The Ohio State University

West Campus Science & Sustainability Festival

2022 Virtual Event Packet

A free, virtual outreach event!

People of all ages are welcome to register for a virtual WestFest program. Please note that some activities are more complex and best suited for students in upper elementary through high school.

October 17th - 22nd, 2022

go.osu.edu/westfest

THE OHIO STATE UNIVERSITY

OHIO STATE ENERGY PARTNERS

STEM Impact collaborative

Schedule of Events

Monday, October 17th
9:30-10:00 a.m. - Astronomy
6:00-7:00 p.m. - Follow Along Pharmacy

Tuesday, October 18th
9:30-10:15 a.m. - Build a Glacier
6:00-6:45 p.m. - Build a Glacier

Wednesday, October 19th
9:30-10:30 a.m. - Packing Oranges to Fix Errors

Thursday, October 20th
9:30-10:15 a.m. - Planting for Pollinators

Friday, October 21st
9:30-10:15 a.m. - Follow Along Pharmacy

Saturday, October 22nd
9:30-10:00 a.m. - Astronomy
10:30-11:15 a.m. - Planting for Pollinators
12:00-1:00 - Packing Oranges to Fix Errors

Register for virtual programs:
https://go.osu.edu/register4wf

Astronomy
Monday, October 17th, 9:30-10:00 a.m.
Saturday, October 22nd, 9:30-10:00 a.m.

Materials

String	30 Bouncy Balls
UV Beads	Diffraction Glasses

Earth – Moon Scale Model

- 30 Bouncy Balls
- 1 UV Bead
- String

What is a scale model? When we think of a model of something we usually do not think of an object that is full sized but something we can hold in our hands. One of the models we may have around are toy cars or toy trains. These are close to the shape of an actual car or train but they are much smaller and can fit in our bedrooms or on the table. If we want an accurate scale model, the ratio of sizes should stay the same as the original object. An example would be if a train engine has a length that is equal to 10 of its wheels, then when we shrink it down to fit on our table the smaller model train's length will still equal 10 of its smaller wheels.

We want to get an idea of how big the Earth and Moon and how far apart they are, so we are going to make a scale model of the Earth Moon System.

Instructions:

There are 30 1-inch bouncy balls in the kit. Any one of these will represent the Earth, so pick your favorite. One of the smaller UV beads is about the size of the Moon, compared to the 1-inch Earth. There should be about 4 Moons that cross the diameter (all the way across) the Earth. You can place 4 beads in a row, and they should be the same approximate size as the bouncy ball.

There are two ways to do this next part. The first we are going to try to line up all 30 bouncy balls in a line. They will roll around a little but start with your Earth and then stack all the other balls to one side. At the end of that row you will place a UV bead. This is how far apart the Earth and Moon are. 30 Earths fit between the Earth and the Moon.

Another way to do this is to tie the string on the bouncy ball. Then wrap the string around the ball 10 times. At this point you can tie a moon bead at that point in the string. If you cut off the rest, you can make a bracelet for the next activity. Now you can hold the Earth and see the Moon on the string. This is the farthest that Humans have ever been from the Earth into space. At this scale, the Sun would be 300 yards away and be 100 inches across. Space is REALLY big.

Exploring the Light Around You

- Diffraction Glasses – NEVER look at the Sun
- UV Beads
- String

Instructions:

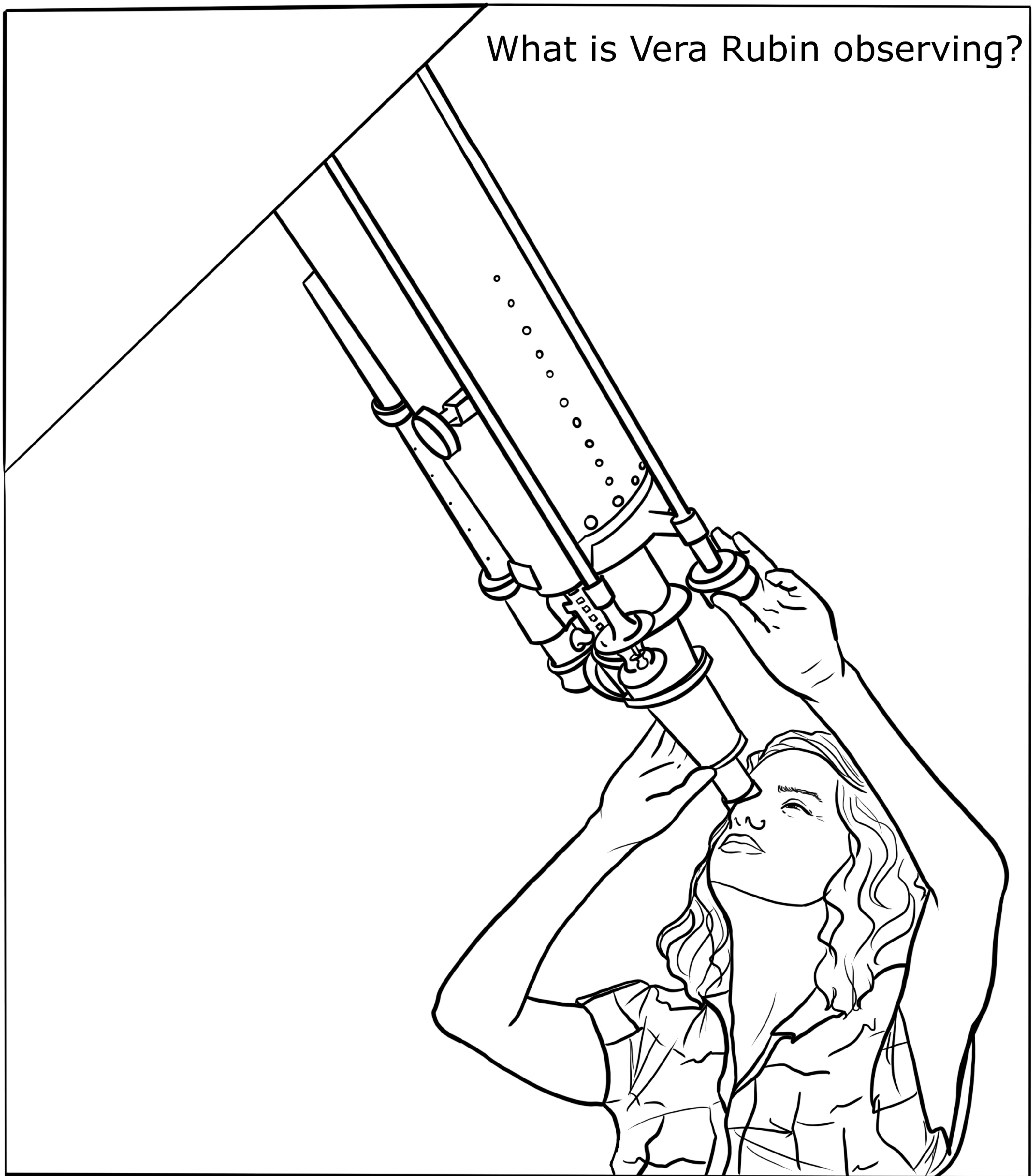
For this activity it is all about exploration. There are two components, one is to look at the light in your house or in your neighborhood with the yellow diffraction glasses and the other is to see what lights make the UV beads change colors.

The UV beads are sensitive to ultraviolet (UV) light, the same light that gives us sunburns. The beads are normally white but change colors when they are exposed to ultraviolet light. Inside your home the beads will likely stay white, but if you go outside,

they will immediately change colors, even on a cloudy day. Some UV light can go through clouds. You should investigate if UV goes through windows, if lights in your home produce UV, and do other fun experiments. You can even try smearing sunscreen over them and see if it makes them change color more slowly.

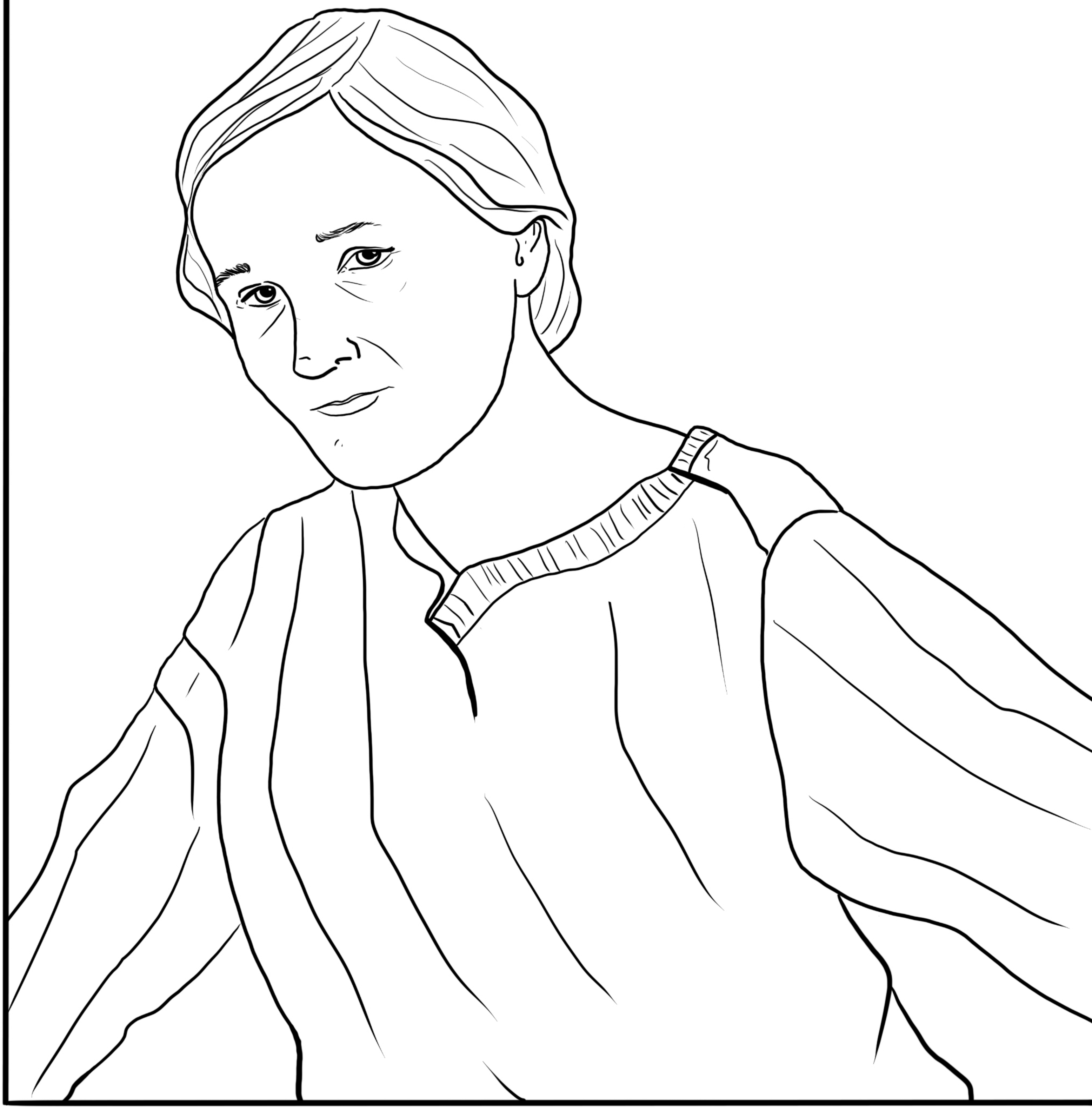
With the diffraction glasses you will see rainbows from everything. These glasses break up the light into the colors that make it up. When we see white lights on our computer screen, it is made of mixtures of Red, Green, and Blue to make all the colors we see. You should investigate all of the lights in your house and at night in your neighborhood. You should also look at a phone screen or computer screen in a dark room to see what colors make up the images you see on the screen. It will surprise you!

What is Vera Rubin observing?



Vera Rubin

Cecilia Payne



Follow Along Pharmacy

Monday, October 17th, 7:00-8:00 p.m.
Friday, October 21st, 9:30-10:15 a.m.

Materials:

Portion cups with citric acid (2)	Portion cup with flour	Portion cup, empty	Roll of Smarties
Fork	Stirs (2)		

Liquid Prep:

- Fill empty portion cup with water
- Fill each of the citric acid portion cups half full of water. Stir until citric acid dissolves.

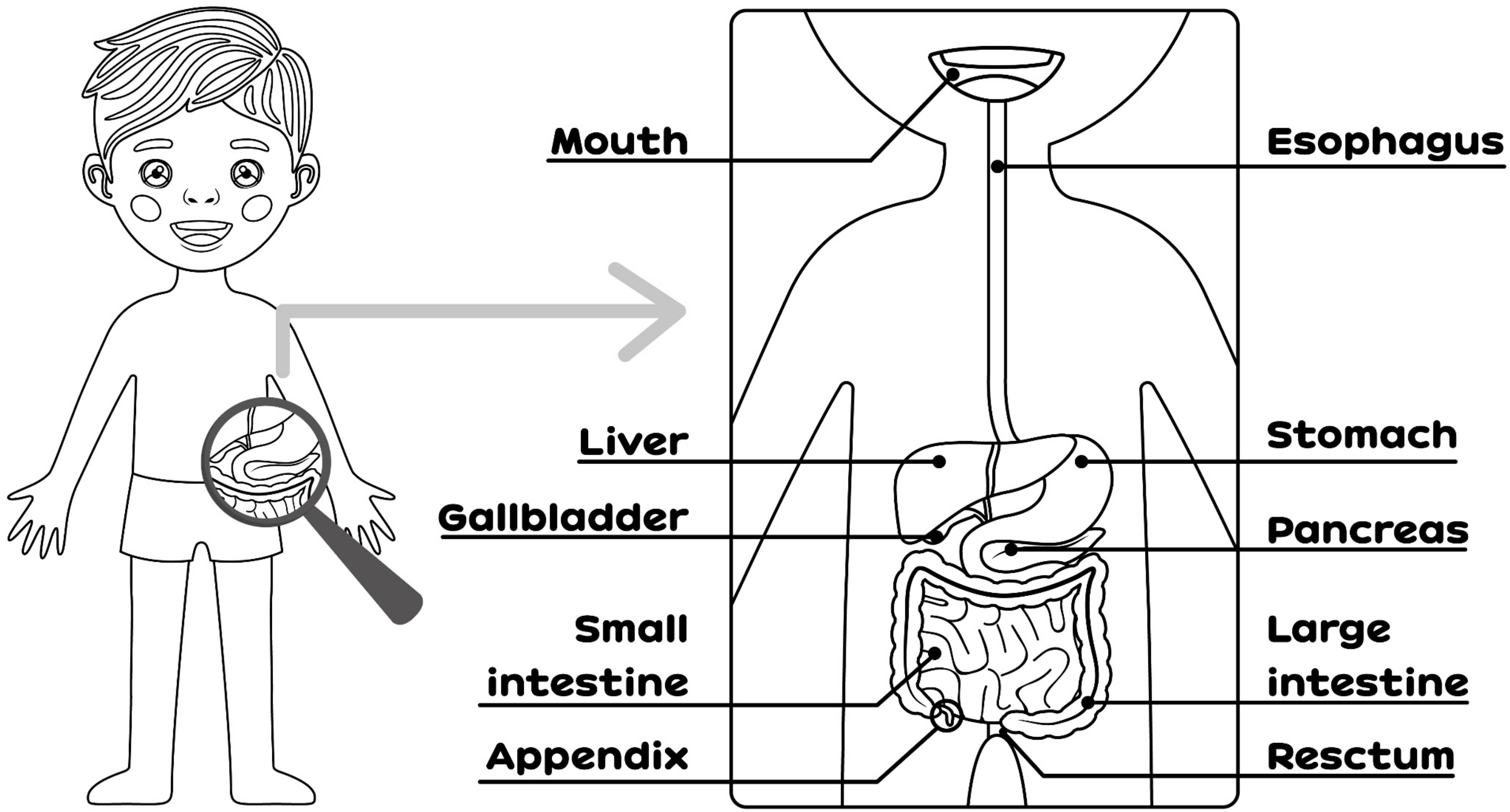
Smartie Prep:

1. Place one (1) Smartie in water only cup.
2. Using the fork, lift the Smartie out of the water and drop it into flour cup. Mix the Smartie in the flour until it is completely coated.
3. Lift the Smartie out of the flour cup with the fork. Using your fingers, squeeze the flour + Smartie so that it is firmly coated.
4. Repeat the process two (2) more times so that the Smartie has a thick layer of flour.
5. Make four (4) total flour-coated smarties.

Directions for Activity:

1. Place three (3) uncoated Smarties into one cup of citric acid.
2. Place three (3) flour-coated Smarties into the other cup of citric acid.
6. Stir each portion cup occasionally.
7. Using the fork, take out one (1) uncoated Smartie and one (1) flour-coated Smartie every 5 minutes.
8. Compare and contrast the uncoated Smarties and the flour-coated Smarties at different time intervals.

THE DIGESTIVE SYSTEM



Build an Ice Sheet

Tuesday, October 18th, 9:30-10:15 a.m. & 6:00-6:45 p.m.

In this activity you will create a substance, flubber, that mimics how ice sheets move. Flubber can act as both a solid and a liquid. Because of this, its slow movements show you how ice sheets would have moved through Ohio.

Materials

½ cup white glue	6 tbsp warm water	1 ½ teaspoons Borax
⅓ cup cold water	Measuring cups	Measuring spoons
Ziploc bag containing this activity Small bowl	Tablecloth or newspaper (optional)	Food coloring (optional)

Making Flubber

1. Set up your station by laying down **newspaper or a tablecloth** to help with cleanup
2. Pour ½ **cup of glue** into a **Ziploc bag**
    - Using a bag can allow for easy mixing and storage
3. Add **6 tbsp of warm water** to the bag with the glue
4. In the **small bowl**, mix **1 ½ teaspoons of Borax** and ⅓ **cup of cold water**
    - Optional: Add a small amount of **food coloring** to Borax mixture, we used blue to mimic ice!
5. Pour the Borax mixture into the bag containing the glue mixture
6. Begin mixing the two together by squishing it around with your hands. Continue for 2 minutes until well-mixed

** View video instructions on how to make flubber, as well as a preview of how we recreate glacial flow at **go.osu.edu/flubber**

Recreating an Ice Sheet in North America

Ice sheets are made of massive amounts of ice, usually the size of continents. There are only two locations with ice sheets today: Greenland and Antarctica. But, about 15,000 years ago, there was one in North America. The center of this ice sheet was over Hudson Bay in what is today Canada.

Take the flubber you made and squish it into a ball. Place the ball in the center of Hudson Bay, marked by the star on the Arctic Map below. Central Ohio is marked on the map with a yellow dot.

Describe what happens to your flubber ice sheet. What direction would it flow through Ohio?

Even though ice sheets are huge and made of solid ice, they flow really slowly. You can easily walk faster than they flow. They are much thicker than your flubber ice sheet, spanning between one half and one mile thick when they reached Ohio. These ice sheets carved out the Great Lakes leaving bedrock in places like the Glacier Grooves on Kelleys Island and dropped off a lot of the material that became the fertile soils that support Ohio agriculture.

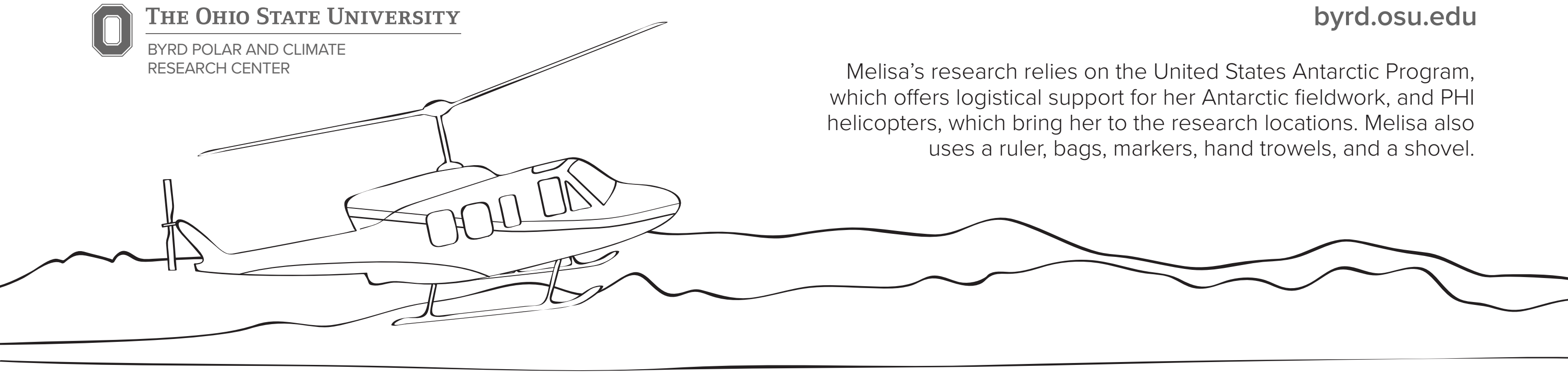
Build an Ice Sheet
Tuesday, October 18th, 9:30-10:15 a.m. & 6:00-6:45 p.m.

Use your computer, tablet, smartphone, or VR headset to check out Kelleys Island in Lake Erie and some of the features left from the last ice age. Direct your browser to virtualice.byrd.osu.edu/kelleys_island/ or access it with the QR code.

Look at the maps on the Geofacts flier that show the parts of Ohio that were once covered by ice.

Did the ice sheet in North America cover a small or large part of Ohio? Was the place where you live once covered by glaciers? What about the places where your family members live?

Melisa's research relies on the United States Antarctic Program, which offers logistical support for her Antarctic fieldwork, and PHI helicopters, which bring her to the research locations. Melisa also uses a ruler, bags, markers, hand trowels, and a shovel.



Melisa looks at soils from exposed mountains along the Shackleton Glacier and works with biologists to understand how ecosystems responded to the advance and retreat of glaciers 20,000 years ago.

Shackleton Glacier research helps us understand how ecosystems structure and function in harsh environments.

There are not many people of color in the geosciences, and there are even fewer in polar research. It is Melisa's priority to make the polar science community a welcoming place for future minority scientists. For Melisa, being a scientist means maintaining a curiosity about the world around her while also having fun.

Melisa Diaz

Melisa is a Latinx Ph.D. student and a National Science Foundation Graduate Research Fellow at The Ohio State University. Native to Massachusetts, Melisa is a cat fanatic and avid juggler. She once juggled rock hammers on the Shackleton Glacier! Melisa's research focuses on the soil geochemistry of ice-free areas in the Shackleton Glacier region of Antarctica.

Packing Oranges to Fix Errors

Wednesday, October 19th, 9:30-10:30 a.m.
Saturday, October 22nd, 12:00-1:00 p.m.

Materials:

Nine 1-inch round chips	1-inch graph paper sheet	Thirty 1-inch balls
Eight 1-inch half balls	Transparent box	Ruler

Background:
In the 17th century, Johannes Kepler, famous for his work in astronomy, posed the following question: What is the densest way of packing spheres? In other words, what is the best way to arrange a given number of balls so that they occupy the smallest space possible.

While he had a hypothesis, he was not able to prove that it was indeed the most efficient way. Since then, mathematicians have tried to solve the problem. It was not until 1998, that American mathematician Thomas Hale finally proved Kepler's hypothesis.

However, that did not end the discussion. Throughout the years, mathematicians have not limited their work on this question to 3-dimensional spheres. In fact, Kepler did what mathematicians often do and started by looking at a simpler problem: how to pack 2D versions of spheres, in other words, circles. He was able to answer and prove the result with circles.

However, one can also answer the question for higher dimensional versions of circles and spheres. In 2016, Maryna Viazovska, a Ukranian mathematician, solved the problem in 8 dimensions. A year later, Viazovska and a team of mathematicians also solved the problem for 24 dimensions. This was such an important discovery, that she was awarded the Fields Medal, a very important prize in mathematics that is only awarded every four years.

In this activity, we will explore Kepler's problem in 2 and 3 dimensions and talk about the problem in higher dimensions.

Packing Oranges to Fix Errors

Wednesday, October 19th, 9:30-10:30 a.m.
Saturday, October 22nd, 12:00-1:00 p.m.

Directions:

Part I. 2D

1. Place the graph paper on a table and arrange the 9 chips on it. The goal is to find an arrangement where the chips are packed as tight as possible. Another way of saying this is that we want the arrangement to cover the smallest possible area of paper.
2. Once you have it, carefully draw a polygon tightly surrounding the chips. Remember that a polygon has straight sides. Use a straight edge if possible.
3. Compute the area of the polygon you drew. To do that, use the ruler to take any necessary measurements. You can also use the grid as reference considering each box is 1 inch per side. Some area formulas are given here for reference.

   Rectangle and romboid: $A = b \times a$ Regular polygon: $A = \frac{P \times a}{2}$
4. Each chip has a diameter of 1 inch. What is the area of a chip? Remember that the formula for the area of a circle is $A = \pi \times r^2$
5. What is the total area of 9 chips?
6. To measure how packed or dense an arrangement is, mathematicians use the following formula:

$$\text{Density} = \frac{\text{Total area of the 9 disks}}{\text{Area of the polygon that surrounds them}}$$

   Use the formula to compute the density of your arrangement.

7. This formula becomes handy when we have several arrangements that we need to compare. Come up with another way of arranging the chips: a second option that you think could compete with the previous. Repeat all the steps to get the density of this new arrangement.
8. Which arrangement is denser?

Part 2. 3D

1. Now we will try to do the same but with the balls.
2. Assemble your box and arrange the balls inside it, trying to fit as many as possible. The sides of this box might bend a little but try not to do that. You should fill the box

with balls without letting the sides bulge. The sides of the box should remain straight.

Hint: You should be able to find a way of nicely fitting 27 balls precisely in the box.

3. The box is a cube with each side measuring 3 inches. Use the formula to compute its volume.

$$\text{Volume} = \text{width} \times \text{height} \times \text{depth}$$

4. Each ball has a diameter of 1 inch, so its volume is about 0.52 cubic inches. What is the total volume of the 27 balls?
5. CHALLENGE: Use the formula for the volume of a sphere to verify that the approximate volume of these balls is 0.52 cubic inches each.

$$V = \frac{4}{3}\pi r^3$$

6. Again, calculate the density using the same formula as before (here with volume instead of area):

$$\text{Density} = \frac{\text{Total volume of the balls}}{\text{Volume of the prism that surrounds them}}$$

7. We can also try to find an arrangement that is similar to the best one we found in 2D. To do this, we should lay the second layer of balls in the dimples between the balls of the first layer. You will notice that by doing this, we actually fit less balls in the box, but we also don't completely fill the box. Make a mark on a side of the box to the height reached by the balls.
8. Compute the volume of the box up to this mark.
9. Moreover, just as we saw in the 2D optimal solution, in this new arrangement, there are some gaps where we can fit half balls. Use the half balls and fit them as appropriate.
10. What is the density of this new arrangement?
11. CHALLENGE: Find a way of fitting 27 balls in total (counting two half balls as a single ball) without filling the whole box. Hint: It should be 23 whole balls and 8 half balls.

Part 3. Higher Dimensions & Applications

You might be able to see the usefulness of the previous problems of packing disks and spheres. In real life, there might be instances in which we might want to draw circles or arrange balls as tightly as possible. However, you might be wondering why would mathematicians care about studying the problem in an abstract, inexistent world, of more than 3 dimensions.

Sphere packing turns out to have an important application in telecommunications. As we will learn in this activity, the method allows to send information on the internet or in cell networks in a way that makes it easier to correct errors that might arise when sending the information. As a reference, you can watch this Numberphile video:

Spheres and Code Words – https://youtu.be/T46FTuHnbvY

Planting for Pollinators

Thursday, October 20th, 9:30-10:15 a.m.
Saturday, October 22nd, 10:30-11:15

Materials:

1 – 1.5” ball of clay	~ 2 tablespoons of soil	Pinch of seeds
7 – 10” square of fabric	String or ribbon	

Directions:

1. Roll the clay in your hands to soften it. Use your thumb to shape the clay into a small bowl.
2. Add a pinch of seeds to the center of the depression in the clay.
3. Add a spoonful of soil to depression with the seeds.
4. Carefully pinch the edges of the bowl closed, sealing in the soil and seeds.
5. Gently roll the clay into a ball then roll the ball in soil to coat the outside.
6. Place the seed ball in the middle of a square of fabric. Fold the fabric up around the seed ball and tie it closed with string or ribbon.
7. Let your seed ball dry. Do not place it in a plastic bag or container. That will hold the moisture in the clay. Store the fabric covered seed ball in a dry place.

What Now?

It is important to ‘plant’ your seed ball when the weather is good for growing in the place where you live. In Ohio, that is usually in May. When you are ready to grow your seed ball simply place it outdoors where you want flowers to grow. You do not need to bury the seed ball. If it is a rainy time of year, the rain will start to break down the seed ball as the seeds begin to grow. If it is not very rainy you should water your seed ball periodically to start the growing process.

Seed balls make a great environmentally friendly gift for friends and family. If you plan to give your seed ball away, be sure to add a label with the type of seeds you used and instructions on how to ‘plant’ the seed ball.

Choosing Seeds

It is best to choose seeds from plants that are *native* to your area. Native plants are ones that have grown naturally in an area for a very long time without human introduction.

These plants are well suited to the soil and weather of the region, and often provide food and shelter to wildlife. There are lots of resources on the internet to help you find out what plants are native to the place where you live

You will also want to think about the type of pollinator you want to attract with your plants. In today's program we talked about Monarch butterflies. Monarch butterflies are considered a federally endangered species. You can support Monarchs and other butterflies by growing plants they use as a food source. The seeds provided for today's activity are milkweed seeds. Monarch butterflies only lay eggs on milkweed plants.

Sources

https://u.osu.edu/beelab/native-plants-for-native-pollinators/
https://carolinahoneybees.com/how-to-make-seed-bombs

WestFest

SCIENCE & SUSTAINABILITY

#OSUWestFest

Automatic captioning will be available for all virtual programs. If you require additional accommodation such as interpretation to participate in this event, please contact westfest@osu.edu or 614-292-8208. Requests made two weeks in advance of the event allow us to provide seamless access, but the university will make every effort to meet requests made after that date.

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