Math Unleashed

Brief Description:

There are three separate puzzles here, at three neighboring stations. For the first two puzzles, the docent sets up the leash, following the diagram on the sign board. The participant then tries to solve the puzzle, figuring out which post can be lifted up to let the dog free. (The dogs are stuffed animals, attached to actual leashes.) The docent can ask the participant, "Which post should I lift?" and once the participant chooses, the docent lifts the post while the participant tries to pull the dog free. If they chose the correct post to lift, the leash will untangle itself from the remaining post when the dog is pulled.

The third puzzle is much harder than the other two. The participant designs a way to wrap the leashes around both posts, so that lifting either one of the posts will allow the dog to be pulled free.

Objectives:

This exhibit provides a surprising example of operations and inverses. It also reinforces spatial reasoning for students of all ages. Activities at this exhibit include solving the puzzles, creating new puzzles, and learning how to express problems of this type and their solutions using mathematical notation.

Links to Websites:

http://mathmidway.org/Training/unleashed.php

http://library.thinkquest.org/12295/data/Knots/Articles/Knots_I_1.html

Vocabulary:

Group theory	Inverse
Isotopy	Knot theory
Operation	

Before:

- ⊙ (*Level 1, 2, 3*) Figure out a way to pick up both ends of a string and tie a half-knot without letting go of either end and without having your hand or arm inside the knot.

- ⊙ (*Level 2, 3*) Many mathematicians study the relationships that exist in diagrams of tangled-up string, like the puzzles in the Math Unleashed exhibit. Students can get a sense of how to untangle something that seems very tangled up in a fun and kinesthetic way by playing the Human Knot game.

  Instructions for Human Knot game:
  Divide the class into groups of 6-10 people.
  Each group forms a tight circle, standing and facing each other.
  Everyone extends their hands into the circle and grasps hands with other members of the group.
  Everyone needs to make sure that the two hands they are holding do not belong to the same person.

The groups' goal: untie the knot that results after holding hands. Members of the group physically climb over/under/through each other's arms to untie the knot. Note: It is possible for a knot to be unsolvable or end in two separate circles.

- (*Level 3*) Study the Reidemeister Moves at the website:
  http://library.thinkquest.org/12295/data/Knots/Articles/Knots_I_1.html
  Hand out pieces of string to give students a chance to reproduce the three types of moves.

During:

- (*Levels 2, 3*) Solve both puzzles and try the challenge for the third puzzle.

After:

- Watch knot doodling videos at http://vihart.com/doodling/.

- Have a student hold 6 strands of rope all the same length in one hand. By twisting the 6 strands together matching the ends of the rope will become difficult. Have a student select two ends from one side of the ends coming out of the student's hand and tie the ends together. Have a second student repeat the process with the remaining ends. Have a third student tie the remaining two ends in a knot. Now choose three students to repeat the activity with the 6 ends on the other side of the student's hand. Ask the class the following three questions:
  What is the probability the result will be 1 loop containing all 6 strands? (8/15)
  What is the probability the result will be 2 loops one of 4 strands and one with two strands?
  What is the probability the result will be 3 loops each contain ing two strands? (1/15)