Grade 7/8 Math Circles  
Fall 2010  
Logic

Opening Problem
Arthur’s family is baking gingerbread cookies for their annual Christmas party. They have baked 100 cookies, but it seems that someone has eaten one. Detective D.W. interviews each member of the family and gets two clues from each of them:

Arthur:  
it was Pal  
it wasn’t Mom  
Kate:  
it was Arthur  
it was Dad  
Pal:  
it was Kate  
it wasn’t Mom  
Mom:  
it wasn’t Pal  
it was Dad  
Dad:  
it wasn’t Arthur  
it wasn’t Pal

Each person is telling one exactly one truth and one lie. Who ate the cookie?

Logic problems are problems that can be solved using reasoning or argumentation.

Tips for solving logic puzzles:

• Read and re-read the question; underline or highlight important words.
• Keep in mind what it is that you are being asked to find.
• Watch out for irrelevant information.
• List out all of the possibilities if you can. Use a chart or draw a diagram if appropriate.
• Start to eliminate options.
• Take it one step at a time
Family Names
Mary’s mom has four children.
The first child is called April.
The second is May.
The third is June.
What is the name of the fourth child?

Measuring Cups
John Smith has two cups with no measuring markings on them. He wants to measure out 4L of water, but one cup holds 3L and the other holds 5L. He can fill each of the cups to the top, empty them out, or pour from one cup into the other. Can you help him out?

The Two Hall Monitors
It is the first day of school and you are trying to get to math class. There are two hallways for you to choose from with two hall monitors standing in front of each one. You can ask only one of them a yes or no question to try to figure out which hallway leads to your class. The problem is, one hall monitor always tells the truth and the other one always lies. What question can you ask in order to find your classroom?

Crossing the River
Three athletes, Alex (whose coach is Liam), Ben (whose coach is Mike), and Carly (whose coach is Nora), are trying to get across the river. None of the coaches trust any of the other coaches to be with their athlete unless they are also there. They have a boat that seats 2 people. How can they all get across?
**Student Housing**

Alex, Bret, Chris, Derek, Eddie, Fred, Greg, Harold and John are nine students who live in a 3-storey building with 3 rooms on each floor. Each student is assigned exactly one room. Can you find where each of their rooms is?

- Harold does not live on the bottom floor.
- Fred lives directly above John and directly to the right of Bret.
- Eddie lives to the right of the room that is directly above Fred.
- Derek lives directly above Fred.
- Greg lives directly above Chris.

**Dog Show**

The Best in Show ribbons are about to be awarded at the Waterloo Annual Dog Show, but someone has misplaced the results! There are four ribbons to be awarded to four dogs, each with a different breed. Determine the name of each dog, their owner, their breed and which place they came in.

1. Daisy was the greyhound’s name.
2. Sampson wasn’t awarded second place.
3. The beagle placed lower than Daisy, but higher than Eric’s dog
4. Fred’s dog, which wasn’t a greyhound, was awarded first place.
5. Barbara’s dog wasn’t named Munchkin.
6. The Dalmation placed fourth
7. In no particular order, the four dogs were the dog named Whiskers, Marcia’s dog, the dog who won third place, and the collie.
Exercises

1. Mr. Red, Mr. Blue and Mr. White meet for lunch at a restaurant. Under their coats, there are each wearing a red, blue or white shirt. Mr. Blue says, ”Hey, did you notice we are all wearing different coloured shirts from our names? The man wearing the white shirt says, ”Wow, Mr. Blue, that’s right!” Can you tell who is wearing what colour shirt?

2. Two fathers took their sons fishing. Each person caught one fish, but when they returned to camp, there were only 3 fish. How could this be?

3. Place 10 balls in 5 lines such that each line has 4 balls in it.

4. You must cut a birthday cake into 8 pieces using exactly 3 straight cuts, and you can’t move the pieces of the cake as you cut. How can you do it?

5. I have 8 real coins and 1 fake coin. All of the coins look the same, but the fake coin is slightly heavier that the others. If you have a balance scale, what is the least amount of weighings you can do in order to find the fake coin?
6. There are three people: Ali, Brad and Cody. One of them plays hockey, the other plays soccer, and the third plays the piano. The soccer player always lies, the hockey player always tells the truth, and the pianist can either lie or tell the truth. Can you figure out who does what?

Ali says: "Cody plays soccer."
Brad says: "Ali is a hockey player."
Cody says: "I am the pianist."

7. Fill in the boxes with the numbers 1 to 9 (the number 5 has been filled in for you). The value of each expression must equal the number at the end of the row or column. The operations are done in the order that they appear (ie. ignore order of operations).

8. Complete the following Soduku puzzle. Each row, column and box of 9 squares must contain each of the numbers from 1 to 9 exactly once.
9. To make things fair, Santa re-arranges the order of his reindeer every year. This year, he decides to form a straight line of nine reindeer:

(a) Comet is behind Rudolph, Prancer and Cupid.
(b) Blitzen is behind Cupid and in front of Donder, Vixen and Dancer.
(c) Cupid is in front of Comet, Blitzen and Vixen.
(d) Donder is behind Vixen, Dasher and Prancer.
(e) Rudolph is behind Prancer and in front of Donder, Dancer and Dasher.
(f) Vixen is in front of Dancer and Comet.
(g) Dancer is behind Donder, Rudolph and Blitzen.
(h) Prancer is in front of Cupid, Donder and Blitzen.
(i) Dasher is behind Prancer and in front of Vixen, Dancer and Blitzen.
(j) Donder is behind Comet and Cupid.
(k) Cupid is in front of Rudolph and Dancer.
(l) Vixen is behind Rudolph, Prancer and Dasher.

10. Last night it snowed! Harry and his friends met up with the other kids at the park for the first snowball fight of the season. Since Harry and his friends were on different teams, they only managed to get one chance to hit their friends with snowballs. Several hours later, all the boys were very wet, tired and hungry. They headed back to Harry’s home for a drink and a snack, his mom’s fresh baked cookies. Determine the full name of each boy, who was hit by who, what each boy had to drink, and what kind of cookie each chose.

(a) Barry, whose last name wasn’t Horn, hit Nathaniel but he got hit by the boy who had the oatmeal raisin cookies. The boy who got peanut butter cookies didn’t hit Curtis.

(b) The snowball that hit Barry wasn’t thrown by Nathaniel, whose last name wasn’t West. Randy Mann didn’t have milk with his cookies. The boy whose last name was Jones didn’t have chocolate chip cookies.

(c) Randy had neither water to drink nor chocolate in his cookies. The boy whose last name was Horn had neither sugar cookies nor apple juice. The boy who hit Harry had chocolate cookies.

(d) The boys who hit Nathaniel and Curtis had apple juice and orange juice to drink, not necessarily in that order. Harry, whose last name wasn’t Horn, didn’t hit Barry nor was he hit by Nathaniel.
(e) The boys who had chocolate in their cookies didn’t have Hathaway for a last name. The boy who had peanut butter cookies had juice to drink, but his last name wasn’t Jones.

(f) The boy who hit Randy had West for a last name. The boy who had iced tea didn’t hit Harry. The Jones boy had water to drink.
Solutions:

1. Since the person wearing the white shirt says “wow, Mr. Blue...”, it must either be Mr. White or Mr Red wearing the white shirt. But since they are all wearing shirts different from their name it must be Mr. Red wearing the white shirt. Now, we have a blue and a red shirt remaining. Mr. Blue cannot be wearing blue, so he is wearing the red shirt, which leave Mr. White with the blue shirt. Therefore, Mr Red wore a white shirt, Mr. Blue wore a red shirt and Mr. White wore a blue shirt.

2. A boy, his father, and his grandfather went fishing.

3. Place the balls on the vertices of a star.

4. Split the cake into 4 pieces with an ‘X’, then cut the cake in half horizontally.

5. It takes 2 weighings to find the fake coin. Place 3 coins on each side of the balance and place 3 coins off to the side. Whichever side is heavier has the fake coin in it. If the six coins balance out, the fake coin is one of the 3 coins that are off to the side. Take the group of 3 coins that contains the fake coin and place 1 coin in each side of the balance and 1 coin off to the side. The coin that is heavier is the fake coin. If the two coins balance out, the fake coin is the coin that is off to the side.

6. If Brad tells the truth, then Ali is the hockey player, which mean Ali must be telling the truth as well since the hockey play always tells the truth, so Cody must play soccer, and Brad plays the piano (since he could either lie or tell the truth - in this case he told the truth), and Cody, being the lying soccer player lied and said he plays piano. Therefore Ali plays hockey, Brad plays the piano and Cody plays soccer.
7.  
\[
\begin{array}{cccc}
7 & - & 3 & x \\
\times & + & \times & 2 \\
1 & + & 5 & + 8 \\
+ & - & + & 14 \\
6 & + & 4 & - 9 \\
13 & 4 & 25 & \\
\end{array}
\]

8.  
\[
\begin{array}{cccccccccc}
7 & 9 & 8 & 2 & 5 & 6 & 4 & 1 & 3 \\
1 & 2 & 4 & 9 & 3 & 8 & 5 & 7 & 6 \\
5 & 3 & 6 & 1 & 7 & 4 & 9 & 2 & 8 \\
4 & 8 & 2 & 6 & 9 & 5 & 7 & 3 & 1 \\
6 & 1 & 3 & 4 & 2 & 7 & 8 & 9 & 5 \\
9 & 5 & 7 & 8 & 1 & 3 & 2 & 6 & 4 \\
3 & 7 & 9 & 5 & 4 & 1 & 6 & 8 & 2 \\
2 & 6 & 5 & 3 & 8 & 9 & 1 & 4 & 7 \\
8 & 4 & 1 & 7 & 6 & 2 & 3 & 5 & 9 \\
\end{array}
\]


10. Barry Hathaway hit Nathaniel, drank apple juice and ate peanut butter cookies. Curtis Jones hit Harry, drank water and ate chocolate cookies. Harry West hit Randy, drank milk and ate sugar cookies. Nathaniel Horn hit Curtis, drank orange juice and ate chocolate chip cookies. Randy Mann hit Barry, drank iced tea and ate oatmeal raisin cookies.