

MODULE SIX

This module addresses solving and graphing solutions to linear inequalities.

SC Academic Elementary Algebra Standards included in this module are:

- EA-4.8 Carry out procedures to solve linear inequalities for one variable algebraically and then to graph the solution.
- EA-5.12 Analyze given information to write a linear inequality in one variable that models a given problem situation.

The resources provided in this module are not all inclusive. They are provided to begin to build the conceptual foundation students need. Additional resources will be required to develop the concepts.

Lesson # 1

Topic: Writing linear inequalities in problem situations

Standard (s): EA – 5.12

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student’s prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
 - In eighth grade, students generate and solve complex abstract problems that involve modeling physical, social, or mathematical phenomena (8-1.1).
 - In Elementary Algebra students will write a linear inequality in one variable that models a given problem situation.
 - In Intermediate Algebra, students analyze a problem situation to determine a system of linear inequalities that models the problem situation (IA-2.3)

- **Taxonomy Level**
Cognitive Process Dimension: Analyze
Knowledge Dimension: Conceptual Knowledge

- **Key Concepts**
Linear inequality
Modeling

II. Teaching the Lesson

In this lesson, students write linear inequalities to model problem situations. This lesson precedes the lesson on solving linear inequalities in one variable because it provides purpose for learning the process of solving linear inequalities. Students have had experience writing linear equations and the use of inequalities symbols.

- **Essential Learning and Understanding**
It is essential for students to do the following for the attainment of this indicator:
 - Assign a variable to the quantity of interest for a given problem situation.
 - Determine the restrictions on a variable of interest in a given problem situation from given information.
 - Write a linear inequality in one variable given restrictions on the variable.

- **Examples of Essential Tasks**

These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

- Write an inequality in one variable to represent the set of numbers that satisfy this statement: Three times a number plus one is less than five.
- Todd wants to make at least \$250 this week working at a convenience store. Todd makes \$6.00 per hour and will earn a \$25 bonus this week. Write a linear inequality in one variable that models the problem situation.

- **Non-Essential Learning and Understanding**

It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

- Solve the linear inequality.
- Write a linear inequality involving two variables.

- **Examples of Non-Essential Tasks**

The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

Todd wants to make at least \$250 this week working at a convenience store. Todd makes \$6.00 per hour and will earn a \$25 bonus this week. What is the minimum number of hours that Todd must work? (The question makes this problem nonessential for this indicator because it involves solving the inequality rather than writing the inequality.)

- **Misconceptions/Common Errors**

None Noted

- **Technology Note**

Use technology where appropriate.

III. Assessing the Lesson

Assessment Guidelines: The objective of this indicator is to analyze given information to write an appropriate inequality to model a situation. Assessment should focus on writing an inequality that models the given problem situation.

- **Assessment Item Examples**

- A car salesman makes a monthly base salary of \$1,500 and receives an additional \$400 for each car sold. Find an equation that gives the number of cars (c) that he must sell to earn a monthly income of at least \$4,700.
 - A. $1500C + 400 \geq 4700$
 - B. $1500C + 400 \leq 4700$
 - C. $400C + 1500 \geq 4700$
 - D. $400C + 1500 \leq 4700$
- A utility company charges a base rate of \$25 plus \$0.02 per unit of power (P) used by the customer. Which formula shows the number of units of power that a family can consume and pay no more than \$50 per month?
 - A. $0.02P + 25 \geq 50$
 - B. $0.02 + 25P \leq 50$
 - C. $0.02 + 25P \geq 50$
 - D. $0.02P + 25 \leq 50$
- Write an inequality in one variable to represent the set of numbers that satisfy this statement: Four times a number minus three is greater than six.
 - A. $3n - 4 > 6$
 - B. $4n - 3 < 6$
 - C. $4n - 3 > 6$
 - D. $3n - 4 < 6$

Lesson # 2

Topic: Solving and graphing solutions to linear inequalities

Standard (s): EA – 4.8

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student’s prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**

- In 6th grade, students represented algebraic relationships with simple inequalities (6-3.3). In 7th grade, students solved two step inequalities (7-3.4) and represent their solutions on a number line (7-3.5). In 8th grade, students represented algebraic algebraically relationships with inequalities and solved multi-step equations but not inequalities
- In Elementary Algebra, students carry out procedures to solve linear inequalities for one variable algebraically and then to graph the solution.
- In Intermediate Algebra, students transfer their understanding of linear inequalities in one variable to linear inequalities in two variables.

- **Taxonomy**

Cognitive Process Dimension: Apply
Knowledge Dimension: Procedural Knowledge

- **Key Concepts**

Linear inequality
Solution
Graphing on the number line

II. Teaching the Lesson

In this lesson, students transfer their understanding of solving linear equations to solving linear inequalities and graphing their solutions on the number line. In addition, students should check their solutions using an appropriate method. Although, the process of solving equations and inequalities are similar, students have difficult connecting the two. Emphasizing how the two representations are different first will help students to focus on what new skills need to be added to their current processes. For example, given $2x + 5 = -5$ and $2x + 5 < -5$, what are the differences in these two representations? Then discuss how they are similar.

- **Essential Learning and Understanding**

It is essential for students to do the following for the attainment of this indicator:

- Use appropriate algebraic techniques to solve for a given variable
- Understand which algebraic techniques and properties were applied in order to get the resulting equivalent linear inequality
- Solve linear inequalities involving one step, two steps, distributive property, variables on both sides, fractional coefficients, decimals and the collecting of like terms.
- Check their solutions using an appropriate method
- Graph solutions on a number line using open or closed circles and shading the appropriate region

- **Examples of Essential Tasks**

These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

- Solve the inequality then graph the solution. $11 > \frac{-1}{3}m$
- Solve the inequality then graph the solution. $-3t + 15 \leq 2t$
- Solve the inequality then graph the solution. $7 - 2(x - 3) \geq 25$
- Solve the inequality then graph the solution. $7.2 - 2.1b < 4.4$

- **Non-Essential Learning and Understand**

It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

- Solve compound inequalities involving "and"
- Solve compound inequalities involving "or"

- **Examples of Non-Essential Tasks**

The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

- Solve the inequality then graph the solution.
 $-13 < 2 - 5x \leq -2$
- Solve the inequality then graph the solution.
 $2x + 3 < 1$ or $5 - 3x > 1$

- **Misconceptions/Common Errors**

- Students may have the misconception that the variable must be on the left side of the equals sign and the solution on the right. This can cause confusion when problems are presented in the form $5 \leq x$. Students should work with examples where the variable is on either side of the inequality symbol.
- Students generalize that the direction of the inequality determines the direction of shading on the number. For example, in $x > -3$ the inequality symbol is pointing towards the right; therefore, students shade to the right of -3 on the number line. But this generalization is not true in inequalities such as $5 \geq x$.
- Students confuse the process of graphing linear inequalities in one variable on the number line with graphing linear inequalities in two variables on the coordinate plane.

- **Technology**

Students may use a graphing utility to verify for which values of x the inequality is true. For example, given the inequality $2x - 3 < 7$, students would graph $y = 2x - 3$ and $y = 7$ then determine for which values of x is the graph of $y = 2x - 3$ below the graph of $y = 7$.

III. Assessing the Lesson

Assessment Guidelines: *The objective of this indicator is for the student to carry out a procedure to solve linear inequalities and graph their solutions. Therefore, the primary focus of the assessment should be for students to carry out such procedures.*

- **Assessment Item Examples**

- Solve: $-4n - 2 \leq n + 5$
 - A. $n \leq -2$
 - B. $n \leq 1$
 - C. $n \geq -2$
 - D. $n \geq 1$

- Graph the solution to the inequality $2 \leq \frac{1}{3}m - 1$.

