THE FUNNY MARBLES

A. Question: *How do moving objects affect stationary objects?*

B. Materials Needed:

1. A plastic ruler (30cm long, with center groove).
2. Seven identical marbles.

C: Procedure:

1. Place the seven marbles in the groove of the ruler all next to and touching each other.
2. Now take one marble and let it roll from about 10cm away, with some speed against the other six (only one will move away).
3. Place the marbles back on their original position and do the same with two marbles bumping against the remaining five.
4. Now separate four marbles and before letting then roll against the remaining three, ask the students: "How many marbles will move ways?"

D: Anticipated Results:

Students should observe the movement of marbles.

E: Thought Questions for Class Discussion:

1. When one marble bumps against six, why does only one marble move away?
2. Are the other five marbles moving much faster after collision?
3. How many would move away if five marbles were pushed against two?
4. Would a marble twice as heavy also move only one way?
5. Would the end marble move also faster when one is hitting the row with a faster speed?

F: Explanation:

This event demonstrates the conservation of momentum. If all the marbles are identical in mass and size, whatever number rolls against a row of stationary ones will move the same number away from the stationary row. These last moving marbles are just taking over the momentum that the first marbles were imparting to the row of stationary marbles. **The momentum of a moving object is the product of its mass and its velocity (mv).** When this is imparted to another stationary object, this second object will have the same initial momentum ($mv_1=mv_2$). When both objects have the same mass, the velocity of the second object (v_2) will be the same as the first object's velocity (v_1). When the moving ball is twice as heavy ($m_1=2m_2$), then two balls with masses m_2 will move away. A faster moving marble will impart the same speed to a marbles of the same mass. A marble with half the mass of a stationary one will only impart half the speed to the heavy marble.

Applications of this principle are encountered in head-on collisions of trucks and cars, where the truck driver almost survives the accident but not the car passengers.