**Wrap It Up!**
Creating paper tubes for a variety of design challenges

A simple technique can be used to turn thin paper into surprisingly strong tubes.

**Assembly** - The following technique can be shown to the students or the students could be given the materials and allowed to come up with their own technique(s).

1. Place a sheet of the paper at a 45° angle on a smooth flat surface, as shown above.
2. Use one of the 2 wrapping techniques listed below and shown above on the left, whichever works best with the paper and the size of the cylindrical object:
   a. For a thin straw sized item first fold the lower corner over the straw as shown above and then place the item inline with the fold. Tightly roll the folded edge and the item toward the rest of the sheet of paper to form a tube.
   b. For a cylindrical item with a larger diameter place the item horizontally at the lower corner as shown and then tightly roll the paper around the item.
3. If the sheet of paper is longer than the length of the cylindrical item continue rolling or pull the cylindrical item partway out from the partial formed tube and then continue rolling up the paper, repeating as necessary, see boxed illustrations.
4. Use tape or part of an adhesive label to secure the upper corner of the paper to the side of the tube to keep the wrapped paper from unraveling.
5. To make a longer tube insert a single tube into the wider opening of another wrapped tube and twisted together until tight and/or tape tubes together.

Note that stronger tubes can be made by laying down 2, or more, sheets of paper on top of each other, or overlapping the sheets, before starting the wrapping process.

**To Do and Notice**
1. Decide on what the design challenge will be (for example make a bridge, tower, or overhang to hold a set weight or meet some other requirement).
2. Choose the amount of materials, paper and/or tape to be used.
3. Decide how much, if any, of the instructions from the Assembly section listed above will be provided to the students.
4. Provide the students with the materials and instructions needed for the selected design challenge. If students are given several different cylindrical items then the students would need to experiment to find the best item and method to use.
5. To add an artistic aspect to the challenge the paper could be decorated with markers before or after being wrapped into tubes.

**The Science Behind the Activity**
Thin flexible material, such as sheets of paper, can become a stronger building element when formed into a cylinder. Wrapping thin material in a spiral, as seen in some exposed inner tree fibers, will make for an even stronger tube. See the RAFT idea sheet *Designing Design Challenges* for related project details.

**Web Resources** (Visit www.raft.net/raft-idea?isid=579 for more resources!)
- Design challenges and more - http://www.asceville.org/just_for_fun.html
- Teacher resources - http://www.asceville.org/resources.html#educators