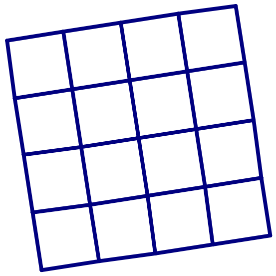
Activity 1

Show the following to the entire group, asking how many squares do you see?



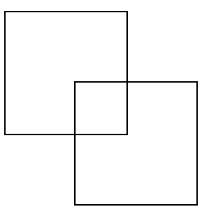
The way the question is phrased, any answer would be correct as long as it could be defended. Many will initially say there are 16. Some will say there are 17 after a few seconds. Pause for a few seconds more and someone will probably say there are a lot. There are a grand total of 30 squares in the figure:

- 1 that is 4 by 4
- 4 that are 3 by 3
- 9 that are 2 by 2, and
- 16 that are 1 by 1.

Please see the discussion in the Workshop details for additional discussion and information.

Activity 2

Show the following to the entire group, asking how many squares there are.



Most will say 3. Some will insert the imaginary segments to create a cube and say 6 or 7. Please see the discussion in the Workshop details for additional discussion and information.

Activity 3

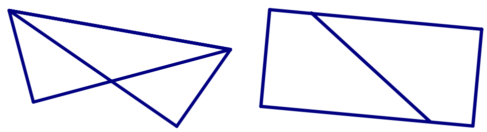
You are giving a party. You are not a guest.

- First doorbell ring brings one guest.
- Second doorbell ring brings 3 new guests.
- Third doorbell ring brings 5 new guests.
- Each new doorbell ring brings 2 more new guests than last one.
  - How many guests enter on the 20th ring?
  - What is the grand total number of guests after the 20th ring?

Please see the discussion in the Workshop details for additional discussion and information.

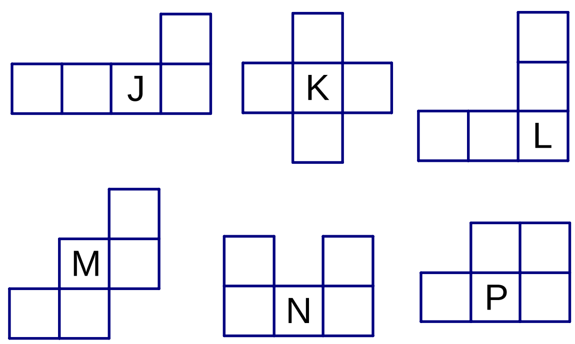
Activity 4

Ask the participants to fold a piece of paper in half. Then ask how they know it is folded in half? More than likely they will say they know because the edges match. Then ask if there are there other ways to fold a paper in half? There number of ways is infinite.



Activity 5

Show the following shapes to the participants and ask, “What is the question?” All squares in the figure are congruent. You will get a variety of answers, each of which can be used to stimulate additional discussion about student learning. After the discussion, say that that was not the question and ask for the question again.



Please see the discussion in the Workshop details for additional discussion and information.

Activity 6

Ask the participants what is the fewest number of weighings for 8 blocks, knowing one is light and 7 are the same? You may place as many blocks on each pan as you want. You want to be able to identify the lightweight in the fewest possible number of weighings each time.

Please see the discussion in the Workshop details for additional discussion and information.

Activity 7

Present the following problem (not the table) to the entire group before a break, challenging them to solve the problem.
Strawberry Ice Cream

There are three children.
Each child has a counting-number age.
The product of their ages is 72.
The sum of their ages is the same as this house number.

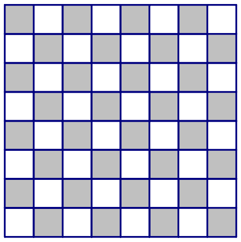
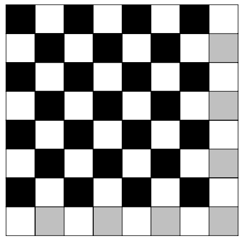
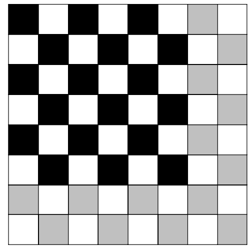
Guest looks at the house number and asks for more information
Guest is told, "The oldest likes strawberry ice cream."
Guest gives ages of the children.
Once the information is given, tell the group that *they have all the information they need to solve the problem*. Repeat the information, again emphasizing that ***they have all the information they need to solve the problem***.

Child A's Age	Child B's Age	Child C's Age	Sum of Ages
72	1	1	74
24	3	1	28
9	8	1	18
6	6	2	14
12	3	2	17
8	3	3	14

The answer is 3, 3, and 8 because there is a clear oldest. There are two situations that yield a house number of 14, indicating that the guest needed more information. If the guest sees any house number in the solution set options, the guest knows the ages of the children because, with the exception of 14, each house number is unique. Please see the discussion in the Workshop details for additional discussion and information.

Activity 8

Ask the participants how many squares are on a checkerboard. This question can prove interesting since it is similar to the earlier activity with a 4 by 4 square.

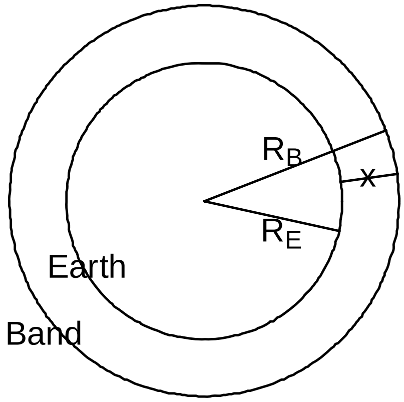
8x8 --> 1
7x7 --> 4
6x6 --> 9

-
-
-

1x1 -->64 TOTAL 204. Please see the discussion in the Workshop details for additional discussion and information.

Activity 9

Ask the participants to suppose the earth is a sphere and the circumference at the equator is 25,000 miles. A band is placed around the earth, concentric with the equator. The circumference of the band is 25,000 miles + 10 feet. What is the thickest thing that could fit between the band and the equator?

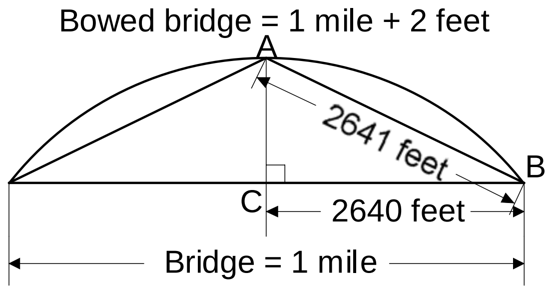


$C_B = 2\pi(R_E + x)$
$C_B = 2\pi R_E + 2\pi x$
$C_B = C_E + 10$ feet
$C_B = 2\pi R_E + 10$ feet
So, $2\pi R_E + 2\pi x = 2\pi R_E + 10$ feet
$2\pi x = 10$ feet Subtracting $2\pi R_E$ from both sides
$x = \frac{5 \text{ feet}}{\pi} \approx 1.59$ feet. This means that most adults could fit between the two bands.

An interesting extension of this is to have a 1 foot string circle and an 11 foot string circle. The resultant distance between the two circles will be the same as that for the earth. The solution presented is independent of the radius of the circle.

Activity 10

Tell the participants that a mile-long, horizontal bridge is built with no expansion joints. Neither end will move. The bridge expands to a length of 1 mile + 2 feet due to temperature changes. The expansion causes the bridge to bow up in the middle. What is the distance between the center of the bridge in its normal and in its expanded state?



ABC is a right triangle - - Pythagorean theorem

$AC^2 = (2641 \text{ feet})^2 - (2640 \text{ feet})^2$

$AC = \sqrt{(2641 \text{ feet})^2 - (2640 \text{ feet})^2}$

$AC = \sqrt{(5281 \text{ feet})^2}$

$AC \approx 72.67 \text{ feet}$

Activity 11

School has 1000 lockers -- all closed
1000 kids enter school and open or close specific lockers
Kid 1 opens every locker
Kid 2 closes all multiples of 2
Kid 3 changes (opens or closes, depending) all multiples of 3
Kid 4 changes all multiples of 4
Etc.,
After all students enter school,
How many lockers closed?
Which ones?

Activity 12

There is a school with 1000 lockers, all of which are closed. Each of 1000 students enters the building, one, following the other. The first student opens every locker. The second student closes all lockers that are multiples of 2. The third student changes (opens the closed ones and closes the open ones) the setting of any locker that is a multiple of 3. The fourth student changes only lockers that are multiples of 4, and so on for each student, changing only lockers that are a multiple of their number. After all 1000 students have gone down the line of lockers, how many lockers are open, and which ones? The table presents a few lockers and what happens to them (O represents open and C represents closed).

Locker #	1	2	3	4	5	6	7	8 ...
Kid 1	O	O	O	O	O	O	O	O ...
Kid 2	O	C	O	C	O	C	O	C ...
Kid 3	O	C	C	C	O	C	O	C ...
Kid 4	O	C	C	O	O	C	O	O ...
Kid 5	O	C	C	O	C	C	O	O ...
Kid 6	O	C	C	O	C	C	O	O ...
Kid 7	O	C	C	O	C	C	C	O ...
Kid 8	O	C	C	O	C	C	C	C ...

The pattern should begin to surface (square numbered lockers are open). A more abstract approach would have the participants consider the factors of each locker number. The numbers must be either prime or composite. Only the squares have an odd number of factors.

This is a fun problem to act out. Have about 20 participants stand in front of the rest of the group, facing them. Facing the group represents a locker being closed. Now, as the instructor, go by representing the first student entering the building, touching each of the people in the front of the room. A touch means they are to turn 180 degrees. Then the second student goes by, touching only numbers that are multiples of 2, etc. In the end, students with their backs to the group represent the open lockers.