

**GEEK
& CO.
SCIENCE!**



PROJECT KIT

Ages
8+

D-i-Y SOLAR SYSTEM



 **THAMES & KOSMOS**

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Safety information

WARNING.

Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Strangulation hazard — long cords may become wrapped around the neck.

Keep the packaging and instructions as they contain important information.

WARNING.

CHOKING HAZARD — Children under 8 yrs. can choke or suffocate on uninflated or broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons at once. Use an air pump to inflate the balloons. Made of natural rubber latex, which can cause allergies.

All art materials in this kit are non-toxic.

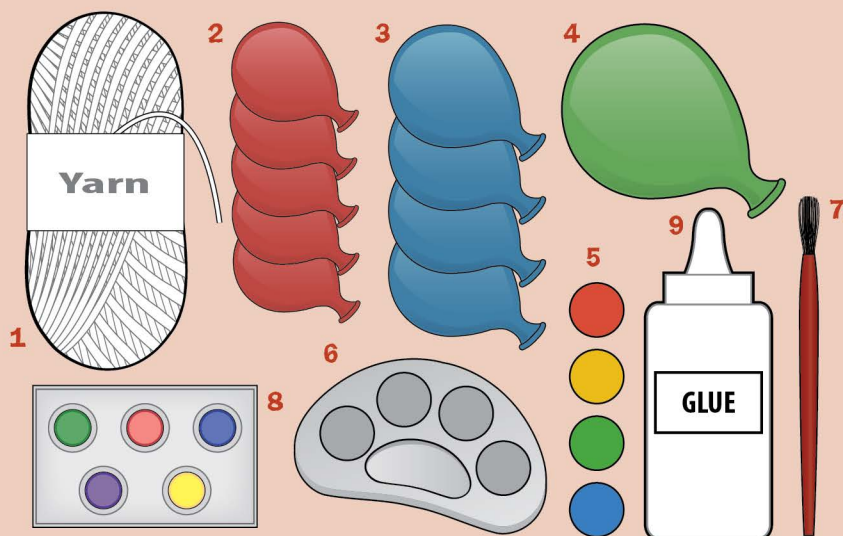
Wash hands thoroughly after handling.

Do not ingest. Use only as instructed.

Use the materials carefully, as they may stick to or stain fabric, wood, carpet, or other materials. Clean with water.

Conforms to ASTM D4236

KIT CONTENTS



- 1 | Yarn, 50 grams (about 200 m)
- 2 | Small red balloons (5)
- 3 | Medium blue balloons (4)
- 4 | Large green balloon
- 5 | Watercolor paints (4)

- 6 | Paint pallet
- 7 | Paintbrush
- 8 | Food color dye tablets (5)
- 9 | White glue (80 ml)

YOU WILL ALSO NEED: *Scissors, cardboard, tape, ruler, newspaper, shallow disposable plastic tub, teaspoon, tablespoon, flour, water, spoon, pin or needle, skewer or pencil, aluminum foil, permanent marker, toothpicks, thumbtacks, string*

Hey Planetary Geeks!

Ready to make a model of the solar system? With this kit, you can make the eight planets, Pluto, and the sun by wrapping paste-saturated yarn around balloons, letting them dry, and then removing the balloons from the rigid yarn planet models. Then you can hang the whole solar system in your room! Ringer the Geeker will be your guide!

I'm Ringer!



PART 1

SETTING UP YOUR PLANET WORKSHOP

You will make the planets one at a time, so that the paste doesn't dry up and you won't have to rush. The instructions on this page describe how to get all your tools and materials prepared. The instructions on the following pages show how to make one planet. Then you simply repeat the steps for each planet you want to make.

Preparing your materials

Gather all of the tools and materials in the list below before you start.

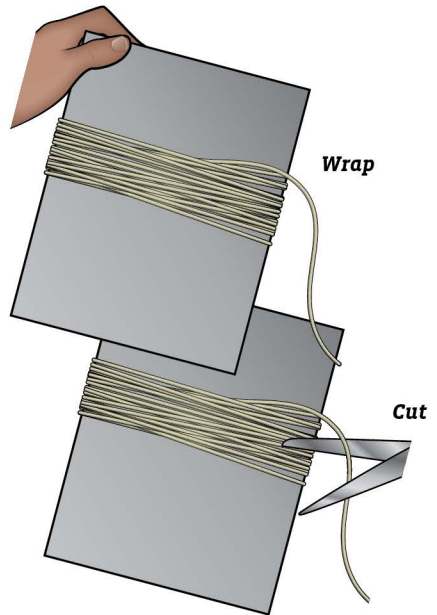
You will need:

Yarn, kit box, balloons, scissors, cardboard, tape, ruler

Here's how:

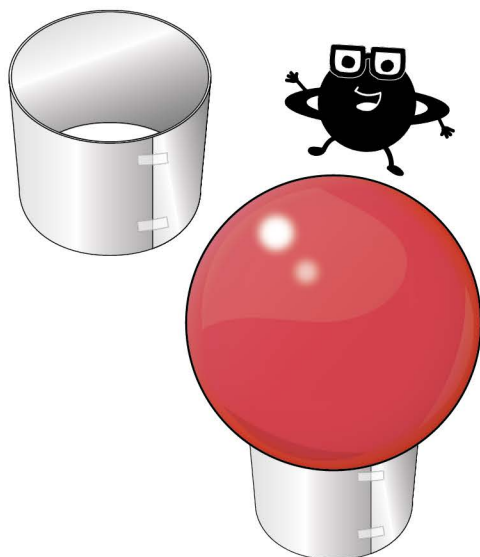
To cut the yarn to the correct lengths:

- 1 You will need to divide up the yarn evenly so you have enough yarn for each planet.
- 2 To measure the correct amount of yarn for each planet, wrap the string around the kit box a certain number of times and then cut. The box is approximately 22.5 inches in circumference. Wrap the yarn around the box's narrower dimension, which is horizontally around the box if the box is standing upright.
- 3 On pages 4 and 5, you will see how many times to wrap the string for each planet. So that you have manageable lengths for the larger planets, you will cut the yarn about every 10 times you wrap it around the box. The instructions in the table on pages 4 and 5 explain exactly how many times to wrap the yarn and cut. If you make a mistake, don't worry. You can still use yarn of different lengths.



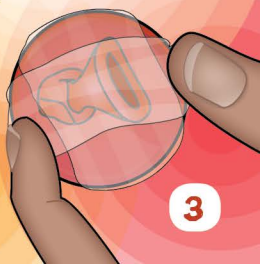
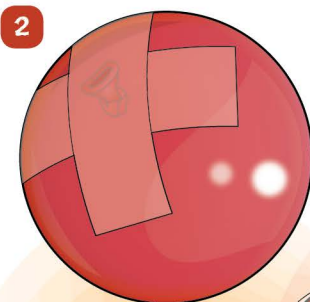
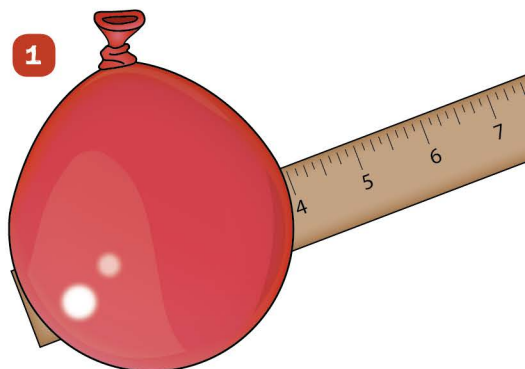
To make drying cradles:

- 1 For each planet, you will need a drying cradle to hold the balloon up off the table while it is drying.
- 2 To make a drying cradle for a specific planet, cut a strip of thin cardboard about 1 inch by 8 inches.
- 3 Roll the cardboard strip into a tube sized to hold the planet, and tape it to keep it together.



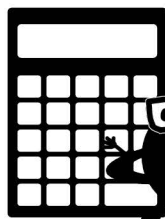
To prepare each balloon:

- 1 For the planet you want to make, choose the balloon size indicated on pages 4 and 5 for that planet. Blow up the balloon to the approximate diameter given for the planet on pages 4 and 5. To measure the diameter, eyeball the distance across the center of the balloon with a ruler.
- 2 Tape the knot down so that the balloon is rounder and results in a more perfectly spherical planet. The tape will help squeeze the oblong balloon into a more spherical shape.
- 3 Make sure you blow up and tape only one balloon at a time, and only when you are ready to cover it with yarn. If you blow them up too far ahead of time, they may deflate or pop before you can get to them!



Overview of the eight planets

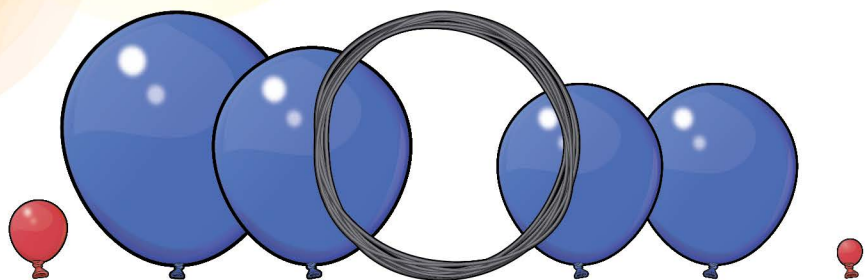
and Photo!



Whoa! Good thing I have my giant calculator ready!



	Sun	Mercury	Venus	Earth
Balloon size (indicated by color)	Green	Red	Red	Red
Balloon diameter (inches)	8	1 1/4	3	3
Total length of string needed (inches)	1730	90	340	340
How to cut the string to exactly the correct lengths:				
1. Wrap the string around the box 10 times and cut. Repeat this until you have this many pieces of yarn:	7	0	1	1
2. For the final piece, wrap the yarn around the box this many times and cut:	7	4	5	5
Total number of times to wrap the string around the box	77	4	15	15
How much glue (teaspoons)	2	1	1	1
How much flour (tablespoons)	2	1	1	1
How much water (tablespoons)	6	3	3	3
Dye tablet colors for yarn	1/4 Yellow	1/4 Green 1/4 Red	1/4 Yellow	1/4 Blue
Painted highlights	Orange	Gray	Yellow	Green Brown



Mars	Jupiter	Saturn	Saturn's Rings	Uranus	Neptune	Pluto
Red	Blue	Blue	None	Blue	Blue	Red
1 1/2	7	6	8	5	5	3/4
110	1400	1010	500	720	720	70
0	5	4	1	2	2	0
5	12	5	12	12	12	3
5	62	45	22	32	32	3
1	2	2	1	2	2	1
1	2	2	1	2	2	1
3	6	6	3	6	6	3
1/4 Orange 1/4 Red	1/4 Orange 1/4 Yellow	1/4 Yellow	1/4 Green 1/4 Red	1/4 Blue	1/4 Blue 1/4 Green	1/4 Orange 1/4 Green
Red	Orange	Yellow	Gray	Blue	Blue Green	Brown

PART 2

PLANETARY FORMATION

Making the colored paste

You will need:

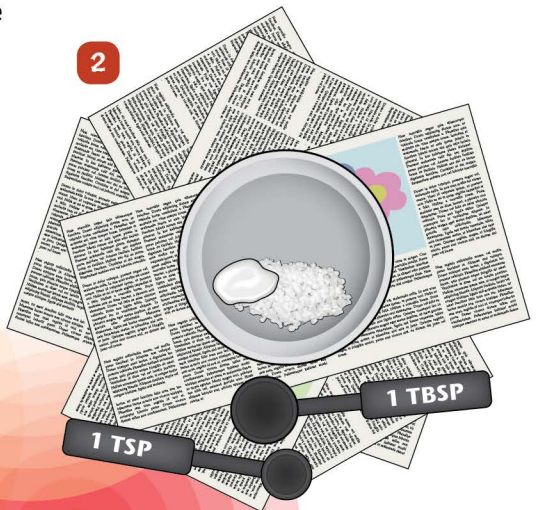
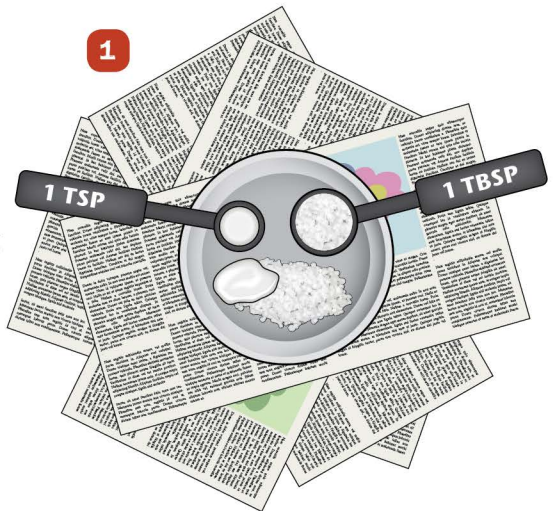
Glue, dye tablet, newspaper, shallow disposable plastic tub, plastic cup, teaspoon, tablespoon, flour, water, spoon

Here's how:

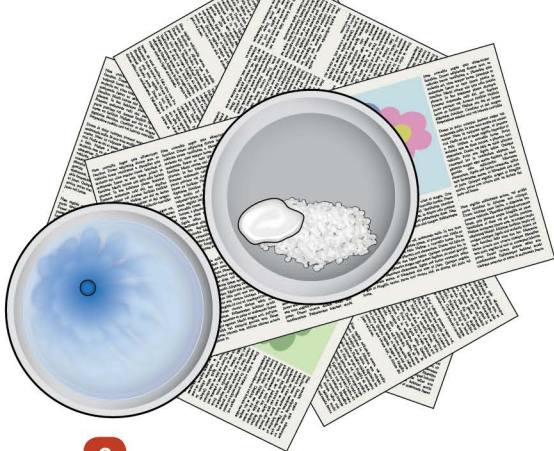
You will make one planet at a time. Decide which planet you are making now.

1 Cover your workspace in newspaper to protect it. Place your disposable tub, such as a shallow plastic food container, on the newspaper. Measure out the amount of flour and glue indicated on pages 4 and 5 for the specific planet you are making.

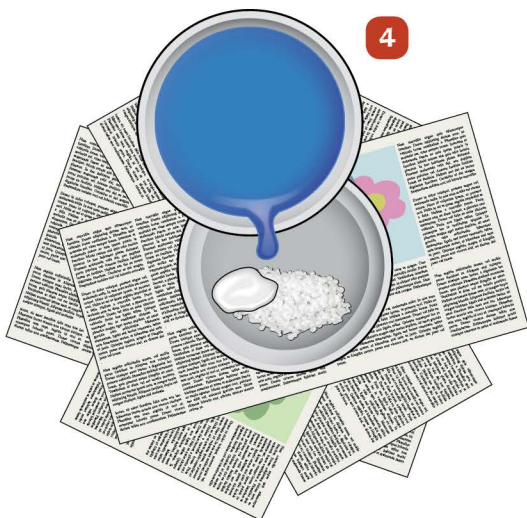
2 Put the flour and glue into the tub.



- 3 In a small plastic cup, place the amount of food coloring dye tablet(s) indicated on pages 4 and 5 for the specific planet you are making. Add the amount of water indicated for the specific planet. Let the dye tablet(s) dissolve completely.

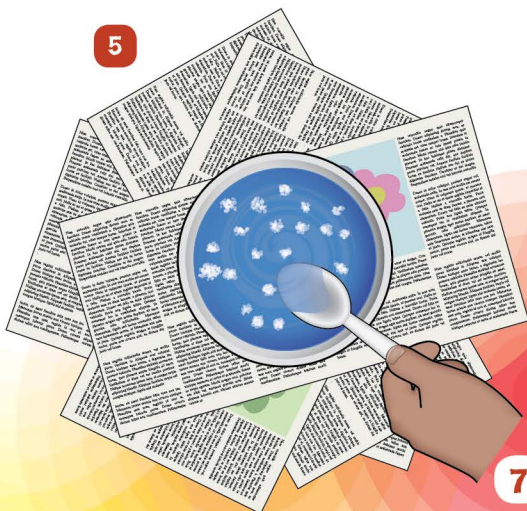


- 4 Pour the colored water into the flour and glue mixture.



- 5 Mix the flour, glue, and colored water with a disposable spoon until it is a smooth, watery paste. It should be the consistency of thin yogurt.

The paste is done! Move on to the string-gluing step immediately.



Wrapping the planets in yarn

You will need:

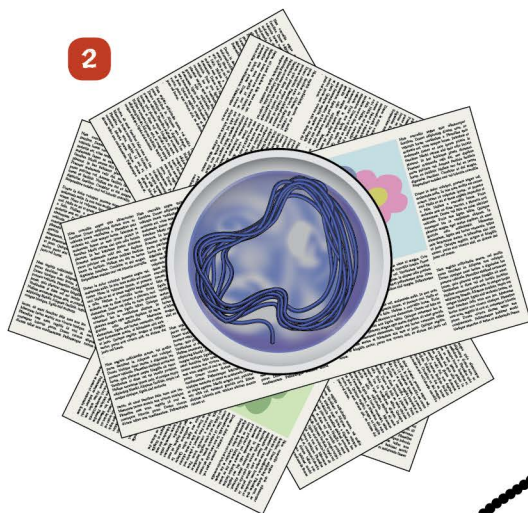
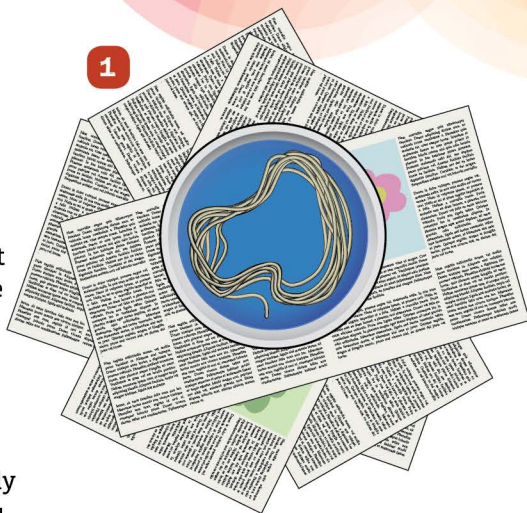
Cut yarn pieces, colored paste in shallow tub, taped balloon, drying cradle, *newspaper*

Here's how:

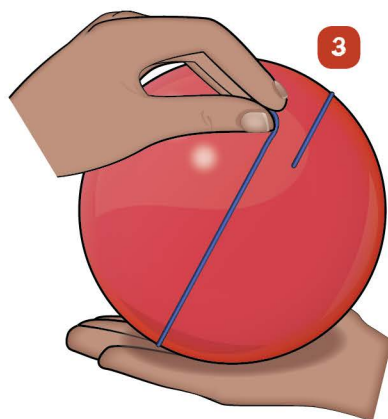
Your hands will get a little dyed. That is okay. It will wash off after a couple good washings.

1 Place the first piece of yarn into the paste solution in the tub. Be very careful not to let it get tangled. Hold onto one end tightly and don't let the end get lost. You want to coil the yarn into the paste very neatly so that as you uncoil it out of the paste, it does not get tangled.

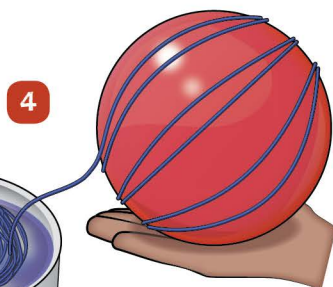
2 Press down on the yarn gently so that it absorbs the paste. Make sure you apportion the paste equally among all the lengths of yarn you cut for this particular planet.



3 Start wrapping the yarn around the balloon. As you uncoil the yarn out of the paste solution, squeeze the excess solution out of the yarn but make sure the yarn has been completely saturated with the paste solution. Hold the balloon in one hand and wrap the yarn with the other hand. Keep it taut.



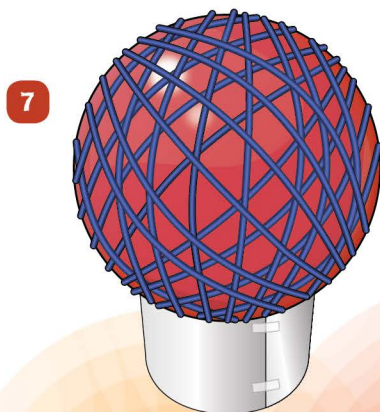
4 Wrap the yarn around the balloon evenly. Try to fill in empty spaces by wrapping the yarn in the middle of those empty spaces.



5 When you reach the end of the piece of yarn, tuck the end underneath another piece of yarn to secure the end.

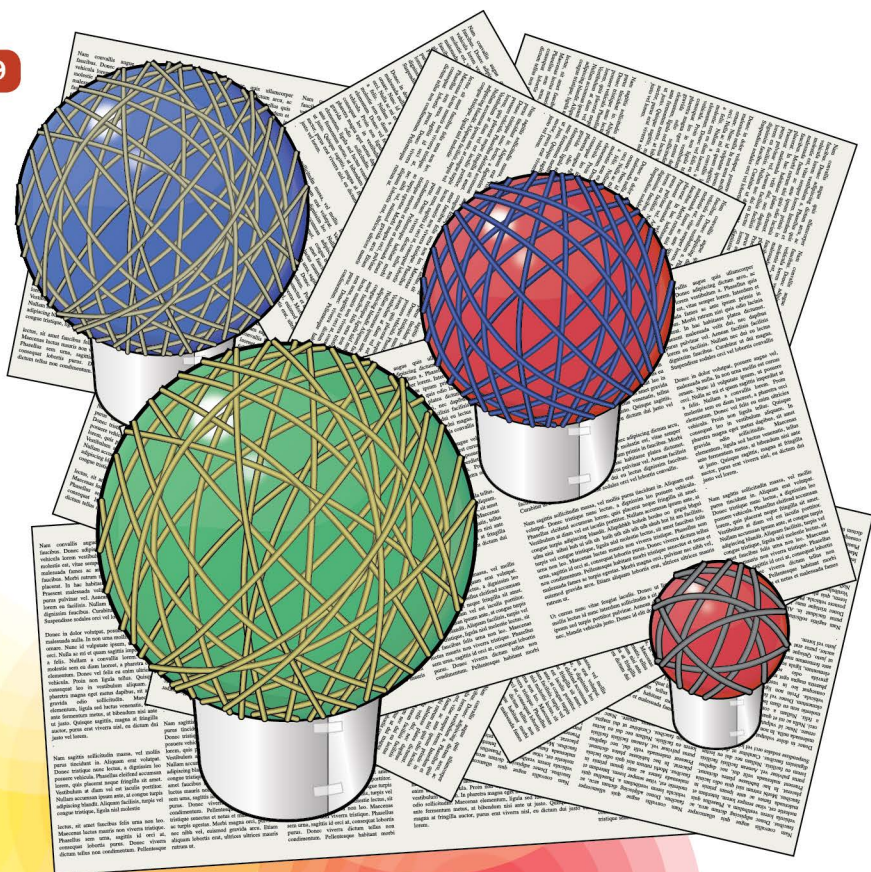
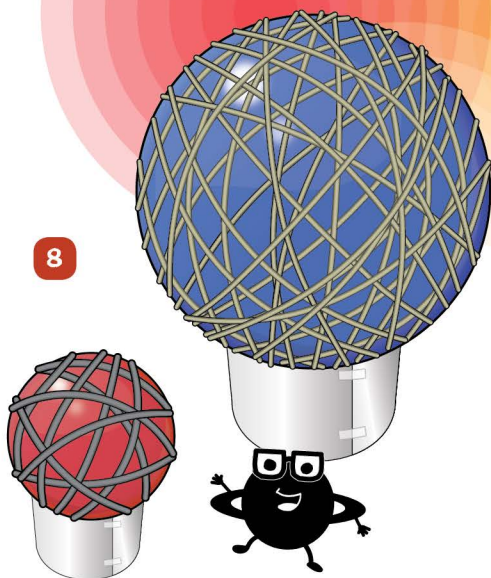
6 Repeat steps 1 through 5 for the remaining pieces of yarn.

7 When you have come to the end of the last piece of yarn, gently tuck the end of the yarn under another piece of the yarn, and set the planet to dry on its tube pedestal. Let it dry at least overnight. You know the yarn is dry when it is completely rigid.



8 Repeat the mixing of the paste and the yarn wrapping for each planet.

9 Leave all planets to dry. You know the yarn is dry when it is completely rigid. If it is even a little soft and flexible, it means that it is probably still a little bit wet and you need to let it dry longer.



Painting the accent colors

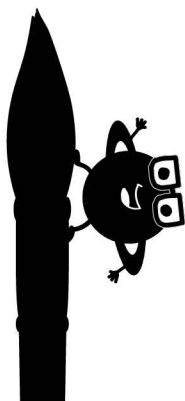
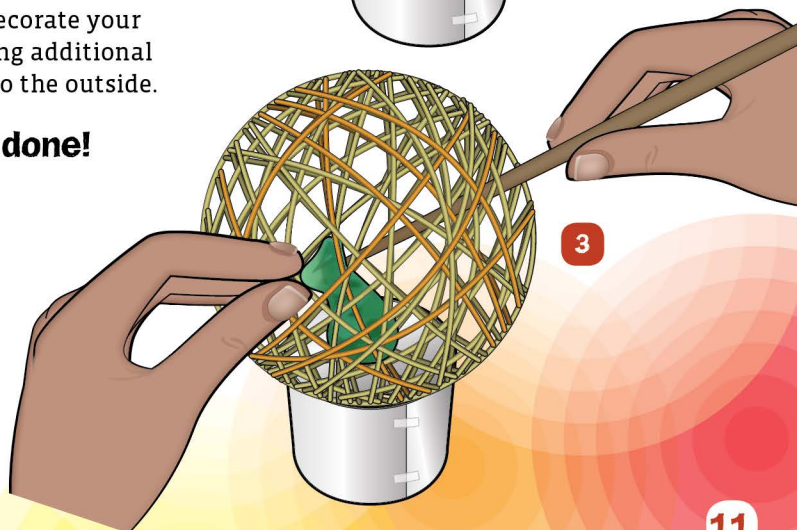
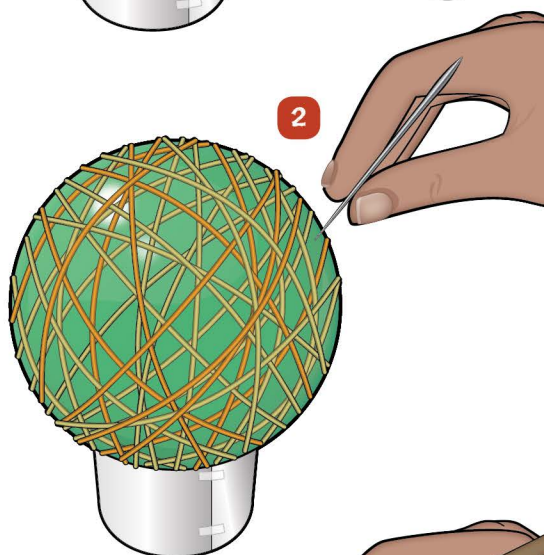
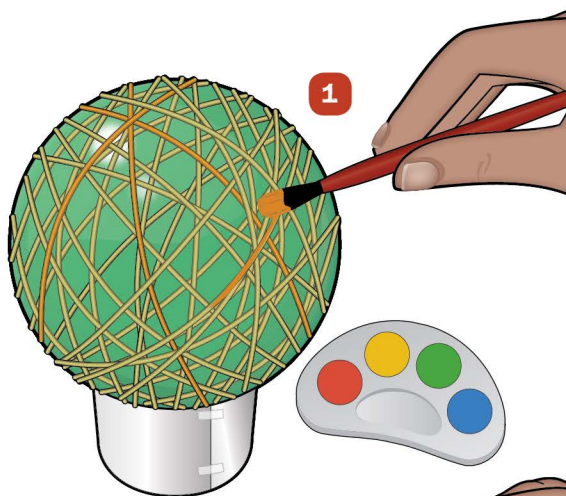
You will need:

Dry yarn planet model, water color paints, paint palette, paint brush, pin or needle, skewer or pencil

Here's how:

- 1 With the watercolors, paint accent colors as indicated on pages 4 and 5 for the planet. Let the paint dry.
- 2 When the paint is dry, it's time to pop the balloon! With a pin or needle, pop the balloon. It will peel away from the inside of the yarn planet sphere.
- 3 Carefully press the balloon out of one side of the yarn sphere by pushing it through from the other side with a skewer, pencil, or chopstick.
- 4 You can even decorate your planets by gluing additional pieces of yarn to the outside.

Your planet is done!



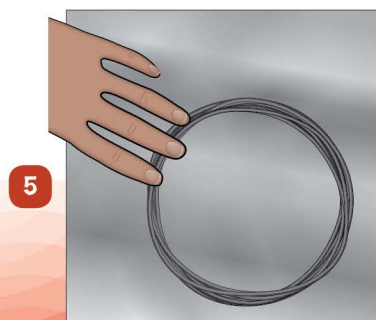
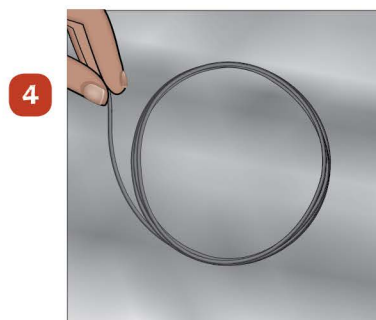
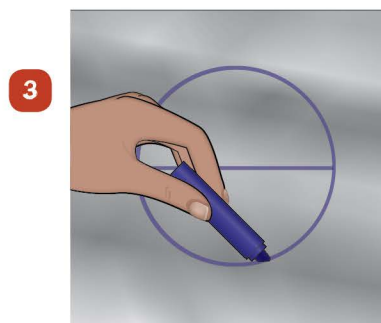
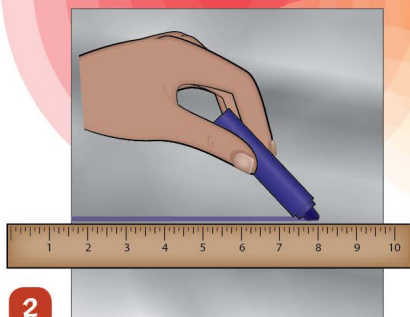
Making the rings of Saturn

You will need:

Cut yarn pieces, colored paste in tub, aluminum foil, ruler, permanent marker

Here's how:

- 1 Set out a piece of aluminum foil or wax paper.
- 2 Measure 8 inches with a ruler.
- 3 Draw a circle that is 8 inches in diameter. It can be rough.
- 4 Start laying the yarn, as measured on pages 4 and 5, out in a coil.
- 5 Once you have coiled up all the yarn, press down on the yarn to make it flat.
- 6 Leave the ring to dry, at least overnight. You know the yarn is dry when it is completely rigid.
- 7 Carefully peel the yarn ring off the foil or paper.



PART 3

ACROSS THE SOLAR SYSTEM

Hanging your solar system

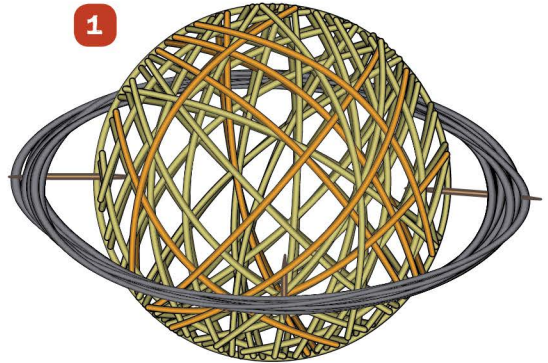
You will need:

Saturn model, Saturn's rings, four toothpicks, 9 thumbtacks, tape or glue, string

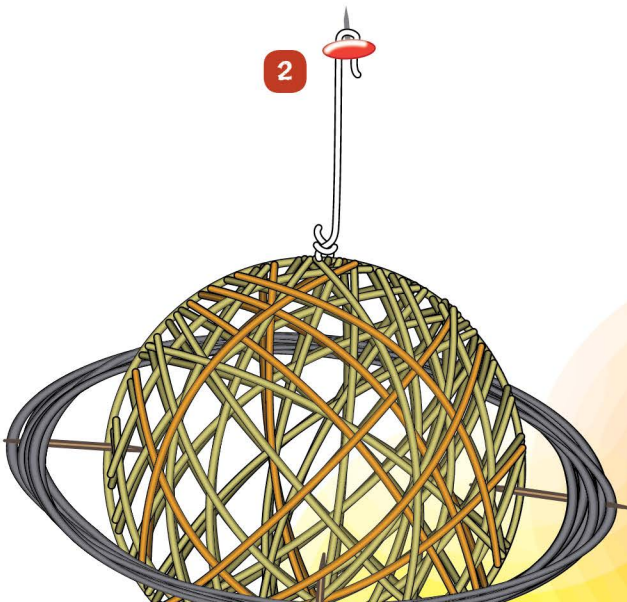
Here's how:

- 1 Use four toothpicks to glue the rings of Saturn onto Saturn as shown.
- 2 Hang the planets from the ceiling with string and tape or thumbtacks. To get an idea of each planet's relative distance from the sun, see page 15.

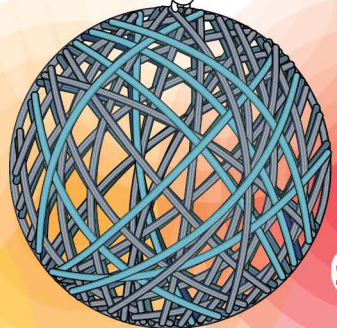
1



2

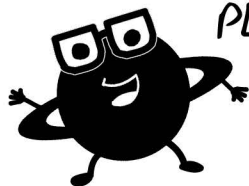


13





AMAZING FACTS ABOUT THE PLANETS!



Mercury is the smallest planet in our solar system but is still one of the five planets that you can see without a telescope. Its surface looks much like our moon's surface, with numerous craters. Mercury has a wrinkled surface which scientists believed was caused by the planet's iron core cooling and contracting. These wrinkles are called scarps and they can be over a mile high and a hundred miles long.

Venus is the second brightest object in our night sky. Our moon is the only object that is brighter. On a clear day, you might be able to see Venus during the daytime. Venus has a retrograde rotation. This means that it is rotating counterclockwise. The only other planet in our solar system to do this is Uranus.

Earth has an iron core and a rapid rotation which causes the planet to have a very strong magnetic field. This is incredibly important as this field protects us from most solar winds which could otherwise strip away our ozone layer.

Mars has the largest dust storms of all the planets. These can last for months and cover the entire planet. Mars has the largest volcanic mountain in our solar system called Olympus Mons. It is

three times taller than Mount Everest and would cover the entire state of New Mexico.

Jupiter is the largest planet in our solar system and has a very rapid rotation. One day on Jupiter is just under 10 hours long. Because of this fast rotation, the planet actually looks more like a squished ball rather than a circle. Jupiter is a gas giant. There are many raging storms on Jupiter, including the largest hurricane-like storm in our solar system, called the Great Red Spot. This storm has been active for over 300 years and is three times larger than the Earth.





Saturn is also a gas giant and is the least dense planet in our solar system. It is believed that because hydrogen and helium make up most of Saturn, that it would float in water. Saturn has many rings made of billions of particles of ice. These particles range in size from a grain of sugar to bigger than a house. These rings have a diameter of over 270,000 km, but are incredibly thin at only 330 meters thick.

Uranus has the largest tilt to any planet in our solar system and essentially spins on its side. This means that at times its poles point almost directly at the sun, which creates very long seasons on Uranus. Scientists presume this may have been caused by something very large colliding with the planet early in its development.

Neptune's moon Triton, one of the planet's 13 moons, is the coldest place in our solar system. It has temperatures as low as -235 degrees Celsius and has active geysers that erupt liquid nitrogen!

THE TRUE SCALE OF THE SOLAR SYSTEM

The planets and sun in the solar system you've made are not really to scale. The actual difference in size from largest (the sun) to smallest (Pluto) is proportional to the difference in size between an average car and an M&M candy! And it would just be too hard to make a yarn planet as large as a car and as small as an M&M! The table below shows the actual size and distances, and proportional examples.

	Diameter	Scaled Diameter	Diameter Example	Distance from Center of Sun	Scaled Distance	Distance Example
Sun	1,391,900 km 864,886 mi	15.5 ft	length of midsize car	–	–	–
Mercury	4,866 km 3,023 mi	0.7 in	 small grape	57,950,000 km	645 ft	almost 2 football fields
Venus	12,106 km 7,522 mi	1.6 in	 ping pong ball	108,110,000 km	1,204 ft	> 3 football fields
Earth	12,742 km 7,918 mi	1.7 in	 golf ball	149,570,000 km	1,666 ft	1/3 of a mile
Mars	6,760 km 4,200 mi	1 in	 small plum	227,840,000 km	2,537 ft	almost 1/2 a mile
Jupiter	142,984 km 88,846 mi	20 in	 beach ball	778,140,000 km	8,665 ft	1.6 miles
Saturn	116,438 km 72,351 mi	16 in	 globe	1,427,000,000 km	15,891 ft	3 miles
Uranus	46,940 km 29,167 mi	6 in	 large grape fruit	2,870,300,000 km	31,963 ft	6 miles
Neptune	45,432 km 28,230 mi	6 in	 large grape fruit	4,499,900,000 km	50,110 ft	9.5 miles
Pluto	2,274 km 1,413 mi	0.3 in	 M&M candy	5,913,000,000 km	65,846 ft	12.5 miles

THE COLORFUL
SOLAR SYSTEM

The planets' colors are determined by the different ways their surfaces and atmospheres reflect light. They aren't as vibrantly colored as most photos of them would lead you to believe. Most photos have been filtered and retouched to make the colors more exciting.

● **Mercury** is just bare iron-heavy rock and craters with no atmosphere, so it looks gray.

● **Venus** appears yellow because of its sulfuric acid clouds, while its surface is iron-gray like Mercury.

● **Earth's** oceans, water vapor clouds, vegetation, and land give it a blue, white, green, and brown marbled appearance.

● **Mars** is reddish-brown because it is covered in volcanic basalt rock, which breaks down into iron oxide (rust) dust.

● **Jupiter** has white bands colored by ammonia clouds and orange-brown bands colored by ammonium hydrosulfide, sulfur, and phosphorus. It also has a giant orange-brown spot which is a huge ongoing storm.

● **Saturn** is mostly hydrogen and helium, and its ammonia clouds give it a pale yellowish-brown color. Saturn has gray rings around it made of particles ranging in size from dust to 10 meters.

● **Uranus** and ● **Neptune** are both bluish due to the methane in their atmospheres, but Neptune is a darker blue because it is farther from the light of the sun.

● **Pluto** is light brown, like a dirty snowball reflecting what little sunlight it receives.

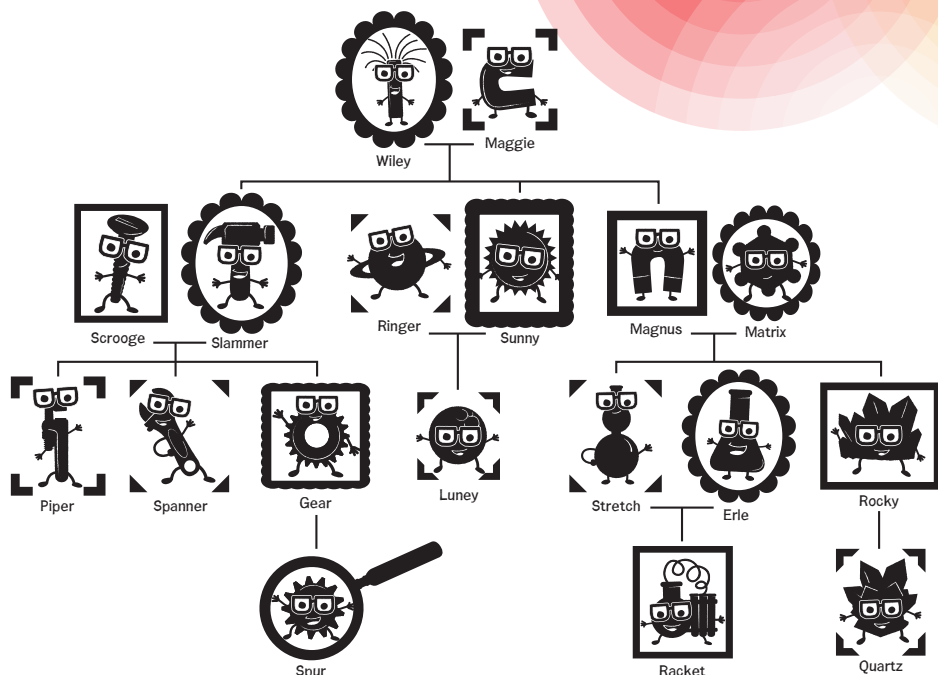




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MEET THE GEEKERS!



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