

### 11/4/14 STARTING PUZZLE

Is it possible to connect 3 houses to each of 3 utilities without crossing any wires/pipes? If it's not possible PROVE it. ☺

OR, if you've seen this before, how many houses and/or utilities can be placed on the surface of a pair of pants with the same constraints

### 3 HOUSES 3 UTILITIES (PROOF ON A PLANE)

Is it possible to connect 3 houses to each of 3 utilities without crossing any wires/pipes?

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## KNOTS AND SURFACES

(and rhombuses!)

### ID YOUR KNOTS

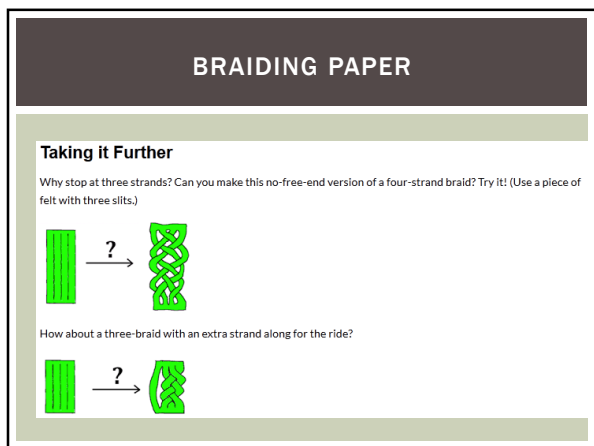
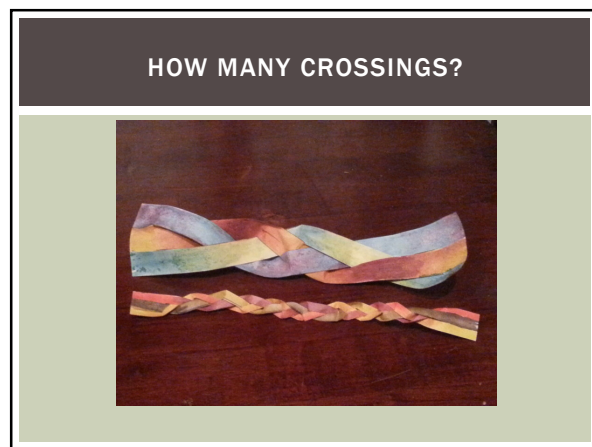
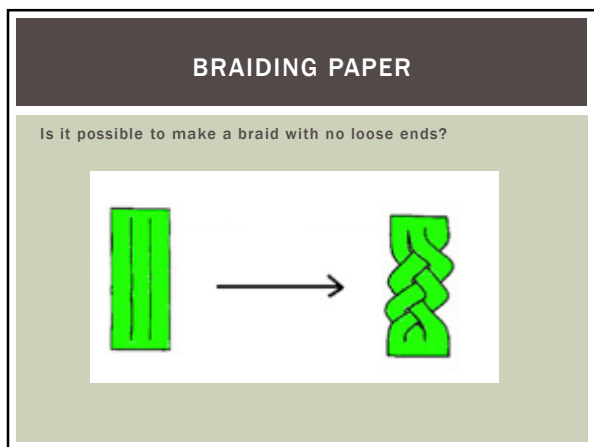
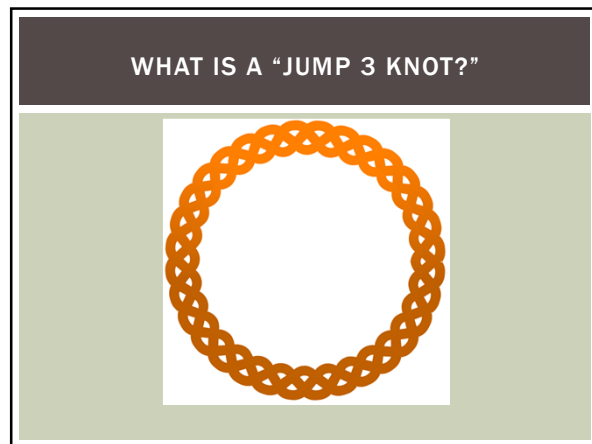
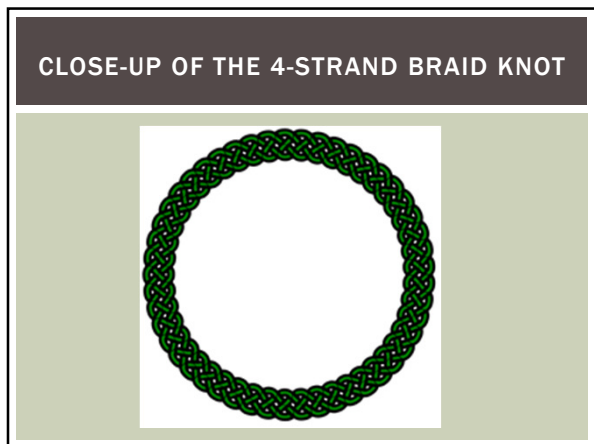
<p>Trefoil</p> <p>Pentafoil</p> <p>Heptafoil</p>	<p>Square Knot</p> <p>The Unknot</p> <p>4-strand braid knot</p>
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### ID YOUR KNOTS

### OTHER POSSIBLE HUMAN NOT-KNOTS


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### TOPOLOGY TRICK 1

Step 1: square the paper  
Step 2: fold into triangular quarters



### TOPOLOGY TRICK 1


Step 3: Cut away the edge and the and then the bottom triangle  
Step 4: Cut away a flap from the top edge parallel to both cuts  
Step 5: and then the far right triangle



### ANOTHER WAY TO MAKE INTERLOCKING LINKS

▪  $\frac{1}{2}$  cut a 2-twist strip

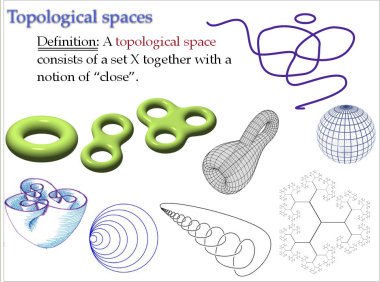
### GEORGE HART'S BREAKFAST



### WHAT IF YOU BEGIN WITH 2 INTERLOCKING LINKS?

### CLASSIFICATION OF SURFACES

**Topological spaces**  
Definition: A topological space consists of a set  $X$  together with a notion of "close".



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### WHAT ABOUT THIS?

### THE MÖBIUS STRIP

### AND THIS?

### A KLINE BOTTLE

**TOPOLOGY TRICK 2  
(GREAT FOR VALENTINE'S DAY)**



**TRY AN EXPERIMENT OF YOUR OWN!**

(This is also your math circle homework for the week!)

This and one more puzzle challenge:

Cut a house/arrow-shaped hole out of a piece of paper with a single, straight cut.

