Paper Dowel Building: Design Challenges for Out of School time STEM Learning

Exemplifies principles of quality in out-of-school STEM learning, including:

- Asking a question/addressing a challenge
- Hands-on, using materials to explore
- Some degree of self direction
- Communication & collaboration
- Opportunity for reflection, application of lessons learned

Activity: Paper Dowel Building

Provide each group with a stack of newspaper (or, smaller paper such as origami squares or regular 8.5 x 11 recycled/scratch paper), masking tape, several drinking straws or round pencils.

Step 1: Introduce basic dowel building instructions and allow time for students to make plenty of paper dowels.
To build paper dowels:
Lay straw or pencil across corner of newspaper or paper so that point of the paper wraps around the middle of the straw. Gradually roll the paper snugly against the straw or pencil (removing straw or pencil after roll is started). Roll paper into a snug dowel. Use a small piece of masking tape to tape dowel closed.

While they are building, students can talk about things that they know about building (shapes, support, strength, what shapes and connection methods are observed in building homes, office buildings, bridges, and other structures, etc).

Step 2: Allow students time to experiment with "free building" with the dowels. Use small strips of masking tape to connect dowels at the ends to form two and three dimensional shapes. Some participants can continue making additional dowels for the next step, while providing feedback and suggestions to the builders.

Step 3: Issue a challenge: What is the tallest freestanding structure that the team can build in a specified amount of time (this can range from 10 to 45 minutes depending on setting, participants) For younger students, a simpler challenge may be to build specific two and then three dimensional shapes.

Step 4: Reflection: What did participants observe? How did they approach the task? What strategies were successful? Which were not?

Additional challenges can include:

- Tallest free standing structure
- Strongest structure
- Structures using only specific shapes (triangles or squares, for example)
- The longest span between two chairs or tables

Here is one example of how to incorporate this activity over multiple days in an OST setting:

Day one: provide the materials, basic instructions for dowel making, and time for free play to explore building with the materials. After given interval (half hour?) ask students to stop building, rotate among the various groups to observe what others are doing, and share observations, questions.

Day two: Issue a challenge such as what is the tallest free standing structure that can be built with these materials? Again, allow time for experimentation, observation, collaboration, and experimentation. Allow time for stopping, rotating to observe other groups, discussing strategies that work well, things that students observe, etc.

Day three: A timed competition to build tallest structure!

Day four: Observations about building, including shapes used, connections, supports, etc. Ask students to design a new challenge (strength, span, etc.)

Day five: Try a new challenge such as longest span or strongest (can hold up a given item such as a book)

Use this activity to build connections with careers in engineering and architecture by including books and video clips about building.

Two impressive local projects with website resources, videos are:

Exploratorium project on the Embarcadero in San Francisco (www.exploratorium.edu and click on "video" to find many videos showing exciting parts of the massive construction project)

Bay Bridge – find videos and information at: www.baybridgeinfo.org