Suggested Learning Activities for 4th and 5th Grade students during the COVID-19 school closure.

Seattle Public Schools is committed to making its online information accessible and usable to all people, regardless of ability or technology. Meeting web accessibility guidelines and standards is an ongoing process that we are consistently working to improve.

While Seattle Public Schools endeavors to only post documents optimized for accessibility, due to the nature and complexity of some documents, an accessible version of the document may not be available. In these limited circumstances, the District will provide equally effective alternate access.

Due to the COVID-19 closure, teachers were asked to provide packets of home activities. This is not intended to take the place of regular classroom instruction but will help supplement student learning and provide opportunities for student learning while they are absent from school. Assignments are not required or graded. Because of the unprecedented nature of this health crisis and the District’s swift closure, some home activities may not be accessible.

If you have difficulty accessing the material or have any questions, please contact Claudine Berry cvberry@seattleschools.org.
Advanced Learning Summer Projects
3rd – 5th grade

Suggested projects for 3rd-5th grade students to work on during the summer.

The Advanced Learning department is committed to making these projects accessible and usable to all people, regardless of ability or technology. These STEM projects represent a curated list of popular projects that are adapted for use by 3rd-5th grade students at home under the supervision of a caregiver. These projects have also been adapted to only use common household items. These projects are not required nor will be graded. Students can engage in whichever projects interest them.

Please note the following information:

**Adult Supervision Required and Caregiver Participation Highly Encouraged**
These projects are intended to be done by students with adult supervision. The directions are intended for adults to read and to support a student as they engage in the projects. We encourage caregivers to work on these projects together with their student as much as possible. To support this collaboration, you will also notice that every project contains a section that involves the student reflecting on their learning with a caregiver.

**Definitions and Vocabulary Building Activities**
The bolded words are defined in a glossary at the back of the packet. As you read through the projects with your student, we encourage you to ask your student about the bolded words, and reference the glossary as needed. Also, to engage your student more deeply in building their STEM vocabulary, we have included directions for using a graphic organizer to further explore the definitions and uses of these words.

**Information about Referring your Student for Advanced Learning Services**
The final page of these materials contains information about how to refer your student for Advanced Learning services.

For questions about these materials, please email advlearn@seattleschools.org or call the Advanced Learning department at 206-252-0130.
Grades
3rd – 5th
Summer Projects

Name:
# Table of Contents

Two-Item **Structure** Building Challenge ........................................................................................................1

The Slime Challenge ..............................................................................................................................................7

Marble Obstacle Course ......................................................................................................................................11

Building a Trebuchet ...........................................................................................................................................18

The Egg Drop Challenge ....................................................................................................................................26

The Glue Strength Test ........................................................................................................................................30

Glossary ..................................................................................................................................................................36

Building Student Vocabulary ..........................................................................................................................40
Two-Item Structure Building Challenge

Materials
This project can use many different types of materials. The challenge is to build one structure of using only two types of materials. Here are a few suggestions for types of structures you can build.

Spaghetti Marshmallow Towers
- Dry spaghetti noodles
- Mini-Marshmallows

Index Card Towers
- 3x5 Index Cards
- Tape (scotch or masking tape may work best, but any tape will do)

Jellybean Towers
- Jellybeans
- Toothpicks

Your choice!
- You may also use materials of your choice. The goal is to select one material that is the “building block,” like the spaghetti, index cards, and toothpicks. You will then pick another material that binds them together, like the marshmallows, tape, and jellybeans.
Can you Make a Stable Structure with Only Two Materials?

A structure is a solid object that has a shape, size, and purpose. A structure should be able to stand on its own. Some structures can hold a load. A load is weight put on to something.

The key to a good structure is for it to be stable. Stable means something is not likely to fall and is firmly placed on something, like the ground or another object.

For example, the Space Needle is one of the most unique structures in Seattle. It is a tower. A tower is a tall, narrow building. A tower can stand on its own, like the Space Needle, or be part of another building, such as a church or castle.

For this challenge, you will pick two materials and build your own unique structure. While it may seem crazy to build a stable structure with just two materials, this is what makes it such a fun engineering challenge! You can build a tower and try to make it as tall as you can! You can also make a unique structure that is a shape of your choice.

This is an engineering challenge but can also be an artistic challenge. You can make a structure that looks just like an existing one, like the Space Needle.
If you are someone who likes building with Legos, or drawing structures, or building things and making messes, this project is for you.

Follow the directions to build your own structure.

**Important Information for Future Engineers!**
Many *forces* are at work on *towers*. *Gravity* and the *load* of the *tower* push down. The ground pushes back up and small air movements push from the side. A *foundation* distributes the load into the *surrounding* ground material and can help *balance* the sideways wind *force*. The size of the *foundation* depends on the strength of the *supporting* ground. For example, a *foundation* placed in rock can be smaller than a *foundation* placed in sand or mud.

---

**Directions**

1. Choose a flat surface with lots of space to build your *structure*. For example, this can be a tabletop or countertop. You can also do this on a large piece of cardboard placed on the floor.

2. Choose the materials you will use to make your *structure*. Are you going to build a *structure* using spaghetti and marshmallows? Jellybeans and toothpicks? Index cards? Your own materials? There is no wrong way to do this project but try to stick with two-items. Remember, you need a *Building Block* and something to *Bind* them.

3. Choose what type of *structure* you want to make. Will you make a *tower*? Will you make a *unique* artistic *structure*? Do you want to make a *structure* that can hold a heavy *load*?

4. [Optional] Choose a goal for your *structure*. For example, if you are trying to build a tall *tower*, make a goal for a certain height. A goal could be to build a *tower* that is 3 feet tall. Your goal could also be to make it as tall as possible
without it falling over! If you are making a structure to hold a heavy load, you make a goal for it to hold a specific weight, or a specific object like a heavy book. Your goal could also be to make a structure that can hold as much weight as possible. This step is optional as you can also build a structure without a goal. Just build, explore, have fun!

5. [Optional] Plan your structure before you start building. On a piece of paper, draw what you want your structure to look like. This step is optional, as you can also just jump right into building your structure and explore what type of structure you want to build while you are building it.

6. Build your structure! Combine your building block material with your binding material. Quick tip: make sure to build a strong base for your structure. Your base can be a triangle, square, hexagon, whatever you think will work best. Once you have a strong base, lay it down flat and build up from there.

7. When finished, think about if you accomplished what you wanted to do with your structure. For example, if you made a goal, did you achieve your goal? Why or why not? What did you learn about structures from building this tower? What would you change for your next tower to make it taller, more stable, or hold more weight?

8. When done with your building time, clean up! Put all materials away and clean off any surfaces that need cleaning.

---

**Reflecting on your Learning**

*Caregiver:* ask your student the following questions and discuss their answers.

- What was challenging about building your structure?

- What did you learn about how to make a stable structure? What did you when building your structure based on what you learned?

- What questions do you still have about engineering and making stable structures? Where can you find answers to these questions?
Extensions
If you would like to continue this project even further, consider the following extensions to increase your engineering skills and deepen your learning.

Multiplayer Engineering Challenge
Building structures on your own can be fun, but it can be even more fun with one or more people to compete with! There are several ways to make this engineering challenge competitive. For example:

- You can challenge one or more people to build the tallest tower in 10 minutes.
- You can challenge one or more people to build a structure that holds the most amount of weight (using heavy books as a weight is always a good option here)
- If you have at least 4 people who want to play, you can form two teams (or more teams depending on the number of players) and have the teams compete for the tallest tower or to see whose structure can hold the most weight.

For each of the multiplayer engineering challenge ideas, make sure every person (or team) has the same building materials and the same amount of them. Make sure everyone is given the same amount of time to build their structure. For example, set the timer on a phone or smart speaker to 10 minutes. When the alarm goes off, all hands off the materials!

Teach a Family Member How to be an Engineer
After you have completed your own successful structure, think about what you learned from the process. How did you make a stable structure? What mistakes did you make that you learned from?

Teach a family member everything you learned about being an engineer and how to make a good structure. Help them build their own structure by showing them every step of the way what you learned.
Unique Structures in the Wild
There are many interesting buildings and other structures in Seattle. Some even in your own neighborhood! When out with your family, whether than be a walk around the neighborhood, a visit to the store, or traveling someplace far away, be on the lookout for unique buildings and other structures.

When you see these structures, think about the following and discuss them with a family member:

- What makes the structure unique?
- What do you notice about how the structure was built to make it stable?
- What can you learn from this structure to build a better two-item one at home
The Slime Challenge: An Exploration into a Non-Newtonian Oddity

Materials
• 1 cup of water
• 1 to 2 cups of cornstarch
• Mixing bowl
• Food coloring (optional)

What is Matter and why does it, uhhh, matter?
Matter makes up everything we can see, touch and feel. Matter takes many forms, but this experiment will look at two of them: solids and liquids. You may be familiar with the most famous of all non-Newtonian fluids: quicksand! If you’ve ever wondered what quicksand is or how it works, this experiment will help you understand how something can be both liquid and solid at the same time. The result also gives you a fun, squishy substance to play or fidget with once you’re done.

You may have noticed I used the phrase non-Newtonian. So, what is that? Well, first you need to know about viscosity. Viscosity is a physical property of fluids. It
shows resistance to flow. In a simple example, water has a low viscosity, as it is 'thin'. It can flow very easily. Syrup, on the other hand has a high viscosity, as it is 'thick. If you spill water, it'll go everywhere quickly! If you spill syrup, it'll be a sticky mess, but it won’t go very far because it has high viscosity.

A way to test for viscosity is the speed at which the substance runs down a slope. Syrup would reach the bottom very slowly, whereas water would be a lot quicker.

For this challenge, you will follow a simple slime recipe and then learn all about it by playing with this strange substance. Is it a liquid? Is it a solid? Is it somehow both? Experiment and find out!

**Directions for Making the Slime**

1. Roll up your sleeves and prepare to get messy! Slime is non-toxic, but please use caution when doing any science activity. Be careful not to get it in your eyes and wash your hands after handling the slime.

2. Pour one cup of cornstarch into the mixing bowl and dip your hands into it. Can you feel how smooth the powder is? How small are the particles that make up the powder? A particle is another word for each individual piece of cornstarch.

3. [Optional] Add a few drops of food coloring to the water if desired. If you want to turn your slime another color, it’s easier to add the coloring to the water before you mix it with the cornstarch.

4. Now pour the water into the mixing bowl of cornstarch. Stir the mixture slowly with a spoon or other kitchen utensil. Keep adding more water until the mixture becomes thick. Add more cornstarch if it gets too runny, and more water if it becomes too thick. You will know the mixture is perfect when you can give it a quick, firm tap with your finger and it feels solid, but then when you slowly press into it with your finger it is runny. Crazy!

5. [Observation] Pay attention to what’s happening as the water mixes with the cornstarch. Use your hands to stir and try to feel the corn starch particles
between your fingers. You’ll feel the viscosity, or “thickness,” of the water increase as you mix. When the corn starch particles are evenly dispersed throughout the mixture and you can feel no lumps, you have finished making your Slime.

6. Cleanup! Wash hands with water. Add a large amount of water to the mixture to make it completely liquid before pouring it down the drain. Wipe up any dried cornstarch with a dry cloth before cleaning up any remaining residue with a damp sponge or cloth.

**Directions for Making Observations about the Slime**

7. Hold a handful of Slime in your open palm—what happens?

8. Try squeezing it in your fist or rolling it between your hands—how does it behave differently?

9. With the slime in a bowl or cup, move your fingers through the mixture slowly, then try moving them faster.

10. What is happening when you squeeze the Slime? What is happening when you release the pressure? Does the Slime remind you of anything else?

11. With the slime in a bowl or cup, drop a small object (something you don’t mind getting dirty), like a coin, onto the surface of the slime. What happens?

12. The Slime mixture isn’t your typical liquid—or solid. The cornstarch-and-water mixture creates a fluid that acts more like quicksand than water: applying force (squeezing or tapping it) causes it to become thicker. If you were trapped in a tub of slime, what would be the best way to escape?

---

**Reflecting on your Learning**

*Caregiver:* ask your student the following questions and discuss their answers.

- What surprised you about the non-Newtonian slime?
• Why do you think it behaves the way it does when touched, thrown, or dropped?
• What questions do you still have about the slime?
• Are there other things in nature similar to the slime besides quicksand?

Extensions
If you would like to continue this project even further, consider the following extensions to increase your STEM skills and deepen your learning.

Slime Ingredients Experimentation
The typical non-Newtonian slime is made with water and cornstarch. But what if you used different ingredients? Would it keep its weird properties and be non-Newtonian.

Experiment with the ingredients and amounts. Here are some ideas you can try, but remember, YOU are the scientist here, so you can use whatever materials you are curious to try and have available. IMPORTANT: Make sure to ask your caregiver before using alternative ingredients. In other words, don’t use all the orange juice for this slime and then have a sibling scream, “Where’s my orange juice!?!” Uh oh. Should have asked. :)

Suggestions for experimenting with ingredients:

• Add more cornstarch than is suggested. What happens? Is it like playdough and can keep its shape, or something else?
• Add a liquid that is not water. Soda? Juice?
• Does temperature affect the slime? What if you add hot or super cold water?
• What about not using cornstarch and using flour? How is the mixture different? Why do you think it is?

There are many things you can try here. Be creative! Be curious! The more experiments you do the more you will learn.
Use Your Marbles: Using Physics to Design an Obstacle Course

Note: This project uses glue and scissors. A caregiver needs to closely supervise this project.

Materials
This project can use many different types of materials. It depends on what recycled materials you have access to. No matter what you are building you will need a few key materials:

- Marbles!
- Tape (any type will do, but a stronger tape like masking, electrical, or duct tape will work best)
- One large cardboard
- Scissors
- [optional] paper and pencil for planning
Here are a few suggestions for the types or recycled materials you can use:

- Cardboard tubes (e.g. toilet rolls, or kitchen paper rolls – or even sturdier tubes from the inside of cling film rolls)
- newspaper (to roll into tubes)
- small cardboard boxes from cereal, tissues, toothpaste, or milk/juice cartons
- plastic drinks bottles
- egg cartons (to catch marbles at the end).

Can your Marble Find its way to the End?

In this project, you’re tasked with creating an obstacle course for a marble. It will start at the top of your course and wind its ways down a series of ramps, tubes, and whatever else your imagination can come up with to reach the end.

This project also challenges you to create your structure with only recycled materials. A couple cardboard boxes alone can be used to make a great obstacle course. If your recycle bin contains paper towel tubes, or newspaper, or egg cartons, even better! If you plan on making an obstacle course, tell your family members to be on the lookout for recyclable materials that can be used.

The best thing about making your own marble obstacle course is that there are no rules. The goal is to take your marble on an adventure through an imaginative obstacle course, using just gravity as ‘fuel’.

Important Information for Future Scientists and Engineers!

Gravity is the force that makes everything fall towards the Earth (like a marble!). But what is it? It turns out that all objects have gravity. It is just that some objects, like the Earth and the Sun, have a lot more gravity than others.

How much gravity an object has depends on how much mass it has. Mass is the amount of matter or substance that makes up an object. It also depends on how close you are to the object. The closer you are, the stronger the gravity.
Directions

Gather the materials you will use to make your obstacle course. Remember, you will need scissors, a good size box, and a marble for every course. Beyond those you should have a good collection of recycled materials to use to make the different “turns” in your obstacle course. A “turn” is where your marble will start heading a different direction on the obstacle course. Often this is when it goes from one ramp to another ramp that inclines a different way. The obstacle course in the picture on the next page has 5 turns.

1. Set your box sitting up on one side with the opening facing out.

2. Think about what you want your obstacle course to look like. Look over the materials you have and think about how each one can be placed in your obstacle course. Also think about how you can make your course fun and unique! Will your course just have a series of ramps, or will it have the marble go through a tube or wind its way through the top of a plastic bottle. Try to be as creative as possible!

3. [Optional] On a piece of paper, draw your plan for the obstacle course. Draw where you want your ramps and other pieces to go in the box. Drawing out your plans can help you think of creative ideas for your obstacle course. It can also help to show family and friends what you plan to do. You can then get feedback on your idea and make it even better.

4. Start building your obstacle course! Remember, stability will be very important to building a successful obstacle course. Make sure each ramp and other materials (like paper towel tubes) are well-taped to the cardboard box so they stay put when the marble rolls onto them.

5. As you’re building your obstacle course, make sure to do frequent test runs. Place your marble on your unfinished course to see what happens. The marble may roll in an unexpected direction or in a way you don’t want it to. This will show you that you may need to make changes to your design.
Your Ideas Not Working How You expected? That is a good thing!
As you build, you may encounter difficulties you did not expect, and your plan may not work out the way you want. You may also make mistakes in building your course. That is a good thing! Encountering unexpected challenges and making mistakes is the best way to learn. When something in your project does not go as well as you want, step back and think about how you can do it better. Even though you may feel frustrated, these challenges are an opportunity to learn how to be a better engineer.

6. Your obstacle course can be finished whenever you want it to be. If you have enough materials, try to fill up the whole box! Experiment with different placements of materials and have fun getting the marble through the wildest obstacles possible.
7. **[Optional]** Decorate your obstacle course. You can draw on it, tape pictures on to it, put silly labels on it, or whatever you would like to do to make it look awesome!

8. When done building your obstacle course, clean up! Put all materials away and clean off any surfaces that need cleaning.

**Helpful Tips on Making Your Marble Obstacle Course**

- It is easiest to build your marble run inside a big cardboard box with no lid. You can use tape to hold different parts in place.

- Cut cardboard tubes in half lengthways and tape them together end to end, forming a long **chute**.

- You can use rolled up newspaper to form covered tunnels as well.

- Cutting the top of a plastic drink bottle off and turning it up-side-down makes a great funnel.

- Whole cardboard tubes or rolled up newspaper can serve as different height **towers** to rest your **chutes** on. Draw around the end of your chute see where to cut a semi-circle out of the **tower**, and slot your **chute** in. Then secure it with tape.

- The top edge of your cardboard box is a good place to attach your first **chute**, giving your marble the helping hand of **gravity**. You could even make a little hole in the side of the box to feed your marbles into.

- Cut your egg carton into little cup shapes, which you can place at the end of your **chutes** for the marbles to drop into. Again, use tape to keep them steady in your box.
Reflecting on your Learning

*Caregiver:* ask your student the following questions and discuss their answers.

- What was challenging about making your marble obstacle course?
- Why changes did you have to make to your obstacle course to get the marble through it?
- What materials do you wish you had to include in your obstacle course?
- Gravity is what is pulling the marble through the obstacle course. What questions do you have about gravity? Where can you find answers to these questions?

Extensions

If you would like to continue this project even further, consider the following extensions to increase your STEM skills and deepen your learning.
Making a Marble Roller Coaster
You can think of this “thinking outside the box.” The original marble obstacle course was built inside of a box. Can you make a **free-standing** obstacle course? This will in some ways be more like a roller coaster!

There is much to consider when making an obstacle course free-standing. You may have to use chairs or other pieces of furniture to prop up pieces of your course, as they won’t be taped to the side of a box anymore.

When building a free-standing **structure**, one helpful item is foam tubes. They can be cut in half and bent to fit the needs of your roller coaster. Even better, you can create a loop-de-loop!

![Image of a marble roller coaster](image)

Teach a Family Member How to Build a Marble Obstacle Course
After you have completed your own marble obstacle course, think about what you learned from the **process**. How did you overcome challenges? How did you make sure the marble could go from start to finish?

Teach a family member everything you learned about making a marble obstacle course. Help them build their own **structure** by showing them every step of the way what you learned.
The Greatest Siege Weapon in History: The Trebuchet

Note: This project uses glue and scissors. A caregiver needs to closely supervise this project.

"Gravity Powered"

Materials

- Cardboard, about one foot by one foot
- Popsicle sticks
- Scissors
- Pencil
- Jumbo or "milk shake" straw
- Strong glue
- Tape
- Rubber bands (approximately 4)
- String
- Paper clip
- AA battery (or something similar in weight and size)
What is a Trebuchet and how does it work?

You may have heard of a catapult that was used to launch heavy boulders at castles in medieval times. Did you know there was an even BIGGER siege weapon, used to launch 90 kg objects over 300 meters?! That’s like launching a full-grown adult over 3 football fields!

A trebuchet is a projectile weapon invented in China over 1,700 years ago and used a lot in battles and sieges throughout the world for hundreds of years. A trebuchet relies on gravitational potential energy—the type of energy you get by raising something up off the ground. A trebuchet has a lever arm with a large, heavy counterweight on one end and a smaller projectile on the other end.

When the counterweight is raised up, it has lots of gravitational potential energy. Then the counterweight is allowed to fall, rotating the lever arm and turning that potential into kinetic energy in the projectile, which is flung through the air!

To build your trebuchet, you will build a frame that looks almost just like a swing set. It will have two "A-frame" shaped pieces on the sides and one crossbar on the top. There is more than one way to do this, so the procedure described here is just one method.

For example, you could decide to build the entire frame out of pencils instead of popsicle sticks and you can choose whether you want to use tape, glue or rubber bands to secure the different joints. Think of this as an engineering design project—there is no single “right answer” or correct way to build the trebuchet. You can modify your design based on your own ideas and the materials you have available.
Directions
Note: Assemble all your materials in a location that is open and clear of people, animals, or breakable objects so that you can test your trebuchet. Only use your trebuchet with adult supervision. Never aim projectiles at people or animals. A toy trebuchet might seem harmless, but even a small projectile can cause eye damage.

1. Start out by building the two side A-frame pieces. Take five popsicle sticks and cut one of them in half using the scissors. Use two long pieces and one half-piece to form an “A” but make sure you cross the long pieces slightly at the top to form a miniature "V" shape (just like in the picture on the previous page). This

This is what your homemade trebuchet will look like. The key parts on this model are labeled. Notice how the counterweight, the battery, is raised up higher than the sling. When the battery drops it will swing the arm fling the projectile forward.
will leave a small notch for the pencil to rest in later. Glue them together and repeat with the other pieces.

2. To make your trebuchet even more stable, glue it to a cardboard base. To do this, get a piece of cardboard that is big enough to hold your trebuchet. Lay it down flat. Place your A-frame piece in the middle of the cardboard. With a pencil, mark where the feet of the A-frame touch the cardboard. Carefully cut slots on the pencil marks on your cardboard. This should allow your A-frame pieces to stand up straight in it like a platform. Stick the ends of the A-frame pieces into the slots. **Reinforce** the connections with glue, tape, and some extra popsicle stick pieces if necessary so they remain standing on their own.

3. Now you will build the trebuchet's arm. Carefully cut two small notches on either side of a popsicle stick close to one end. The notches should be wide enough to slide in a piece of string. This will help hold your counterweight in place. Without the notches, your string will just slide right off!

4. Attach a small loop of string to your AA battery using tape or rubber bands. Hang the battery from the notches in the popsicle stick (look at the picture on the previous page for help!). If necessary, make the notches deeper or secure the string with tape, glue, or rubber bands.

5. Unbend one end of a paper clip so it is almost, but not quite, straight. Attach the remaining flat part of the paper clip to the other end of the popsicle stick, with the straightened part pointing outward and up (away from the counterweight). This will serve as a hook to hold the "sling," which in turn holds the projectile. If the paperclip were completely straight, the projectile would fling off backward! Not something you want to happen while during a castle siege.

6. Remove the eraser from the pencil and attach it to a small loop of string. Hang the eraser from the paper clip hook. This is your projectile.

7. Cut a small section of milk shake straw, about one inch long. Attach this perpendicular to the popsicle stick arm using glue, rubber bands or tape. The
straw should be much closer to the counterweight than it is to the hook. (This distance is something you can try adjusting later.)

Here is a close up of the directions for step 7, 8, and 9. Notice how the short piece of straw is in the middle of the pencil. Also notice how the popsicle stick is attached to the pencil and straw with a rubber band. This step can be tricky but persevere! You can do it!

8. Slide the pencil into the milk shake straw.

9. Place the pencil into the two V notches on top of your A-frame pieces. Secure it in place with rubber bands. This forms a crossbar and completes your trebuchet's frame. The straw and pencil form a pivot and should allow the arm to rotate. (We do not recommend using glue for this step—that way you can remove the crossbar and swap out the arm to make changes.)

10. Make sure your trebuchet is sturdy and the frame holds together. Try rotating the arm with your hand. If any of the joints seem weak or the frame wobbles significantly, reinforce them with tape, glue or rubber bands.
Observations and Exploration

Now it is time to test your trebuchet. Use one hand to pull down on the eraser. This should raise the **counterweight** up in the air. Then, making sure no people, animals, or breakable objects are nearby, let go. Think of the answers to these questions as you play with your trebuchet.

- What happens when you let the eraser go?
- Does it get launched forward? Does it go straight up in the air? Does it fail to release at all?
- Can you find the best starting point for the eraser? What makes it go the farthest?
- You will likely need to tinker with your trebuchet in order to get the best launch. Try pulling the eraser under the trebuchet frame. In the picture on the right, you can see how the **projectile** starts underneath the pivot point. This allows the **counterweight** to drop much farther and for the arm to swing much stronger. It is okay if the eraser is resting on the ground and there is slack in the sling. When the **counterweight** falls, it will drag the eraser along the ground and then pull it up into the air.

Attention Historians!

We don’t give them enough credit, but ancient peoples accomplished some of the most amazing feats of engineering from all throughout human history. If people were able to build a massive trebuchet and conquer entire kingdoms with it in the 4th Century BCE, what else were they able to do?! Ask an adult to help you find information about nearly 500-foot tall pyramids, massive handmade wood ships that could carry 122 tons, and other amazing ancient technology from around the world!
Reflecting on your Learning

*Caregiver:* ask your student the following questions and discuss their answers.

- What was difficult about making the trebuchet?
- What did you have to adjust to make your trebuchet work well?
- What surprised you when using the trebuchet?

Extensions

If you would like to continue this project even further, consider the following extensions to increase your STEM skills and deepen your learning.

**Vary it up**

There are lots of **variables** you can tinker with to improve your trebuchet’s performance. Can you optimize your design?

- The size of the counterweight: Try using lighter (or heavier) batteries. What impact do you think the weight of the counterweight will have on your projectile?
- The length of the lever arm: Both the overall length and the ratio between the distance from the pivot to the counterweight and the pivot to the sling. What happens if you move the **pivot** so it is exactly in the middle of the arm? What if you glue multiple popsicle sticks together to make a longer arm?
- The length of the sling: What happens if you make it longer or shorter?
- The shape of the hook: What happens if you bend the paper clip so it is straighter or more curved or if it is cut to be shorter?
- The weight of the projectile: What happens if you use something other than an eraser, such as a small balled up piece of paper?

**Teach a Family Member or Friend**

This is complicated project. Now that you’ve built it, you’re a trebuchet expert, right!? One way to prove you are a true trebuchet engineer is to teach someone else to build it.
Show a potential student (a family member or friend) your trebuchet and teach them how to build their own. Walk them through each step. As they build theirs, tell them what you learned in building your own trebuchet. Make sure to answer any questions they have. Use the directions on the previous pages as a reference if you cannot remember a step. However, see if you can teach them without just reading the directions to them.

When their trebuchet is complete, compare theirs and yours. Do they fling the projectile the same way? Why or why not?
Cracking the Code: The Egg Drop Challenge

Note: while the egg drop STEM challenge typically involves using an egg, there are several reasons why families would choose not to use an egg. If this is the case, you can replace the egg with any similar sized object that can safely “break” when dropped. For example, you could use a small water balloon.

Materials
- 2 eggs. Try to use two that have been sitting in the fridge for a while, and of course ask the owner of the egg if it’s okay to destroy it. *reminder, an alternative option can also be used.
- 2 balloons
- 2 small paper cups
- 4 straws
- 1 sq ft of cellophane (plastic food wrap)
- 4 rubberbands
- 4 popsicle sticks
- 2 ft of masking tape
- Floor covering (newspaper, etc.)

How do you engineer protection for fragile objects?
This is the classic egg drop experiment. You will try to build a structure from a limited set of materials that will prevent a raw egg from breaking when dropped from a significant height. This experiment has all sorts of practical applications,
from designing better egg cartons to engineering protective packaging for fragile materials, such as medical or sports equipment.

When an object is raised up to an increased height, the force of gravity invisibly pulling down on the object toward the Earth increases. This is called potential energy. When the object falls, all its potential energy is transformed into kinetic energy in the form of motion. When the object hits the ground, the same amount of kinetic energy is again transferred back through the object and into the ground. If the material that makes up the object cannot resist that transfer of energy, the structure of the object breaks to release the energy.

You should think about creating a design that would reduce the amount of energy transferred from potential to kinetic energy on the eggshell. Some ways you might consider doing this could be to decrease the final speed of the egg using air resistance, to increase the time of the collision using some sort of cushion, or to transfer the energy into something else. Or perhaps there could be another way...

Directions

Note: this eggperiment may result in a huge mess. Adult supervision and sanitary cleaning with plenty of hand washing afterward is required.

This project is a little different in that we are not going to give you specific directions for how to build the device that will protect the egg. Instead, you will need to use the materials suggested to come up with your own design for the device. That is the challenge! How can you use the materials we suggested to build something to protect a fragile object when dropped? Is it possible? Yes! It'll just take a bit of creativity, engineering smarts, and persistence.

1. Select an area in your home that can be considered a “significant height.” This could be the top of your refrigerator, the top of a bookcase, a tall cabinet, an outdoor deck, or elsewhere. If you can’t safely reach this height, ask an adult to help drop the egg from the significant height.
2. Place a floor covering such as a newspaper where the egg will be landing.

3. Using any or all the listed materials, design and build a structure or device that will protect the egg from breaking when it hits the ground. This instruction is intentionally vague, and you will need to use your own creativity and ingenuity!

4. When your protective device is complete, take the egg (or alternative delicate object) in its protective device to the significantly high area (ask an adult for help if needed). Gently release the egg from the height so that it falls in a straight and unobstructed line to the covered landing spot.

5. It is likely that on your first attempt your device will not protect the egg. No worries! This is an essential part of the design process. Review your design and see why it did not work the way you expected. Change your design based on what you notice and try again.

What Exactly is Going on When the Egg Hits the Ground?
The Egg hitting the ground is a collision between the Earth and the Egg. When collisions occur, two properties of the colliding bodies are changed and/or transferred: their Energy and Momentum. This change and transfer occurs due to many forces, including gravity on the egg, the shell on the egg yolk and white, the hardness of the floor, and of course your engineered protective device. If the forces on the egg are too strong, it can cause the shell of the egg to crack and break.

Reflecting on your Learning
Caregiver: ask your student the following questions and discuss their answers.

- What was difficult about making a device to protect an egg?
- What did changes did you make to your design after the first drop?
- What was the process you went through to create a successful device?
**Eggstension**
If you would like to continue this project even further, consider the following eggstension to increase your STEM skills and deepen your learning.

**Time to leave the nest!**
Compete with your family members or friends to see who can create the best egg protection device. Before conducting the experiment, have everyone explain their design and their prediction about what will happen to their egg.

**Design Your Own Drop Challenge**
This challenge had you design a device to protect an egg when dropped. Would you like to design your own design challenge? Here’s some advice for designing your own way to challenge the aspiring engineers that you know.

1. **Pick a specific set of materials.** An important piece of the challenge is that everyone has the same, limited set of materials. They must design a device based on these materials. You can use materials you have available around the house, or you can also provide clean recycled materials (cardboard boxes, milk and egg cartons, paper, clean food containers) along with something to bind them together (tape and glue).

2. **Pick a goal for the device.** In the egg drop challenge, the goal was to build a device that could protect the egg from a high drop. You could do a similar goal of protecting a fragile object. You could also make a goal about the time it takes for a device to reach the ground when dropped. In other words, a device that uses a parachute! Be creative and pick a goal that you think will require designing a unique device to accomplish.

Make sure you clearly communicate with the people participating in your challenge what the materials are and about what goal they need to accomplish with their device.
Sticking To It: The Glue Strength Test

Note: while all the projects in this packet require adult supervision, please give special attention to this project for health and safety reasons. Students will, as the name suggests, be using glue!

Materials

- A variety of at least 3 different types of glue (your choice, or whatever is available in your house. The bigger variety of glues, the better!). Some examples are Elmers, wood, glue stick, and super glue.
- String or fabric thread
- 1 panel of cardboard at least 1 foot in length
- 1 small paper cup (a Dixie cup is perfect)
- Coins of the same type (e.g. all pennies, all quarters, etc. The amount you’ll need will depend on the strength of your glues. If you don’t have coins around, you can use any small weight that will fit in the cup. Just make sure they’re about the same size.)
- Scissors
- Scotch tape
- notebook or lined paper for recording observations
- Pen or marker
- Optional: kitchen scale
What is glue and how does it work?
Before you can test the strength of glue, it’s important to understand how it works so you can have a successful experiment. Glue works in two ways: **adhesion** and **cohesion**. **Adhesion** is the ability of glue to stick to a surface, while **cohesion** is the ability of glue to stick to itself. A strong glue will have both good **adhesion** and **cohesion**.

Most seemingly smooth surfaces that we can see and feel have tiny, microscopic gaps and holes all over. Liquid glue fills these **molecular** gaps in the material and then over time it hardens to a solid, sticking to the material (**adhesion**) and itself (**cohesion**).

As an **adhesive**, glue is unmatched in its strength and variety. You are introduced to glue from the moment you get your first school supplies. But have you ever had a piece of a big, important project suddenly falls off right before it’s due, even though you swear you used the right amount of glue? Or have you ever broken a favorite toy, and you can never keep it together with your school glue? How do you know which type of glue is best for the job? Do this project to find out!

Directions
*Note: this experiment uses sharp scissors, as well as glues which could be dangerous if touched to your skin. Adult supervision is required.*

This project can seem complicated at first, so read through the directions carefully and reference this picture. This picture contains all the pieces you will make to conduct your test.
Close up pictures of how to arrange your pieces of cardboard.

1. Using the scissors, carefully cut a strip about an inch wide from one length of your large panel of cardboard. Then cut this inch-wide strip into smaller pieces about the length of a popsicle stick. Make sure all pieces are the same length and cut as many pieces as you have glues to test. You can cut another strip from the larger panel of cardboard if you need more.

2. Using a pen, label BOTH ends of each small strip of cardboard with the name of the glue you will be testing on it. For example, on the end of one strip you might write “Elmer’s.” On another strip you might write “Glue stick.”

3. Using the scissors, carefully cut each small strip in half. You should now have identical half strips of cardboard, each with the name of the same glue on it.

4. Using the scissors, carefully cut two notches near the end of each half strip on opposite sides. Be careful not to cut all the way through, as this is where you’ll hang the string onto the half-strip of cardboard.

5. Cut two notches near one end of the large panel of cardboard on opposite sides, just like you did with the smaller pieces. Make sure the notches are at the same height and use a ruler and a pen to check before cutting.
6. Take a length of string that will just barely wrap around the cardboard and slide each end of the string into the notches you cut in the large panel of cardboard. Tie the string to itself on one side with a strong knot. This string is where you will hang your weighted and glued small pieces of cardboard.

7. Tape a length of string to the rim of the paper cup. This will act as a “bucket” for your coins or weights.

8. Place a VERY small amount of your first test glue on both ends of its matching labeled small piece of cardboard. Allow it to dry according to the instructions on the glue label. Repeat for the remaining test glues and their matching labeled pieces of cardboard.

9. When all the glues have dried and you’re ready to test, slide the hanging string on the large panel of cardboard into the notches of one end of your first test piece of small glued cardboard.

10. Lean the large panel of cardboard against a wall so that it is freestanding at a steep angle against the wall and so that the hanging string is on the higher end of the panel.

11. Attach the “bucket” to the other end of the glued piece of cardboard by sliding the bucket string into the notches. Begin testing by adding one coin or weight at a time and keep careful track of the number of coins or weights added until the glue fails and the cardboard breaks. Record the number of coins or weights that broke the cardboard in your lab notebook or a scrap piece of paper.

12. Repeat the procedure for each small glued piece of cardboard until you have recorded all the breaking points for each type of glue.

**Reflecting on your Learning**

*Caregiver:* ask your student the following questions and discuss their answers.

- What were the **results** of the glue test?
• What was difficult about conducting this glue test?
• What surprised you about the results of the glue test?
• What is the difference between adhesion and cohesion?

Extensions
If you would like to continue this project even further, consider the following extensions to increase your STEM skills and deepen your learning.

Extension: Use the Forces
This experiment tests the cohesion and adhesion of the various types of glues you found. Those forces are at work against gravity. But is there some other aspect you could add to test other forces at work in this experiment?

• Try changing the glue placement. For example, you could glue the smaller pieces of cardboard on their sides rather than their ends to test each glue’s friction abilities and apply your results to your next class project or artwork.

• If none of your glues broke, you can turn this result into another experiment: testing the abilities of each glue to dissolve. You can start with water, then soapy water, then rubbing alcohol to see what will finally get the glues to break.

The Stuff That Holds Us Together
The applications of this experiment cover a wide range of sciences, from building construction and furniture-making to artwork conservation and historical restoration. The results will also make you reconsider claims in the packing of glues, such as “The Strongest” or “The Best,” as all scientists should be skeptical of unsupported claims.

Stick Together
You can take this same idea of testing brands or types of glue and apply it to
things your family uses around the house. For example, you could devise a similar test for the strength of different types of tape, or the strength of different types of paper.

Your scientific method will help your family reduce your overall accidental waste of products, like when you use the wrong glue and need to use more. You’ll use the right tool for the job and prevent unnecessary waste while discovering new hobbies along the way.
Glossary

Here are all the definitions to the bolded words in the text. If there is a word you are not sure about, check the definition below. If you want to make sure you fully understand the word, use the graphic organizer after the glossary to practice using the word and defining it.

**adhesion**: the act of sticking or attaching to something

**balance**: to make something steady by keeping weight equal on all sides

**bind**: to tie or wrap something with rope, string, etc.

**building block**: a basic unit from which something is built up.

**chute**: a narrow tube or passage that things and people go down or through

**cohesion**: the internal strength of an adhesive that makes it stick to itself

**compare**: to look at (two or more things) closely in order to see what is similar or different about them

**conclusion**: an opinion or decision that is formed after spending time thinking or learning about something

**conducting**: to manage, lead, or guide.

**counterweight**: a weight that provides a balance against something of equal weight

**detection**: the discovery of what was hidden

**distribute**: to spread or place something over an area

**energy**: the ability to be active

**experiment**: a scientific test in which you perform a series of actions and carefully observe their effects in order to learn about something

**feedback**: helpful information about what can be done to improve something
**force:** a natural power or effect that is able to change the speed or direction of something

**foundation:** a **structure** that supports a building from underneath

**frame:** a **structure** made of parts that are joined together and that supports a larger object.

**freestanding:** standing alone without being attached to or supported by something else

**frequent:** happening often

**gravity:** the force that causes things to fall towards the Earth

**kinetic energy:** the energy an object has due to its motion

**liquid:** a substance that is able to flow freely

**load:** the weight that is carried or supported by something

**matter:** the thing that forms physical objects and occupies space

**mass:** the amount of matter which something contains

**medieval:** having to do with the middle ages (years 500-1500)

**mixture:** something made by combining two or more ingredients

**modify:** make partial or minor changes to something.

**molecular:** concerning, caused by, or consisting of molecules. Molecules are the smallest unit of a substance that has all the properties of that substance. A molecule is made up of a single atom or group of atoms.

**momentum:** the strength or force that something has when it is moving

**motion:** an act or process of moving

**non-Newtonian:** fluids that change how easily they flow under stress
**observations**: the act or an instance of perceiving the environment through one of the senses

**optional**: available as a choice but not required

**perpendicular**: at a right angle to. For example, a pole is perpendicular to the ground.

**pivot**: the action of turning around a point

**pliable**: able to bend, fold, or twist easily

**potential energy**: stored energy caused by an object’s position

**procedure**: a series of actions, usually done in a set order, to accomplish a goal

**property**: a special quality or characteristic of something

**process**: a series of actions that produce something or that lead to a particular result

**projectile**: something (such as a rock) that is thrown as a weapon

**receiver**: the part of a telephone apparatus contained in the earpiece, in which electrical signals are converted into sounds

**reinforce**: to strengthen or make more effective

**research**: to collect information about or for something

**results**: something that happens because of something else

**siege**: a military act of surrounding a city or base, attacking it, and cutting off supplies. The goal of a siege is to force the city or fort to surrender.

**solid**: firm or hard

**stable**: not easily moved

**structure**: something (such as a house, **tower**, bridge, etc.) that is built by putting parts together and that usually stands on its own

**substance**: a material of a particular kind
**supporting:** keeping something from falling down

**surrounding:** near or around someone or something

**tower:** a tall, narrow building or **structure**

**transmitter:** a device that sends out radio or television signals

**trebuchet:** a medieval engine of war with a sling for hurling missiles

**variable:** something that changes or that can be changed

**vertical:** positioned up and down rather than from side to side

**viscosity:** thick or sticky, not flowing easily

**unique:** special or unusual
Building Student Vocabulary

[INFORMATION FOR ADULT FAMILY MEMBERS]

While doing these STEM projects, you can also support your student’s vocabulary by exploring the glossary words with the graphic organizer below. This graphic organizer below can be used as a great tool for building vocabulary.

This technique requires students to define target vocabulary and apply their knowledge by generating examples and non-examples, giving characteristics, and/or drawing a picture to illustrate the meaning of the word. This information is placed on a chart that is divided into four sections to provide a visual representation for students. Here is a blank example of this graphic organizer:

<table>
<thead>
<tr>
<th>Definition</th>
<th>Facts / Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>Vocabulary Word</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On the next page is an example of this graphic organizer when filled out.
### Filled Out Example

<table>
<thead>
<tr>
<th>Definition</th>
<th>Facts / Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A reptilian animal with a large shell on its back.</td>
<td>Turtles spend most of their lives in water. They have webbed feet and flippers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
</table>
| - Sea turtles  
- Northwest pond turtles at woodland park zoo. | - Lizards  
- Snakes  
- Fish  
- Alligator |

There is also a large blank version on page ### that you may make copies of or print out.

**Suggestions For Use**

If your student is doing other Summer Learning activities, you can incorporate some of this vocabulary building into their schedule/routine. For example, they can work on a new vocabulary word every summer school day. Here are some suggestions for how they can do this vocabulary work:

- If you have recently worked on one of these STEM projects, pick a relevant word from that project to dive into with the graphic organizer. This can be a word your student had questions about or a word you think your student could benefit from more thoroughly understanding.
- Get a printed copy of the graphic organizer OR get a notebook or piece of lined paper and draw the graphic organizer on it or have your student draw it themselves. Make sure to label each section (definition, examples, facts/illustration, and non-examples).
- Have your student fill out the graphic organizer. Help as needed. Have them show you the finished graphic organizer and explain to you each section.
2020-21 Advanced Learning Referral Window

OPEN: August 28th - October 1st, 2020

Will your student benefit from receiving Advanced Learning Services? Here are three ways to refer them for evaluation.

1. You may refer your student through the Source. New to the Source? Please go to www.seattleschools.org. The Source is located in the “Student Family Portal.” Click “Set Up” to set up your Source account.
2. You may contact your school office to arrange for support in filling out the online referral on the Source.
3. You may fill out a translated paper form and mail it to the Advanced Learning Department at Seattle Public Schools no later than October 1st, 2020. Please contact your school office to obtain this form and arrange for support with this process.

¿Se beneficiará su estudiante de recibir servicios de aprendizaje avanzado? (Spanish)
Aqui hay tres formas de referirlos para evaluación.

2. Puede comunicarse con la oficina de su escuela para solicitar ayuda para completar la referencia en línea en la fuente.
3. Puede completar un formulario en papel traducido y enviarlo por correo al Departamento de Aprendizaje Avanzado de las Escuelas Públicas de Seattle a más tardar el 1 de octubre de 2020. Comuníquese con la oficina de su escuela para obtener este formulario y coordinar su apoyo con este proceso.

你的学生能从接受高级学习服务中受益吗? (Chinese)
以下是推荐他们进行评估的三种方法。

1. 你可以通过 the Source 来推荐你的学生，从未使用过 the Source？请查看 www.seattleschools.org。The Source 位于“Student Family Portal”中。请按“Set Up”以设置你的 Source 帐户。
2. 你可以联络你的学校办公室，以帮助你在 the Source 上填写在线推荐。
3. 你可以填写翻译好的表格，并在 2020 年 10 月 1 日之前将其邮寄至西雅图公立学校的高级学习部门，请联络你的学校办公室以获取此表格并安排帮助。

ادعاء (Advanced Learning) referrer (عربية) ((فارسی)) (اردو) (العربية)

1. The Source (اردو) میتوانید از طریق Source نیز اطلاع رسانی کنید. منبع جدیدی برای Source نیست؟ لطفاً www.seattleschools.org گزیده شده‌اند. Source یکی از “Student Family Portals” است. به عنوان یکی از منابع مورد نیاز شما، Source را تنظیم کنید.
2. شما می‌توانید با مدرک فارسی به عنوان یک منبع اورژانسی در منبع لیست راه حل‌های بهتری را دریافت کنید.
3. شما می‌توانید با مدرک فارسی به عنوان یک منبع اورژانسی در منبع لیست راه حل‌های بهتری را دریافت کنید.

Miyuu ardayaaga ku faa'iidho dumaad helaanika Ateegyada Wuxbarashada Sare? (Somali)
Halkan waxaa ah sedgee xaan u dhiiriin oo loogu xidhiyaynta.

2. Waaqadd la xiriir kartaa xafiiska dugsigaaga si aad iskuu fabaabusho tageer inda buuxinta tikoocko aasaas oo ee internetka ee The Source.
3. Waaqadd buuxin kartaa doon waxa ahaan oo la raaxaay u dhaq ugu dhirataa Qaybta Wuxbarashada Sare ee Dugsigaada SeattlePip dhamaanadka Oktober 1, 2020.

Tajajila Barnoota Foy'aaga argachuu isaanittif daaa'manimo keessan faayyadaa argatnan jiru? (Oromo)
Qormaatuffisa aane akkeefuuf karaawwan sadii asliyaa dhisamnii.

2. Soorsiihaa akkeeku onlaynii irratti gargaarsa argachuu hasboona haara maana barumsaa keessanii qurunmuu no dandeessu.
Học sinh của quý vị sẽ được lợi ích từ việc nhận Dịch Vụ Học Tập Nâng Cao hay không? (Vietnamese)

Đây là ba cách thức để giới thiệu các em để được đánh giá.

2. Quý vị có thể liên hệ với văn phòng nhà trường để sắp xếp sự hỗ trợ cho việc triển thông tin giới thiệu trực tuyến trên Source.
3. Quý vị có thể điện vào mẫu đơn gây đầy đủ dịch vụ gửi đơn đến Advanced Learning Department tại Seattle Public Schools không quá ngày 1, tháng 10, 2020. Vui lòng liên hệ với văn phòng nhà trường của quý vị để có được mẫu đơn này và sắp xếp việc hỗ trợ cho quá trình này.

Advanced Learning | 206-252-0130 | www.seattleschools.org/advlarning