

Time:

45-60 minutes

Explore:

structural science, (shape of structure affects stability), material science, engineering design process (define a problem, imagine and plan, create, test, and improve)

Materials:

Gather up a bunch of household items for kids to build their structures. Each team should have access to the same materials.

Here are some suggestions for materials:

- Large Objects:** cardboard tubes, cereal boxes, plastic bottles, paper plates, card stock, paper/plastic cups
- Fasteners:** pipe cleaners, rubber bands, paper clips
- Long Objects:** straws, popsicle sticks/tongue depressors, toothpicks
- Wildcard Ideas:** tinfoil, plastic wrap, sandwich bags

You'll also need:

- Three sheets of paper per team
- Timer
- 6 inch piece of yarn per team
- Tape measure (optional)

Build It Up, Knock It Down

Kid Description: Grab a grown-up and some friends for a building contest! Each team will build a structure without using tape and then try to knock down the other team's structure using only paper. The last one standing wins!

This game is for four or more players (teams of two to four) and can be played indoors or outdoors. Each team should find a private space so the other team can't see their structure.

Wonder

- ★ Brainstorm what makes a strong structure.
 - **Ask:** What makes some materials better to build with than others?
 - **Ask:** Does the shape or size of a structure make it stronger? How?
- ★ Lay out all the materials on the floor.
- ★ Ask kids to use their senses to explore each material.
 - **Ask:** How does each material look?
 - **Ask:** How does each material feel? Are they heavy or light?
 - **Ask:** Based on your investigations, which materials do you predict will be the strongest for building?



pbskids.org/ruff

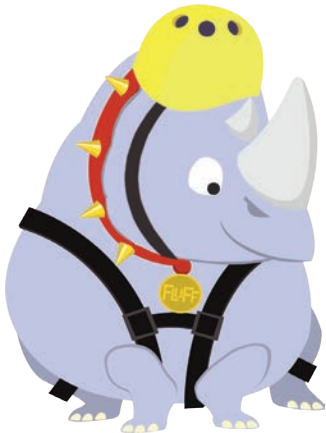
Education
IOWA PBS



Define a Problem

★ Explain the rules:

- **Explain:** Each team will have 15 minutes to design a structure using only these materials. The tower must be 6 inches tall (hold up the six inch piece of yarn), and you can't use any tape. After you build your structure, each team will have two chances to knock down the other team's structure using only paper.



Imagine and Plan

★ Split kids into teams.

★ Give each team five minutes to plan what materials they will use and how they want their structure to look. Have kids make a plan by drawing their structure on the printout.

- **Explain:** Let's make a plan for our structure. On the printout, draw what you want your structure to look like and list all the materials you're going to use.

Create

★ If kids are working in larger teams, assign a role to each team member:

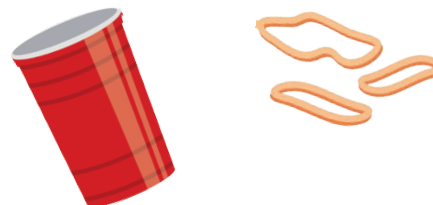
- **Measurer** – measures the structure to make sure it is at least 6 inches tall
- **Architect** – compares the structure to their plan
- **Clean-up Crew** – cleans up the materials at the end of the game
- **Team Leader** – makes sure every team member is helping

★ Set a timer for 15 minutes. Ready, set, build!

★ An adult should work with each group to help resolve any disputes, facilitate the building process, and offer support when asked.

★ Remind kids to test the stability of their structures as they build so they can improve upon their structures as needed.

- **Ask:** Do you think another team would be able to knock your structure down? How could you test your structure to find out?
- **Ask:** What materials could you add to make your structure stronger? How else could you improve your structure?
- **Ask:** Do you need to change your plan?

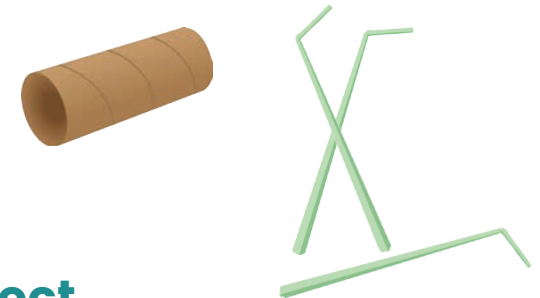


★ If kids need more support:

- **Hint:** Use pipe cleaners. Try poking holes in an object using a toothpick and then threading pipe cleaners through. Knot them at the ends to keep them from slipping through the hole. You can also use straws to connect pipe cleaners together.
- **Hint:** Use rubber bands to group or attach things together.
- **Hint:** Use a cup as a base, and put other materials in the cup to make it a stronger base.

★ After ten minutes, give kids a five-minute warning. Remind them to measure their structure to make sure it's six inches tall.

★ Time's up, materials down!



Reflect

★ Have kids reflect as a team.

- **Ask:** Which materials are the strongest?
- **Ask:** What is the shape and size of your structure?
- **Ask:** How is your finished structure different from the one you planned?
- **Ask:** Is there anything you would do differently next time?

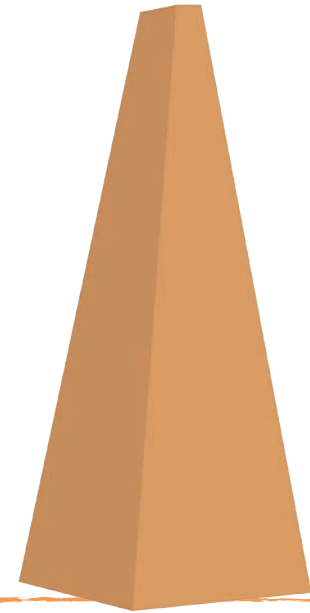
Share

- ★ Optional: Take photos of each structure to document each design before trying to knock them down.
- ★ Give kids five minutes to tour each team's structure.
- ★ Encourage kids to ask other teams about their structure.
 - Questions kids could ask:
 - Why did your team choose those materials?
 - How is your plan different from your structure?
 - How would your team improve their structure if they were to build it again?



Test

- ★ Time to knock it down!
 - ★ Brainstorm devices kids could make to knock down the other team's structure.
 - **Explain:** You're going to work with your team to make a device using only three pieces of paper that will knock down the other team's structure from five feet away. Each person only gets two tries to knock down the other team's structure.
 - **Ask:** What could you make with paper that would knock down the other team's structure?
 - ★ If kids need some help brainstorming, offer a few ideas. (i.e. crumpled balls, paper airplanes, long skinny tubes)
 - ★ Use a tape measure (or the same person's footsteps) to set up a marker five feet away from each structure.
 - ★ Give each team three pieces of paper. An adult should help facilitate the paper construction and turn-taking.
- ★ Have each kid stand behind the marker and each take turns throwing the device. If a kid throws and misses, the adult could move him closer to the structure. Each kid gets two tries (one try counts if it touches the structure).
 - ★ If both structures fall, give teams five minutes (or more, if needed) to reconstruct and improve their designs. Then, get ready to try to knock them down again!
 - ★ The team whose structure remains upright wins! If both structures still remain after each kid has had two tries, both teams win.



Plan

Build It Up, Knock It Down



Draw your structure in the space provided, and list which materials you're going to use. What do you predict will happen when you test your structure?



Education
IOWA PBS

pbskids.org/ruff

Materials:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Prediction:



Funding for The Ruff Ruffman Show is provided by the Corporation for Public Broadcasting and the Department of Education. The contents of this document were developed under a cooperative agreement #PRU295A150003, from the U.S. Department of Education. However, these contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government. PBS KIDS® and the PBS KIDS® Logo are registered trademarks of PBS. Used with permission. TM/© 2017 WGBH Educational Foundation. Visit pbskids.org/ruff for more!