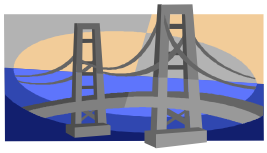

Name_____
School_____

Vocabulary that we will be using today-

Stress	**Strain**	**Span**	**Force**	**Deform**
Compression	**Tension**	**Beam**	**Pier**	**Buckling**
Cantilever	**Load**	**Truss**	**Stable**	**Snapping**
Dissipate	**Transfer**	**Types of Bridges**		

Before we start to build our bridges, please answer the following questions:

1. **Please provide the formula for the Pythagorean Theorem?**

2. **How can this equation be used in engineering?**

3. **What are the force(s) that act upon a bridge?**

4. **Explain in your own words what "elasticity" means to you.**

5. **What does the term structural stability mean?**

6. **List several types of bridges.**
   - **a.**
   - **b.**
   - **c.**

GatorTRAX Math

1) Pythagorean Theorem:

$C^2 = a^2 + b^2$
Angles (a+b+y) = 180 degrees

2) Fundamentals of Statics:

$F = 0$

$F = R + R + -P = 0$

3) Modulus of Elasticity (E):

E = Stress/ Strain = (F/A)/ L/L

4) Truss Analysis: (See example problem on teacher lecture)

- Structural Stability Formula (K=2J-R)

  Where: K = is the unknown
  J = number of joints
  M= number of members
  R = 3 (number of sides of a triangle)

1. Loads and Forces: Buckling

Push on the ends of a piece of uncooked spaghetti. The sideways bending is called buckling. The compression force that you apply causes complex internal forces that bend the spaghetti sideways. If you push hard enough, it will snap. The snapping starts on the edge where the tension forces within the spaghetti are great enough to pull it apart.

2. Beams

Make a clapper bridge out of a flat rubber eraser. First mark the eraser with some parallel lines. Push on it. It is hard to break, but you can see something else too. The lines spread apart at the bottom edge. When you increase the load on the bridge, you are producing tension on the bottom edge. (You can also see the compression on the top edge.) Long, heavy stone beams don't work because stone can't take much tension without cracking.

3. Arches

Try making a thin, flexible arch of cardboard. Bend it carefully – a crease will make a weak spot and spoil the arch. Support the ends first with two small books. Push down to see how the arch pushes out on these abutments. Then use a whole pile of books. Push down to see how the arch pushes out on these abutments. When you push down hard enough, you will see the arch buckle at the sides.

4. Triangles and Trusses

You can do these experiments with coffee stirrers and pieces of pipe cleaners. You can also use drinking straws and paper clips, strips of wood, and small finishing nails, or even toothpicks and miniature marshmallows.

Here's the basic connection with coffee stirrers: using four stirrers and four joiners, make a square frame. Notice that you can change its shape easily into a new form (a parallelogram).

Now attach one more stirrer with two joiners to make the parallelogram into two triangles. A triangle tends to retain its shape when you push or pull on it. When you push on one corner, for instance, the other two corners try to spread apart, but the opposite sides hold them together. When you load this truss frame by pushing on it, it will keep its shape much better. Now build a structure using triangles as the basic building unit.

5. Suspension Bridge

Tie a string between two books. Push down on the string. The "cable" pulls down and inward, toppling the books.

Now set up the books on a board. Pass the string over the books to thumbtack-anchors. Push down slowly, harder and harder. You'll be able to put a lot of load on the string-cable; you may even be able to push hard enough to life the thumbtacks out of the board.

Design and Construction of a Bridge

1) Amount of load that your bridge can hold:
2) Final cost
3) Bridge Aesthetics
4) Final Presentation