Explore Marvel Moon:
KID MOON: SPLAT!

OVERVIEW —

Participants model ancient lunar impacts using water balloons. Like huge asteroids, the water balloons are destroyed on impact and leave a splash (i.e. a "crater") that is 10 to 20 times wider than the impactor.

WHAT'S THE POINT?

- Impact craters and basins are caused when an impactor, such as an asteroid or comet, collides with a planet or moon.
- The size of an impact crater or basin depends on the speed and size of the asteroid or comet before the collision and the material it impacts. Most impact craters will be 10 to 20 times the size of the impacting asteroid.
- Models can be tools for understanding the natural world.

MATERIALS —

Facility needs:

- ☐ An outdoor area, such as a concrete patio or parking lot

For each child:

- ☐ Water balloon
- ☐ Kid Moon: Splat! comic panel
- ☐ Ruler
- ☐ Pencil

For the facilitator:

- ☐ Splat! children's guide
- ☐ Access to water
- ☐ (Option) bucket or tub for holding water balloons

PREPARATION —

- If possible, tell participants ahead of time to wear an old shirt or apron, or you may wish to provide trash bags for them to wear. Have a towel handy for cleaning spills.
- Either prepare enough water balloons for each participant, or identify where and how they will make their own.
- Identify a safe location for dropping them.
- Provide the balloons — contained in the bucket, if desired — at that location with clipboards and rulers or tape measurers.

ACTIVITY —

1. **Share ideas and knowledge.**
   - What do the participants know about craters? Invite them to share their ideas about where they are and how they form.

2. Let the participants know that they will be experimenting with a model of the impact process, using water balloons.
   - What will the water balloon represent? [The impactor—an asteroid or comet]
   - What will represent the crater? [The splash marks]

3. Go outside and hand out the filled water balloons and rulers. (For less disciplined groups, you may want to hand out one balloons, and have the rest of the group watch the experimental impact before handing out the second balloon.)

4. Have participants measure and record the balloon's width.

5. Have them break a balloon by throwing it onto an outdoor concrete patio or sidewalk, taking care to avoid each other.

6. Participants should measure the width of the impact (splash of water) that has been created.
   - What happened to the asteroid or "impactor"? [It exploded.]
   - What happens to comets or asteroids that impact a planet or the Moon? [They explode.]

7. Ask participants to calculate the ratio of the size of the balloon to the size of the impact, and compare their results.

8. Hold a group discussion:
   - In what ways does this model work for an asteroid or comet impact on the Moon? What ways does the model fail? [This model does not show the depth of craters, the ridges and mountains that can form. Other models, like impact boxes, can show these features but not the scale.]
   - What was the range of ratios that the students calculated? [The impact area should be about 10-20 times bigger.]
   - Is a crater on the Moon bigger or smaller than the asteroid that made the crater? [Craters are bigger than the asteroids.]
   - Invite participants to predict what would if they threw the balloons faster. *What might happen when an asteroid or comet is moving faster?* [The crater might be larger.]

BACKGROUND —

The size of an impact crater depends on the speed and size of the asteroid or comet before the collision. A faster impact will create a larger crater. Typically, asteroids hit Earth at about 20 kilometers (slightly more than 12 miles) per second. Such a fast impact produces a crater that is approximately 20 times larger in diameter than the asteroid. Most impacts will be 10 to 20 times the size of the asteroid. Smaller planets have less gravitational "pull" than large planets; asteroids and comets will strike at lower speeds.

CONCLUSION

Once they have completed the experiment, participants should understand that the large circular features they observe on the Moon (and other planets and asteroids) are impact basins. They were formed by large impactors — asteroids or comets — striking its surface. Craters and basins on the Moon are larger than the asteroids and comets that created them — 10 to 20 times larger!

Impactors are like water balloons because they are destroyed upon impact, and very little of the asteroid or comet remains. (Remnants of asteroids found on a planetary surface are called meteorites.) Asteroids are much more rocky and moving faster than the balloons in this model; they are far more damaging.

Scientists experiment with physical models and computer models to determine the effects of an impactor. Their models use projectiles that can move at high speeds and impact different types of materials. They also study impact craters on Earth, like Barringer Crater (Meteor Crater) in Arizona to understand impact processes.

CORRELATION TO STANDARDS

Next Generation Science Standards

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Disciplinary Core Ideas:

ESS1.B: The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
ESS1.C: The History of Planet Earth: Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.

Science and Engineering Practices

- Developing and Using Models: Develop and/or use models to describe and/or predict phenomena.
- Developing and Using Models: Identify limitations of models.
- Using Mathematics and Computational Thinking: Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Crosscutting Concepts

- Patterns: Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
- Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale.

The Nature of Science

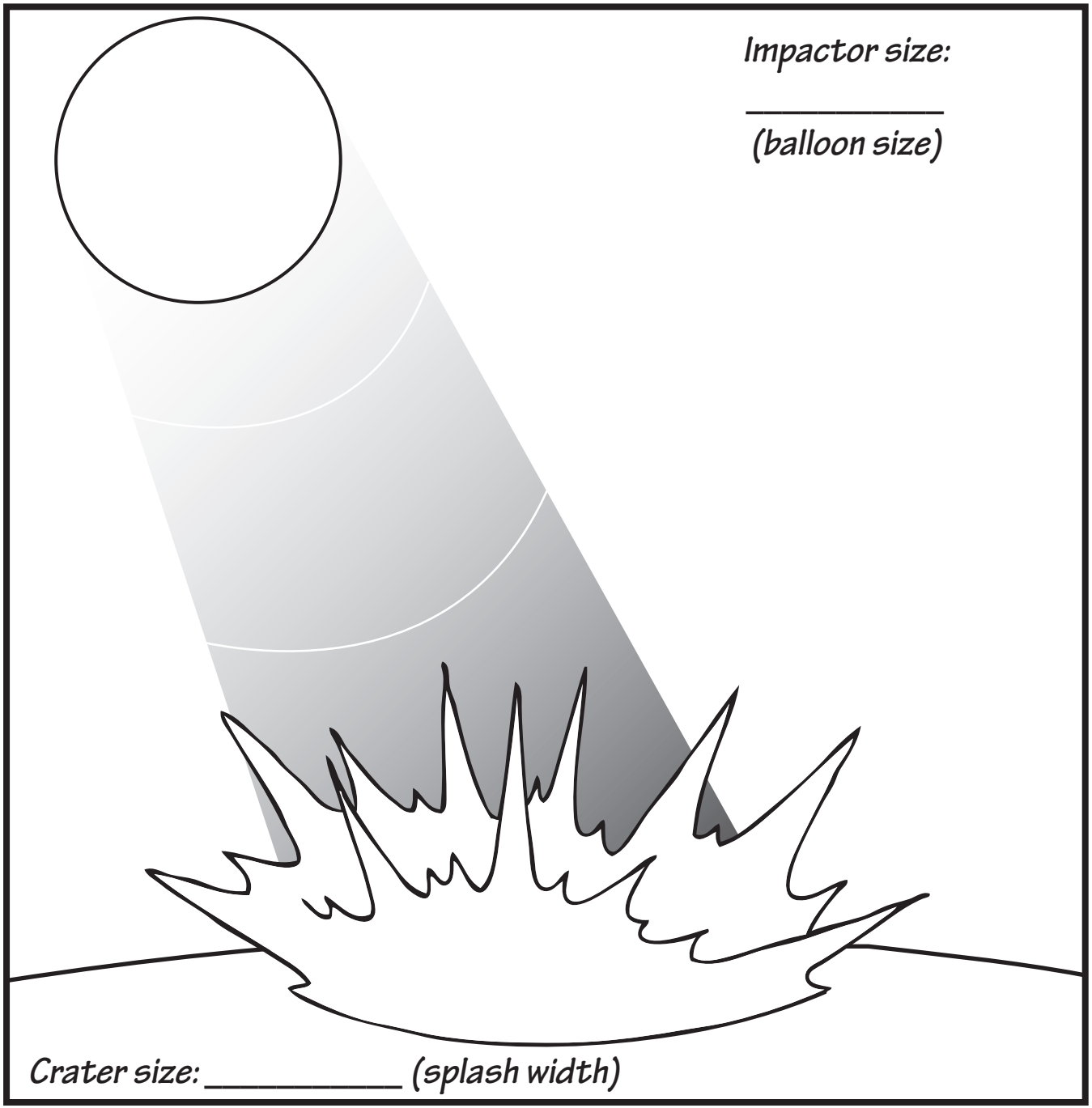
- Scientific Investigations Use a Variety of Methods: Science investigations use a variety of methods and tools to make measurements and observations.

CHECK IT OUT	WHAT TO DO	WHAT TO ASK...
1 The **young Moon was hit by large asteroids**.	**Model your own impact** with a water balloon! **Record** your measurements on the *Kid Moon: Splat!* comic panel.	**How wide across is your water balloon?**

CHECK IT OUT	WHAT TO DO	WHAT TO ASK...
2 These impacts **left scars** that we can see today: **impact basins** — really big craters!	**Break the balloon** by throwing it onto an outdoor concrete patio or sidewalk. **Record** your measurements on the *Kid Moon: Splat!* comic panel.	**How big is the splash (the "crater")?**

CHECK IT OUT	WHAT TO DO	WHAT TO ASK...
3 **Craters on the Moon are larger than the asteroids that created them** — 10 to 20 times larger! Like the water balloon, the **impactors broke apart** when they hit the Moon.	**Calculate** the ratio of the size of the impact to the size of the balloon. **Record** your measurements on the *Kid Moon: Splat!* comic panel.	**How much larger is your splash compared to the size of the balloon?** Asteroids and comets travel much faster than you can throw a balloon. They are also rocky and hard. What do you think would happen if you **threw the balloon faster**? How would the **"splash"** caused by an impactor on the Moon look **compared to the balloon's splash?**

Kid Moon: Splat!



Crater size ÷ baloon size=_____