

# Barrel Roof

**Overview:** This roof can support more than 400 times its own weight, and you don't need tape! One of the great things about net forces is that although the objects can be under tremendous force, nothing moves! For every push, there's an equal and opposite pull (or set of pulls) that cancel each other out, so all forces balance.

**What to Learn:** A force is a push or pull on a object that results from an interaction with another object. Forces always come in pairs.

## Materials

- template print out (heavy weight paper works best)
- scissors
- pencils (2)
- thread
- book or light clipboard
- paper to load the roof

## Lab Time

1. Trim each of the four corners from the paper.
2. You will fold the diagonals following one direction first. Flip the template over to the plain side, and then find the first diagonal line by curling the paper back until you see the diagonal. Fold and crease well on the diagonal, making sure the fold is straight.
3. Continue this process of locating and carefully creasing each diagonal in one direction. Then fold all of the diagonals which are oriented in the other direction. These are called mountain folds in origami, because they go up and down like the sides of a mountain.
4. The horizontal lines will be valley folds, which means they are folded on the inside and will be the opposite of the mountain folds. Crease the horizontal valley folds very well.
5. Once all the lines are folded, it's time to prepare the accordion shape which will be used in your roof. This will happen naturally as you push down on the valley (horizontal) folds and push up on the mountain (diagonal) folds. These works best if you start on the outside edges first and pinch the folds together, guiding the diagonals up and the horizontal folds down.
6. After it's all folded, fluff out the structure. Tie two pencils together with about  $\frac{1}{2}$  inch of space between them with a bit of string. The pencils make the barrel roof easier to load. Begin stacking on your book or clipboard, making sure that the bottom of the barrel structure is spread out at the bottom and supported. Also add about 50 sheets of paper to see how the structure does.
7. How many sheets can you pile on without collapsing your barrel roof?

## Barrel Roof Data Table

*You'll be making several different barrel roofs for this data table. You may change the type of paper it's made from, the size, or even the fold lines if you're feeling adventurous. Record your observations here.*

[illegible]

**Exercises** Answer the questions below:

1. What is Newton's Third Law?
2. What kind of groups do forces come in?
3. What is another name for Newton's Third Law?

### **Answers to Exercises: Barrel Roof**

1. What is Newton's Third Law? (For every action, there is an equal, but opposite reaction.)
2. What kind of groups do forces come in? (pairs)
3. What is another name for Newton's Third law? (the action-reaction law)