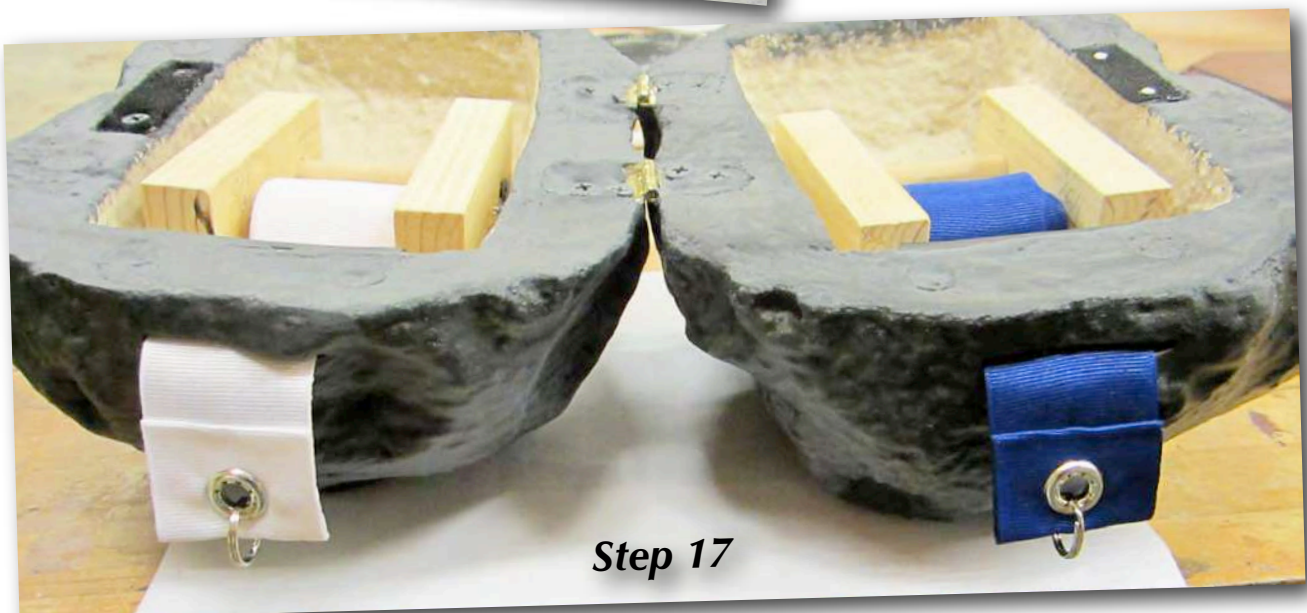
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16. I found that the power magnets were not going to be strong enough to securely hold the comet shut. Dremel out spaces in the lip of the comet to accommodate the ceramic block magnets. Cover the spaces with Foam Coat mixed with Bounce and place in the magnets. Cover the magnets with Foam Coat and Bounce and build it up around the magnets so they will be securely held into the comet.



17. Cut the white and blue ribbons to the desired length. Mine ended up being about 6' long. Fold the ends over by about an inch and glue to prevent fraying. To add strength, continue folding and gluing 2 more times. Attach eyelets to the ends of the ribbon following the instructions in the kit and then attach a 16 mm split ring onto each eyelet.



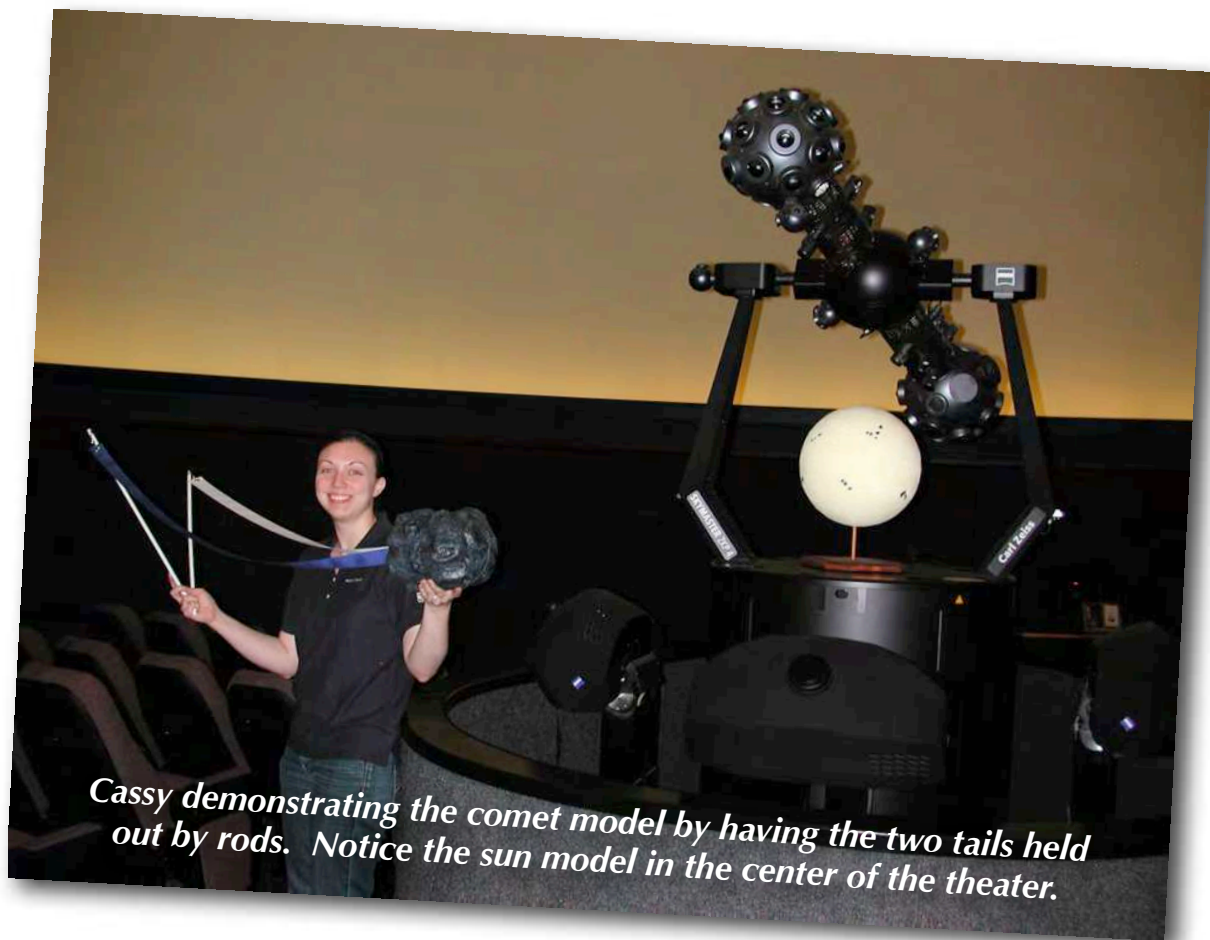
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18. For the rods that attach to the tails: Take the rod from a set of window blinds and attach a large lobster claw clasp to the hole in the top of the rod using a 16 mm split ring and a 6 mm split ring. Make two of these, one for each tail. The lobster claw clasps and split rings are available in the jewelry-making section of any craft store.



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Comet model designed and constructed by Cassandra Rose
Comet model concept and classroom instructional use by Adam Thanz

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