Our goal today is to use, recognize, and name some problem-solving techniques!

1. Warm-up: The Problem-Solving Salute!

2. Second warm-up: “Even Split”, a Tom-Tom puzzle by Thomas Snyder

**Wishful Thinking**

3. Courtesy of Paul Zeitz: connect A to A, B to B, and C to C, without crossing lines or leaving the box.

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A
   
B


C

B

A
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**Organization**

4. Add up the numbers 1 through 100. If you already know a trick, try to think of another way to do it!

5. Instead of the numbers 1 through 100, add up all the numbers in the usual multiplication table. What are different ways to find that sum?

6. Challenge: How many ways are there to make change for a dollar?

**Patience**

7. Challenge: On a 5 × 5 chessboard, place 5 wolves (who can move like chess queens) and 3 sheep so that all the sheep are safe from being eaten by the wolves.

8. Challenge: Find a 9-digit number using each digit 1 through 9 once, such that the first $n$ digits are divisible by $n$. 
Getting Dirty

9. Challenge: A long hallway has 1000 light bulbs with pull strings, numbered 1 through 1000. If the light bulb is on, then pulling the string will turn it off. If the light bulb is off, then pulling the string will turn it on. Initially, all the bulbs are off. At one end of the hallway, 1000 people numbered 1 through 1000 wait. Each person, when they walk down the hallway, will pull the string of every light bulb whose number is a multiple of theirs. Which light bulbs will be on after everyone is done walking?

Invariants

10. A mad veterinarian has three animal transmogrifying machines.
- Machine 1 turns two cats into one cat.
- Machine 2 turns a cat and a dog into one dog.
- Machine 3 turns two dogs into one cat.
Each machine can also operate in reverse.
Can the veterinarian begin with three cats and one dog, and end with just one cat?
What starting situations can end with just one cat?

11. A mad veterinarian has three animal transmogrifying machines.
- Machine 1 turns a cat and a dog into a mouse.
- Machine 2 turns a cat and a mouse into a dog.
- Machine 3 turns a dog and a mouse into a cat.
Each machine can also operate in reverse.
Can the veterinarian begin with three cats and one dog, and end with just one cat?
What starting situations can end with just one cat?
Notes

How is a problem different from an exercise?

List all the problem solving strategies we discussed and describe them in your own words.