**Situation/Challenge** *(Read and Think About It)*

A zip line (also known as a flying fox, zip wire, aerial runway, aerial rope slide, death slide, or tyrolean crossing) consists of a pulley suspended on a cable mounted on an incline. They are designed to enable a user propelled by gravity to traverse from the top to the bottom of the inclined cable, usually made of stainless steel, by holding on or attaching to the freely moving pulley. Zip lines come in many forms. Many times they are used as a means of entertainment. They may be short and low, intended for child's play and found on some playgrounds. Longer and higher rides are often used as a means of transportation in remote areas, such as a rainforest canopy.

Your challenge is to design and build a zip line carrier to carry a “valuable load” (ping-pong ball) safely from the top of a zip line to the bottom as quickly as possible.

**Criteria & Constraints** *(Read and Know)*

- Each person must design and construct his or her own zip line carrier.
- You do not have to use all the Tools, Materials, Equipment provided.
- Your carrier needs to be quickly put on and taken off the zip line.
- The ping-pong ball must be easily removed from the carrier.
- The ping-pong ball must remain in the carrier the entire time and after the stop.
- Tape may stick to the ping-pong ball.
- Your name and Engineering Notebook number must be clearly displayed on your carrier.
- When using any of the web links in this Design Brief, click ALLOW if asked.
- Test your carrier on the zip line at your workstation – use the online stopwatch at: [http://www.onlinestopwatch.com/full-screen-stopwatch/](http://www.onlinestopwatch.com/full-screen-stopwatch/).
- The ping-pong balls are not to leave (bounce) from your workstation – no excuses!
- Prizes will be awarded to the three fastest times (per class).
- A prize will be awarded to the most creative device.

**Tools, Materials, Equipment** *(Read and Know)*

- Each person gets the following:
  - 1 piece of cardstock approximately 2 ¼” x 5 ½”
  - 1 small cup
  - 4 paper clips
  - 2 plastic straws
  - 2 wooden skewers – to change size or shape, you may file or put it in a vise and carefully cut it with a handsaw
  - 4 flat steel washers
  - 12” of electrical tape – a teacher will measure this out for you
  - 12” of string
  - Endless scrap paper (at your workstation – bottom stacking tray)

- Scissors
- Glue
- Ping-Pong ball (one per workstation – return at the end of the period)
- Single hole punch (return at the end of the period)
- File (be sure to file over a waste can)
- Handsaw at the vices – watch this demonstration below to see how this works: [http://wms.podcasts.westside66.org/users/dshabram/weblog/4cd12/Cutting_Sticks_with_Handsaw.html](http://wms.podcasts.westside66.org/users/dshabram/weblog/4cd12/Cutting_Sticks_with_Handsaw.html)
- Markers and colored pencils (return at the end of the period)

**Procedure** *(Read and Do IN ORDER)*

1. **Identify the Need or Problem**
   a. In your Engineering Notebook write the word PROBLEM.
b. After where you wrote the word PROBLEM, restate the problem in your own words using at least one complete sentence.

2. Research the Need or Problem
In order for your zip line carrier to run smoothly and quickly, it must be balanced and have little friction. To understand how balance and friction will affect your zip line carrier, follow the steps below.

a. In your Engineering Notebook write these words: Balance and Friction
   1) Go to: http://discover.edventures.com/functions/termlib.php?action=&alpha=A
   2) Find both Balance and Friction on the Term Browser.
   3) Define both words using complete sentences for each.
   4) Make a sketch of what each looks like.

b. Now on your computer, in GOOGLE, type: zip line.

c. Click on images and look to see how some other zip lines look like and work.


e. Scroll down to EXERNAL LINKS and watch at least one video about a zip line.

3. Develop Possible Solutions
Engineers, Architects, and YOU apply what they learn and know. When developing possible solutions, do not forget what you have learned in this class: the research you just did, Flat to 3D, Isometric sketches, etc. Also, do not forget concepts have you learned about in science and math. Use what you know!

a. In your Engineering Notebook, make DETAILED sketches of at least three possible solutions to the problem.

b. After each sketch, use at least one complete sentence to describe how each solution solves the problem by using the 2 key words (balance & friction) from your research.

4. Select the Best Solution
a. Select your best solution or combine solutions to best fit the Criteria & Constraints.

b. Make a DETAILED Isometric Sketch of your solution and label the materials you will be using.

c. When you think you have your detailed isometric sketch completed, turn your call light on and make the request to have a teacher check your sketch.

d. Once a teacher has approved your sketch, you may go on to step 5.

5. Construct the Prototype or Model
a. You may only pick up the materials that are labeled on your best solution.

b. Once you have your materials, you need to build your carrier.

6. Test & Evaluate the Solution
a. Compare your solution to the Criteria & Constraints. Make any adjustments to your device to meet the Criteria & Constraints.

b. Set up to test. In your Engineering Notebook draw a table like the one below.

```
<table>
<thead>
<tr>
<th>TEST RUN</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
```

c. Check your zip line – it needs to be tight. If it is not, adjust the tape and make it tight.

d. Place your carrier by putting it on the zip line.
e. Work as a team. Your partner can say go and start the online stopwatch. You say stop when the device touches the workstation surface.

f. Do at least 3 test runs for each carrier and record your times in the table.

7. **Communicate the Solution**
   a. You will not do this step – go to the next step.

8. **Redesign or Improve**
   a. Make any adjustments to your device to:
      • Keep the ball in place
      • Balance – you may need to add or adjust weight
      • Reduce friction
   b. Record in your Engineering Notebook what changes you made to your device and **why** you made them using at least one complete sentence.
   c. Test your device again.
   d. Repeat steps 8a, 8b, 8c, and 8d until you are satisfied with your test results.

9. **You will now DESIGNit – BUILDit – FIDGit**
      1) Click on play
      2) Click on start the challenge
      3) Select any room
      4) Read the challenge and click go

      5) Click **Need help?** to learn how to play the game and move the pieces.
      6) Continue to play – each room brings a new challenge!