

# Lockers



## Strand D: Algebraic Thinking

**Benchmark MA.D.1.2.2:** The student generalizes a pattern, relation, or function to explain how a change in one quantity results in a change in another.

**Grade Level Expectations:** The student:

- analyzes and generalizes number patterns and states the rule for relationships (for example, 1, 4, 9, 16 . . . ; the rule: +3, +5, +7 . . . ; or the "squares of the whole numbers").

**Overview:** In this activity, students will discover and explore the connection of number sense, working with multiples and algebraic thinking and finding a pattern. Students will be given locker cards with the numbers 1-28. The teacher will lead them through the multiples of numbers.

### Materials:

- Two-color Counters
- Locker Worksheet

### Procedures:

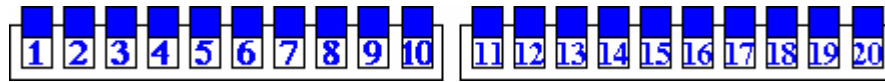
- Ask students to define the term multiple. A **multiple** of a natural number is the product of that number and another natural number. Multiples of 2 are 2, 4, 6, 8, 10, etc.
- Relate to the students to imagine that they are at a school with 28 lockers all shut and unlocked. Twenty-eight students are assigned lockers 1 through 28.
- Have students work in pairs. Each pair of students will be given the *Lockers* worksheet and twenty-eight two-color counters. The students will work together as the teacher proceeds to call out the numbers of the lockers.

#### Here's the problem:

All the lockers are closed. Place the red-side up of the two-color counter on each locker space. (see *Lockers* worksheet)



4. The first student goes along the row and opens every locker. This changes the state of every locker. Therefore, have the student flip the two-color counters to the yellow side.



5. The second student then goes along and shuts every other locker beginning with the number 2 (the multiples of 2). Students will flip the two-color counters to represent the opening and closing of the locker.



6. The third student changes the condition of every third locker beginning with locker number 3 (the multiples of 3). If the locker is open, the student shuts it, and if it is closed, the student opens it.



7. The fourth student changes the condition of every fourth locker beginning with locker number 4 (the multiples of 4).

8. Imagine this continues until all twenty-eight students have followed the pattern with the twenty-eight lockers. At the end, which lockers will be open and which will be closed?

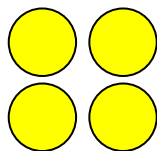
9. Which lockers will be left open? The students will describe the resulting pattern, using symbols or words, in their math journals. Some of the entries may include listing of the perfect squares and/or the pattern increasing by 2, for example +3, +5, and +7. Students may illustrate by drawing perfect squares.

10. Discuss square numbers with students. A square number is the number multiplied by itself. The square of 3 is  $3 \times 3 = 9$ . The square of 3 is written  $3^2$ .

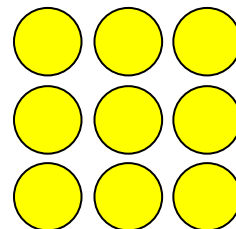
11. If students are using two-color counters, have them form perfect square numbers.



$$1 \times 1 = 1 \text{ or } 1^2$$



$$2 \times 2 = 4 \text{ or } 2^2$$



$$3 \times 3 = 9 \text{ or } 3^2$$

12. *Questions for students to ponder:*

- Which lockers were switched the most times?
- If locker 24 was switched the most, what are the factors of 24? This is due to the number of factors in that number, for example  $1 \times 24$ ,  $2 \times 12$ ,  $3 \times 8$ , and  $4 \times 6$ .
- How many lockers and which ones were touched exactly twice? The only doors touched twice were the doors with prime numbers.

**Literature Connection:** *Sea Squares* by Joy N. Hulme (ISBN: 1-562-82520-8)

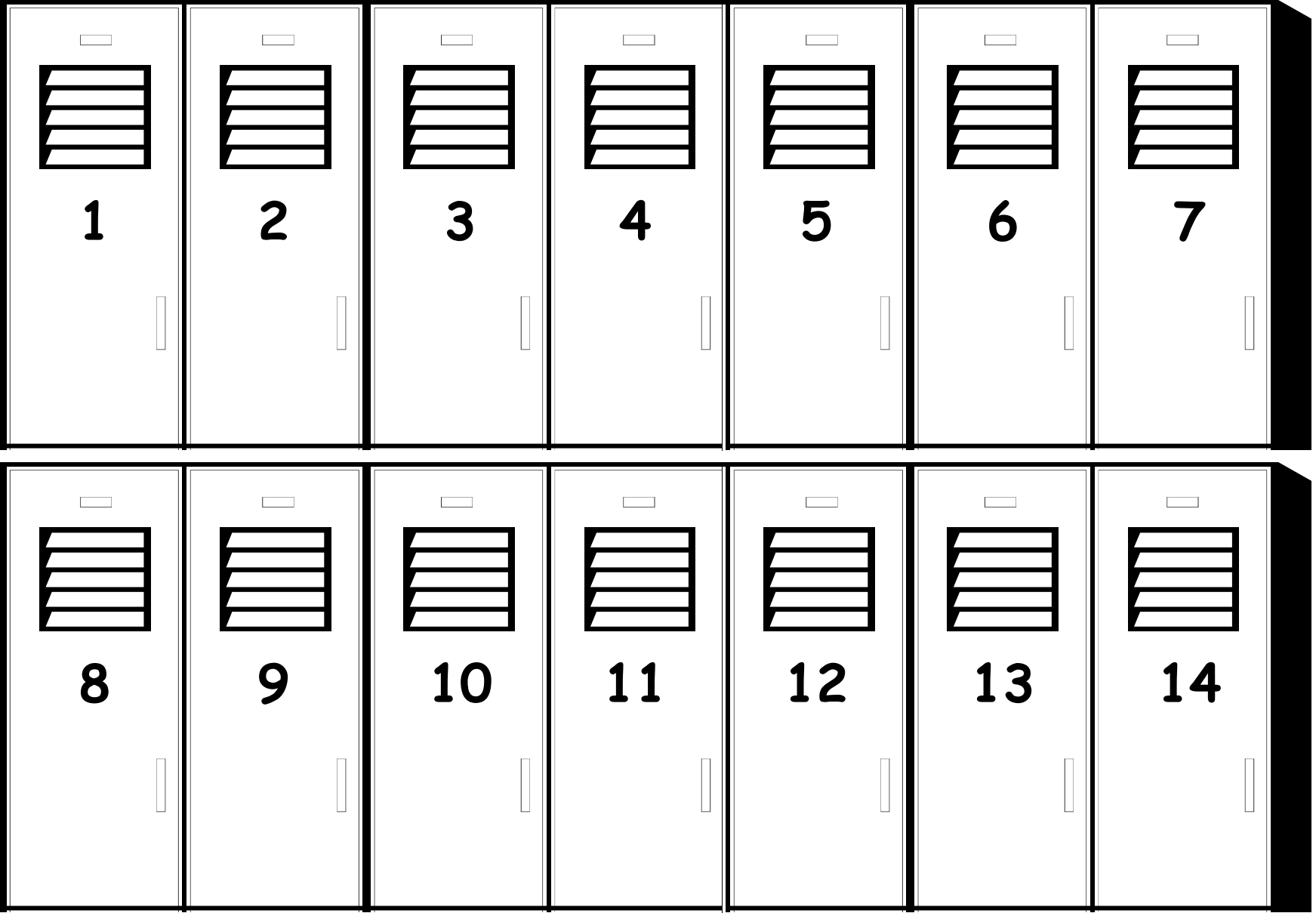
**Assessment:**

- Have students write about which lockers would be open if there were 100 lockers and explain why.

**Extension:**

- Have students write about what they think the outcome would be if there were 1000 lockers.

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