# Activity 1: OPPOSITES

(Concrete Action)

**Materials:** Commercial algebra tiles or small counters in two colors
Paper
Pencils

**Management:** Partners (40–50 minutes)

**Directions:**

**1.** Give each pair of students 20 counters or tiles of each of two colors. (Various commercial counters are available; one-inch paper squares also may be used.) For convenience in our discussion here, we will use red and blue as the two colors. Red will be for positive integers and blue for negative integers.

**2.** Have two students stand at opposite ends of a small desk or table. Ask one student to push against the table to move it a few inches, then ask the other student to push the table, moving it in the opposite direction. Now ask both students to push against the table at the same time but in opposite directions to each other. They should try to match each other's force so that the table does not move in either direction. Discuss how both students are using force against the table, but their combined effect acts like a zero force since the table does not move. The two forces can be described as *opposites* or *inverses* of each other. When joined together (i.e., applied to the same object), they form a *zero-pair* in that they neutralize each other and produce no effect. One student's force can be called *positive one* (written as *+1*) and the other student's force, which is opposite in direction to the first force, can be called *negative one*, the *inverse of one*, or the *opposite of one* (written as *–1*). Numbers that can be used to count or measure such *opposite* forces are called *integers*.

**3.** Ask students to describe other pairs of actions in their daily lives that are opposites of each other. Such actions, when used together or following each other, appear to produce no change in the object they are affecting (although when done separately, each action does cause change). For example:

(1) *open* a closed door, then *close* the door again—the door finally looks like it did at the beginning

(2) *lift up* a light switch (light turns on), then *push down* the light switch—the light is off again or looks as it did at first

(3) *fold* in half, then *unfold* a sheet of paper

(4) *pick up* a book from the table, then *put down* the book on the table again

(5) *pour in* a quart of water to a bucket holding a gallon of water, then *pour out* a quart of water from the bucket—a gallon of water remains in the bucket

**4.** Now use the water in-water out example to help students place the integers in order. Discuss how +1 indicates that 1 cup of water has been placed in a bucket and –1 indicates that 1 cup of water has been removed from the bucket. You may even want to demonstrate these two opposite actions with real water, a cup, and a medium-sized, transparent container so that students may see how the water level in the container actually changes with each action. The size of the container should be such that the change in the water level is *visually* obvious when only *one* cup of water is added or removed. Ask: *Which action on the initial amount of water produces the higher water level in the bucket: +2 or –3?* The +2 means 2 cups of water have been added to the initial amount (water level raises); –3 means 3 cups have been removed from the initial amount (water level lowers). For many students the answer will be obvious, but we need to develop a thinking strategy here that can be applied later to more complex problems.

**5.** Have students show 2 red counters for +2 and 3 blue counters for –3. Whenever a red counter is brought in, this means the water level will be increased. First ask students to see if the –3 water level can be raised to the +2 level. Students can do this by bringing in a new red counter to match each of the 3 blue counters; this action represents putting 1 cup of water (red) back in the bucket to replace the 1 cup of water (blue) that has been removed. When 3 red counters have been matched to the 3 blue counters, this means that the water is *back* at its *original level* in the bucket. (Hence, –3 and +3 are *opposites* or *inverses* of each other.) So when 2 more red counters are brought in, the water reaches the +2 level. We then can say that the $-3 < +2$, because the –3 water level could be *raised* to the +2 level, which shows that the +2 level is *higher* than the –3 level. (You might want to write this inequality on the chalkboard for students to record on their own papers.) Now begin again with just 2 red counters or +2. When other red counters are joined to these red counters, other positive amounts are found—not any negative amounts. Thus, the +2 water level cannot be *increased* to the –3 level; +2 will not be less than –3.

**6.** Give the students other integers to compare by means of the red and blue counters. For example, compare the two negatives, –1 and –4. Can the –1 level be increased to a –4 level? Students should join red counters to the 1 blue counter (–1) to first reach the 0 or initial water level, then other levels above the 0 level (i.e., positive amounts). So –1 cannot be *increased* to the –4 level; –4, however, can be increased to –1 by joining 3 red counters to the 4 blue ones. Thus, we have $-1 > -4$. For positive examples like + 3 and + 5, only +3 can be increased by more red counters to reach + 5, so $+3 < +5$.