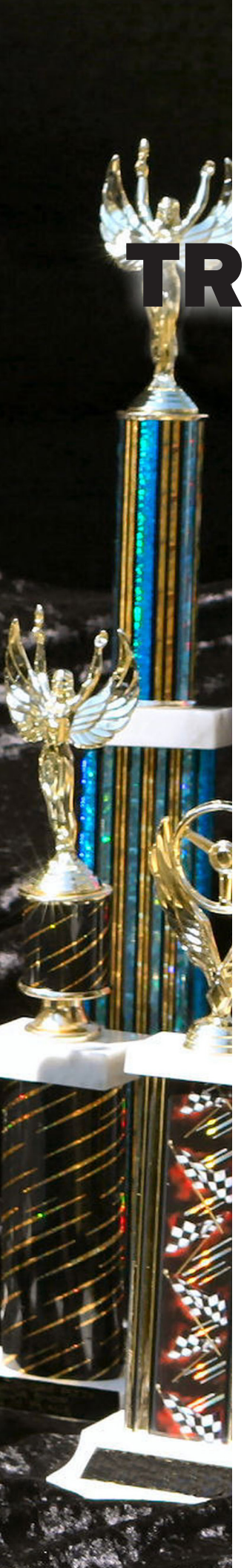

Grades 3–5, 6–8

45 minutes

TROPHIES TRIATHLON

DESIGN CHALLENGE

Participants make the tallest trophy possible that can support a sports ball of their choice.

SUPPLIES AND EQUIPMENT

Per whole group

- ☐ Newspaper
- ☐ Wooden dowels
- ☐ Small and large craft sticks
- ☐ Rubber bands
- ☐ Range of sports balls: tennis, baseball, basketball, soccer, bowling
- ☐ Measuring tape

Per team

- ☐ 1 cone (plastic conical spool) or cylinder (plastic tube)
- ☐ 12" of masking tape

GETTING READY

Designate a space where a facilitator can introduce the activity to participants and where participants can inspect the sports balls they will design for. Organize whole group materials into separate supply bins. Have cones/cylinders and masking tape ready to distribute to teams. Designate an area for construction and another area for testing and measuring.

MacGillivray Freeman's DREAM BIG

INTRODUCTION

Introduce the activity to participants by saying the following, adapted for your audience:

Do you think a trophy designed to hold up a tennis ball would look different from one designed to hold up a bowling ball? In this activity, the material selection is limited to newspapers, wooden dowels, craft sticks, rubber bands, and plastic cones and cylinders. Use your engineering skills to work within these constraints and assemble a tall trophy for any sports ball of your choice.

INSTRUCTIONS

Divide participants into teams of four at most. Introduce the design challenge: each team will build a trophy that holds the sports ball of their choice on top. The trophy needs to be a specific height, according to which ball will sit on top. Note the constraints of this activity (you may want to post this information for teams to refer to, and demonstrate each height using the measuring tape):

- Each ball has a goal height for the trophy that will hold it: tennis at 50 cm, baseball at 40 cm, basketball at 40 cm, soccer at 35 cm, and bowling at 25 cm.
- Each trophy can use only one cone or cylinder.
- Each team can use only 12" of masking tape.

Provide guidance to participants if necessary:

Instruct teams to pick a sports ball. Tell them to explore the available materials and consider various shapes and designs for their trophy. Ensure that each team has one cone or cylinder and 12" of tape.

Once teams have made a plan, give them about 20 minutes to construct their designs.

Test each design by balancing the chosen sports ball on top of the trophy. Then measure from the bottom of the ball to the tabletop or ground to determine the trophy's height.

Evaluate the results:

- ☐ Did the trophy hold the ball without crumpling or falling over?
- ☐ Was the trophy the designated height, or taller?

As time allows, encourage teams to improve on their designs and retest.

ACTIVITY VARIATIONS

Have participants make a blueprint of their design before getting supplies; participants should keep their blueprint updated as their design changes.

Try the activity without masking tape.

Limit the material supply.

RELEVANT TERMINOLOGY

Distributed load: The weight that something must support, distributed evenly across a surface. The weight of the ball on the trophy is a load that has to be distributed to prevent the trophy from toppling over or crumpling.

Prototype: An initial model of something from which other variations or innovations are developed.

Structural stability: The ability of a structure to support a designed load or weight without breaking, tearing, or collapsing.

GUIDANCE FOR YOUNGER CHILDREN

QUESTIONS TO ASK AFTER THE ACTIVITY

- Which trophy designs worked the best?
- If any trophies fell over or crumpled up, what do you think went wrong?
- How is your trophy different from a real trophy?

ENGINEERING CONNECTIONS

Engineers enjoy the challenge of building tall structures that can support a weight. It's what building bridges, houses, and skyscrapers is all about. In the case of a trophy with a ball on top, the weight is literally on top of the structure, rather than distributed among different floors of a building. A ball's weight also rests on one point, so the structure has to have strength at the top.

SCIENCE CONNECTIONS

The strength of a material can depend on its shape. For example, a flat page of newspaper has no strength to stand on its own. But if you roll it into a cylinder, it becomes much stronger. Scientists conduct experiments to learn the properties of a material and how those properties change in different shapes. They work with engineers to come up with new ways to use materials, just as the participants did when designing their trophy.

GUIDANCE FOR OLDER YOUTH AND ADULTS

QUESTIONS TO ASK AFTER THE ACTIVITY

- If you could use any material to construct a trophy, what would you use and why?
- In what ways is designing a tall trophy similar to designing a skyscraper?
- What would you have to do to make a trophy twice as tall as the one you built?

ENGINEERING CONNECTIONS

The process of creating a tall trophy is similar to the one engineers go through as they design and build tall towers. The tower or trophy is stable if the force of gravity pulling downward is equal to the force of the ground or tower materials pushing upward. This has to be the case even with a ball perched on top! The taller the trophy, the more error is introduced into the structure, until eventually the push upward is not equal to the opposite force of gravity. This instability causes the trophy to topple.

SCIENCE CONNECTIONS

Classical mechanics in the study of physics includes gravity, forces, and the attributes of rigid bodies. *Structural load* describes the forces that apply to a structure. Compression, tension, and stability change with the addition of a load. In this activity, the load was the sports ball on top of the trophy, which causes compression force on the materials holding it up.

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