BONUS ACTIVITY 1:

**PAPER STRUCTURE**

(60 min.)

**OVERVIEW**

**PAPER STRUCTURE (60 min.)**

Build a stable structure out of paper that can support the weight of several heavy books.

**SESSION GOALS**

**ENGINEERING**

Explore how the shapes used to build a structure can help support its weight.

**GLOBAL COMPETENCY**

Raise awareness that recycling and reusing our natural resources is an issue that affects everyone in all parts of the world.
PREPARE AHEAD OF TIME (about 60 min.)

1. **Read through** these instructions and make notes.
2. **Divide up the tasks** with your co-leader/assistant.
3. **Do this activity yourself** or together with a co-leader/assistant.
4. **Practice the demonstrations.** You’ll be demonstrating ways to make paper stronger.
   - Newspaper becomes stronger when it’s rolled tightly.
   - Newspaper in the shape of a triangle is stronger than newspaper in the shape of a rectangle or a square.
5. **Gather materials.**
   - **Per Team**
     - masking tape
     - 8 sheets of newspaper
     - 4 or 5 heavy books
     - 1 piece of cardboard (about the size of a piece of copy paper). Use it as a platform for the books.
     - 1 12-inch/30-centimeter ruler to measure height of the structure
     - pencil and paper/notebook
   - **Print out handout**, which appears at the end of the session:
     The Design Process poster
LEAD THE SESSION (60 min.)

PAPER STRUCTURE

Tell kids: Your challenge is to design and build a strong structure out of newspaper. The structure has to be strong enough to support the weight of several heavy books. (Hold up the books.)

Define the Need (10 min.)

Explain that communities all over the world need to build structures (homes, schools, towers, dams, etc.) that are sturdy and stable, but sometimes the building materials available to them aren’t very strong. One way to make a material stronger is to change its shape.

• Demonstrate Ways to Make Paper Stronger
  – Show kids how to roll newspaper into a tight tube. (Start at one corner, rolling diagonally toward the other—the tighter the better. Tape the tube closed with a strip or two of tape.)
  – Then make a loosely rolled tube and ask kids to compare it to the tightly rolled tube. What do they notice?

• Triangles versus Squares and Rectangles
Then have kids compare a newspaper tube bent into a triangle shape with one bent into a rectangle. Ask: Which shape seems to be stronger? Why do you think that? (The triangle can withstand more force and is more stable than the square. In general, the more triangles used in the structure, the stronger and more stable it’ll be.)
Brainstorm and Design (10 min.)
Have kids work in teams and pass out the materials. Tell kids their structure must be at least 8 inches/20 centimeters tall. (Explain that the piece of cardboard can be used as a platform to support the books.)
Ask:
• How can you assemble the tubes to make a strong, stable structure?
• How can you support the structure to keep it from tilting or twisting when you’ve placed a heavy book on it?
• How can you use the cardboard as a platform for the books?
Have kids sketch out their ideas.

Build, Test, Evaluate, and Redesign (30 min.)
Have kids:
• Build the structure. Use the ruler to make sure it’s at least 8 inches/20 centimeters tall.
• Test the structure by carefully setting a heavy book on it.
• Observe what happens and redesign and rebuild the structure if necessary.
• Continue to add books to find out how many your structure can hold!

What if . . .
• the tubes tilt or twist? Find a way to stabilize and support them, like attaching tubes in between them.
• a tube buckles when you add weight? See if the tube is loosely rolled. If so, reroll it tighter and tape it securely. Also, dents, creases, and wrinkles can put stress on some areas more than others and make a material weaker.
• the structure collapses? Make its base as sturdy as possible.
• it wobbles? Remind kids that triangles are a good way to increase a structure’s strength and stability. Turn squares into triangles by adding supports that go from one corner of the square to the other.
Share and Discuss (10 min.)

Have kids talk about their structures and ask them:

- What made your paper structure especially strong?
- What problems did you run into, and how did you solve them?
- How did having a team to work with help with the designing and building? Would it have been hard to design and build your paper structure alone? Why?

Then talk about the materials they used:

- Where does paper come from?
- What happens to old newspaper after we’re done using it?
- Why might it be a good idea to build something like this structure out of paper? Why might it be a bad idea?
- Can you think of other resources or materials that we throw away that could be reused to make something else?

Tell kids: Around the world nearly four billion trees are cut down each year just to make paper! Finding new uses for discarded paper helps conserve one of our most important resources. That’s exactly what the Paper Structure challenge does: instead of old newspaper being thrown away, it’s used to build something new!
THE DESIGN PROCESS

Used by engineers, inventors, and other problem solvers, the design process is a series of steps that help people think creatively and come up with solutions.

DEFINE THE NEED

BRAINSTORM

DESIGN

BUILD

REDESIGN

TEST & EVALUATE

SHARE SOLUTIONS