# Lesson 5: Understanding Subtraction of Integers and Other Rational Numbers

## Classwork

### Example 1: Exploring Subtraction with the Integer Game

Play the Integer Game in your group. Start Round 1 by selecting four cards. Follow the steps for each round of play.

1. Write the value of your hand in the Total column.
2. Then, record what card values you select in the Action 1 column and discard from your hand in the Action 2 column.
3. After each action, calculate your new total, and record it under the appropriate Results column.
4. Based on the results, describe what happens to the value of your hand under the appropriate Descriptions column. For example, "Score increased by 3."

| Round | Total | Action 1 | Result 1 | Description | Action 2 | Result 2 | Description |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |

**Discussion: Making Connections to Integer Subtraction**

1. How did selecting positive value cards change the value of your hand?

2. How did selecting negative value cards change the value of your hand?

3. How did discarding positive value cards change the value of your hand?

4. How did discarding negative value cards change the value of your hand?

5. What operation reflects selecting a card?

6. What operation reflects discarding or removing a card?

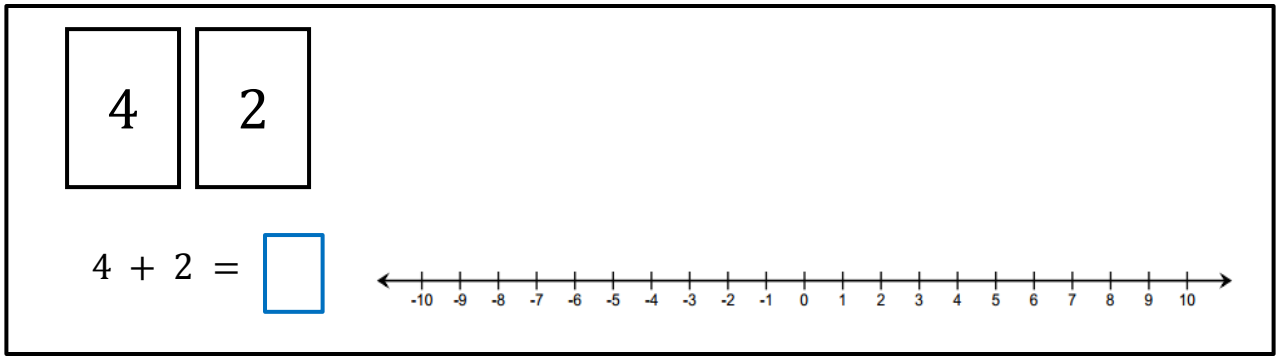
7. Based on the game, can you make a prediction about what happens to the result when
   a. Subtracting a positive integer?

   b. Subtracting a negative integer?

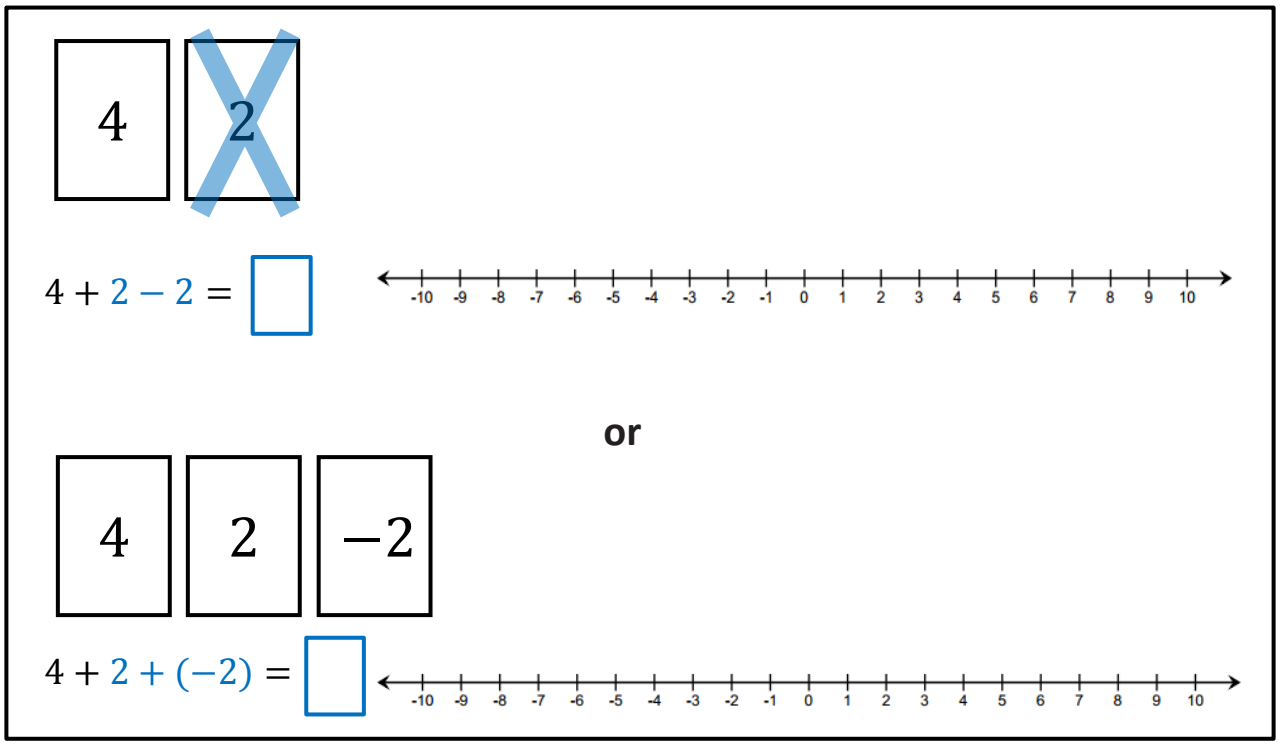
At the end of the lesson, the class will review its predictions.

## Example 2: Subtracting a Positive Number

Follow along with your teacher to complete the diagrams below.



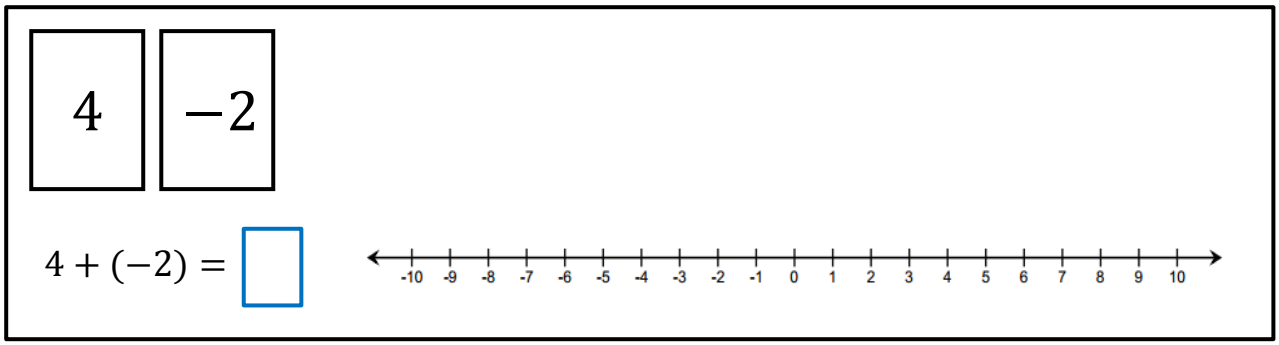

Show that discarding (subtracting) a positive card, which is the same as subtracting a positive number, decreases the value of the hand.



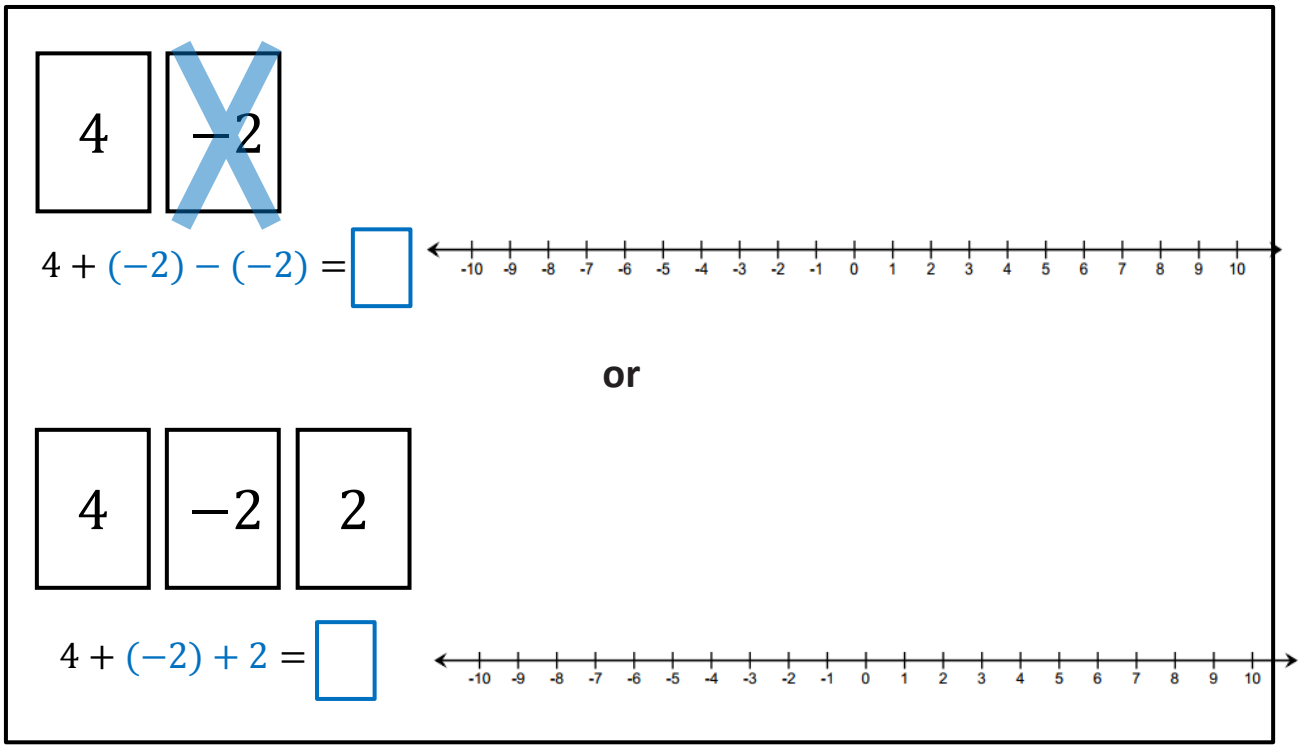

Removing (_____) a positive card changes the score in the same way as _____ a card whose value is the _____ _____ (or opposite). In this case, adding the corresponding _____.

## Example 3: Subtracting a Negative Number

Follow along with your teacher to complete the diagrams below.




How does removing a negative card change the score, or value, of the hand?




Removing (_____) a negative card changes the score in the same way as _____ a card whose value is the _____ _____ (or opposite). In this case, adding the corresponding _____.

***The Rule of Subtraction***: *Subtracting a number is the same as adding its additive inverse (or opposite).*

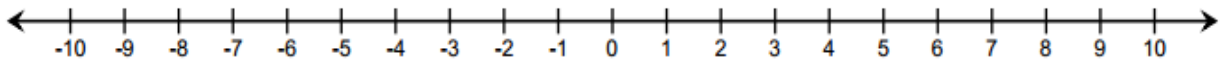
**Exercises 1–3: Subtracting Positive and Negative Integers**

1. Using the rule of subtraction, rewrite the following subtraction sentences as addition sentences and solve. Use the number line below if needed.
   a. $8 - 2$

   b. $4 - 9$

   c. $-3 - 7$

   d. $-9 - (-2)$




2. Find the differences.
   a. $-2 - (-5)$

   b. $11 - (-8)$

   c. $-10 - (-4)$

3. Write two equivalent expressions that represent the situation. What is the difference in their elevations?
   "An airplane flies at an altitude of 25,000 feet. A submarine dives to a depth of 600 feet below sea level."

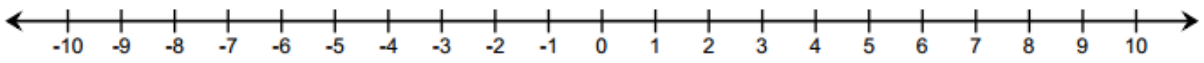
**Lesson Summary**

- **The Rule for Subtraction**: Subtracting a number is the same as adding its opposite.
- Removing (subtracting) a positive card changes the score in the same way as adding a corresponding negative card.
- Removing (subtracting) a negative card makes the same change as adding the corresponding positive card.
- For all rational numbers, subtracting a number and adding it back gets you back to where you started: $(m - n) + n = m$.

## Problem Set

1. On a number line, find the difference of each number and 4? Complete the table to support your answers. The first example is provided.

| Number | Subtraction Expression | Addition Expression | Answer |
|---|---|---|---|
| 10 | $10 - 4$ | $10 + (-4) = 6$ | 6 |
| 2 | | | |
| $-4$ | | | |
| $-6$ | | | |
| 1 | | | |



2. You and your partner were playing the Integer Game in class. Here are the cards in both hands.

*Your hand*

| | | | |
|---|---|---|---|
| $-8$ | 6 | 1 | $-2$ |

*Your partner's hand*

| | | | |
|---|---|---|---|
| 9 | $-5$ | 2 | $-7$ |

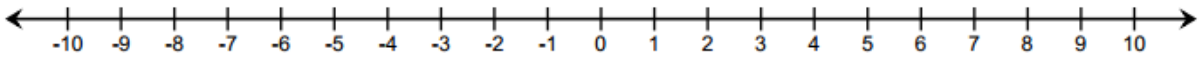
   a. Find the value of each hand. Who would win based on the current scores? (The score closest to 0 wins.)
   b. Find the value of each hand if you discarded the $-2$ and selected a $5$, and your partner discarded the $-5$ and selected a $5$. Show your work to support your answer.
   c. Use your score values from part (b) to determine who would win the game now.

3. Write the following expressions as a single integer.
   a. $-2 + 16$
   b. $-2 - (-16)$
   c. $18 - 26$
   d. $-14 - 23$
   e. $30 - (-45)$

4. Explain what is meant by the following and illustrate with an example:

   "For any real numbers, $p$ and $q$, $p - q = p + (-q)$."

5. Choose an integer between $-1$ and $-5$ on the number line, and label it point $P$. Locate and label the following points on the number line. Show your work.




   a. Point $A$: $P - 5$
   b. Point $B$: $(P - 4) + 4$
   c. Point $C$: $-P - (-7)$

Challenge Problem:

6. Write two equivalent expressions that represent the situation. What is the difference in their elevations?

   "An airplane flies at an altitude of $26{,}000$ feet. A submarine dives to a depth of $700$ feet below sea level."