Classroom Interactions 5E Lesson Plan Template

Author: KP Preut	**Title of Lesson**: Inequalities: Special Solutions **Lesson Source/Resources: Algebra 1, Unit 2 Inequalities Spiral**
Lesson #: 1 Date lesson will be taught: **10/5**	Subject/Grade level: Algebra 1, 9th Grade

Concepts/Main Idea – *explain the concept(s) that will be the focus of this lesson in detail.*

★ Problems will be expressions with variables that are being compared with inequality symbols
- > greater than symbol
- ≥ greater than or equal to symbol
- < less than symbol
- ≤ less than or equal to symbol
- Example of problems
  - $2x+3 < 10$
  - $2x+3 < 2x+5$

★ Students will need to simplify the expression to make the inequality true
- Example: $2x+3 < 2x+5$
  - Students will need to simplify the expressions to see if the inequality is true. There are a few ways to do this, but in this case it should be concluded that any value can be substituted for x to make the inequality true
- Example: $2x+3 < 2x+1$
  - In this case, there is no value that can be substituted for x to make the inequality true

★ Students will then need to express their answers in interval notation
- If any number can be substituted in for x, students express all real numbers as $(-\infty, \infty)$
- If there are no values that can be substituted in for x, students express the answer as "No solutions" or "NS"

Instructional model and strategies – *The strategies from the learning center that will be used during the lesson*

★ Instructional Model: 5E lesson template
★ Non-linguistic representation:
  ○ This means using non-verbal explanations or models to showcase ideas. In this lesson, modeling solutions to equations as lines on a graph will be the non-verbal representation. This will take place during the explore section.

Objective/s- Write objectives in SWBAT form… ***The Students Will Be Able To:***	**Evaluation** *Based on your objectives, draft the content of the questions you will ask on your pre- and post-tests; at least 1 question for each objective. Questions do not have to be multiple choice. Your actual pre- and post-tests will be included in the interview paper.*
★ Students will be able to solve equations in one variable. ★ Students will be able to solve inequalities in one variable. ★ Students will be able to write solutions in interval notation. ★ Students will be able to determine if there are no solutions or infinitely many solutions.	**Pre-test assessment** – This should line up with the learning targets and provide the teachers with the information needed to make instructional decisions *before* the lesson begins. Be sure the assessment will make the students' thinking visible. ★ Provided below
	Formative assessment(s) – This should line up with the learning targets and provide teachers with the information needed to make instructional decisions *during* the lesson. Be sure to describe the format of the assessment and what it is designed to assess. ★ Explained below

	Post-test assessment - This should line up with the learning targets and provide teachers with the information needed to be confident that students understand the content. Be sure to describe the format of the assessment and what it is designed to assess.
	★ Provided below

Kansas Science and Math Standards- Include standard, benchmark and indicator where applicable

For math lessons:
    Common Core Math Content:
        ★ A.REI.B Solve equations and inequalities in one variable.

    Common Core Math Practice:
        ★ M6: Attend to precision.

    NGSS Science and Engineering Practice:
        ★ S5: Use mathematics and computational thinking.

    Common Core ELA Practice:
        ★ E4: Construct viable arguments and critique reasoning of others.

Materials list (BE SPECIFIC about quantities)	**Accommodations:** Include a general statement and any specific student needs. Be sure to include struggling readers.
per Student: ★ 25 Unit 2 Spiral Notebooks (students should have these) ★ 25 Pre-tests ★ 25 calculators (in the classroom) ★ 25 iPads (students should have these) ★ 25 word problem worksheets per Group (approx 12 groups): ★ 1 large whiteboard Advance preparation: ★ Before class, it would be helpful to write the problems on the white board to save time. **Include handouts** at the end of this lesson plan document (blank page provided to paste a copy of your document). List handouts in your materials list.	★ Read aloud for word problems. ★ Students may request to work in the learning pocket in the hall.
	Safety: Include a general statement that indicates how you will establish a learning environment where safety for all is assured. Include physical safety concerns specific to this lesson. Identify when you will address these specific concerns with the students ★ There are no specific physical safety concerns with this lesson. ★ Students will be working in small groups and reporting their work back to the whole class. At the beginning of the lesson, the teacher will establish that students need to respect everyone's ideas and not make disparaging comments if classmates make mistakes.

Extension Activities:	Backup Plans:
★ **Word problem worksheet** ★ **More practice on IXL math**	★ If the majority of students are not understanding the material, elaborate examples can be done as a class with more teacher direction.

Describe what the student and the teacher will do during each stage of the lesson. Be sure to describe the learning experiences and the assessments. You also need to discuss any management considerations (e.g., picking up materials, movement of students, etc.)

Engagement: Estimated Time: _____20 min_____ (This should be a block day or two-day lesson)		
What the teacher does AND how will the teacher direct students: (Directions)	**Probing Questions:** Critical questions that will connect prior knowledge and create a *"Need to know"*	**Expected Student Responses AND Misconceptions** - *think like a student to consider student responses INCLUDING misconceptions:*
★ Before the new lesson begins, students will take the pre-test over special solutions and compound inequalities. 　○ Teacher will pass out the pre-tests as class begins and tell students this is a non-graded test to see what they know. They will also be told there is information on the pre-test that has not been covered, so it's okay if they don't know the answers. ★ Teacher will do 2 warm up problems on the board asking for student input. 　○ Prompting questions included to the right. ★ Teacher will show (x,y) plane representation of the warm up problems. ★ Teacher will ask two thumbs up/down questions about solutions. 　○ Is it possible for an inequality to have no solutions? 　○ Is it possible for an inequality to have infinitely many solutions? ★ Teacher will do fist to five to gauge if students are prepared to move on 　○ Fist- not ready 　○ 5 fingers up - completely ready	Is it possible for an inequality to have no solutions? Is it possible for an inequality to have infinitely many solutions? What is the first step? (Distribute) What should we do next? (Combine like terms and isolate variables.) Does this answer make sense? (f=f or 0=0) / (0=5) What does this answer mean? (Infinitely many solutions?) / (No solutions)	★ Thumbs up/ thumbs down ★ Distribute ★ Solve for f ★ Add 1 ★ Add 3 ★ Divide by 6 ★ Combine like terms ★ Solve for f ★ Subtract 17 ★ Divide by 6 ★ f=f makes sense? 　○ Yes, there are infinitely many solutions 　○ No, a variable cannot equal itself 　○ Yes, but I don't know why ★ 0=5 　○ Yes, there are no solutions to this problem 　○ No, 0 cannot equal 5 ★ f=f means? 　○ Infinitely many solutions 　○ You can plug any number in for f and get the same answer on both sides 　○ The equations are the same

○   2-4 fingers up - varying degrees of readiness
○   If majority of students are not prepared, teacher will go over confusions students have
★ Teacher will direct students to form groups of 2-3. Students will be in these groups for the majority of the lesson. A large white board will be given to each group to do their work on.
		○ Equation doesn't make sense
		
		★ 0=5 means?
		       ○ No solutions
		       ○ The equations will never equal each other
		       ○ The equations don't make sense

Exploration: Estimated Time: _____15 min_____		
What the teacher does AND what the teacher will direct students to do: (Directions)	**Probing Questions: Critical questions that will guide students to a "Common set of Experiences"**	**Expected Student Responses AND Misconceptions -** think like a student to consider student responses INCLUDING misconceptions:
Explore Part 1: ★ The teacher will direct students to do problem #2 in groups on their white boards ○ How did you solve for your variable? ○ How many solutions were there? ○ How can we put all real numbers in interval notation? Explore Part 2: ★ Students will work in groups to solve problem #3 on their whiteboards ○ How did you solve for your variable? ○ How many solutions were there? ○ How can we put no solutions in interval notation? ★ While groups are working, the teacher will walk around the room and answer questions. They will also pick groups to go up and discuss their answers.	How many solutions are there? How can we put all real numbers in interval notation? How can we put no solutions in interval notation?	★ No solutions ★ Infinite solutions ★ 1 solution ★ A few solutions ● (-infinity, +infinity) ● We can't ● [-infinity, +infinity] ★ We can't ★ (0,0) ★ [0,0] ★ NS for no solutions

Explanation: Estimated Time: _____10 min_____		
What the teacher does AND what the teacher will direct students to do: (Directions)	**Clarifying Questions:** Critical questions that will help students *"clarify their understanding"* and introduce information related to the lesson concepts & vocabulary	**Expected Student Responses *AND* Misconceptions -** think like a student to consider student responses *INCLUDING* misconceptions:
Explain Part 1: ★ Students will display their white boards and explain what they did to solve the problem. ○ If there are misconceptions, the teacher will clarify. ○ Students will then be directed to copy down the correct work into their spirals Explain Part 2: ★ Students will display their white boards and explain what they did to solve the problem. ○ If there are misconceptions, the teacher will clarify. ○ Students will then be directed to copy down the correct work into their spirals ★ Teacher will do fist to five to gauge if students are prepared to move on ○ If majority of students are not prepared, teacher will go over confusions students have	How many solutions are there? How can we put all real numbers in interval notation? How can we put no solutions in interval notation?	★ No solutions ★ Infinite solutions ★ 1 solution ★ A few solutions ● (-infinity, +infinity) ● We can't ● [-infinity, +infinity] ★ We can't ★ (0,0) ★ [0,0] ★ NS for no solutions

Elaboration: Estimated Time: _____20 min____		
What the teacher does AND what the teacher will direct students to do: (Directions)	**Probing Questions:** Critical questions that will help students *"extend or apply"* their newly acquired concepts/skills in *new situations*	**Expected Student Responses AND Misconceptions** - think like a student to consider student responses *INCLUDING* misconceptions:

★ Teacher will go over problem #1 as a whole class.
   ○ Asking prompting questions to students
 	
★ Teacher will direct students to go back to their groups and do problems 4, 5, and 6.
 	
★ While students work, the teacher will go around the room answering questions.
 	
★ Students will check their answers with a teacher before being able to move on.
 	
★ After students finish these problems, they may work on their homework assignment, IXL, or do extension word problems.
   ○ Homework: pg. 25-26 in spirals
	For #1:
	Is this a special solution?
	
	How do we write this in interval notation?
		★ Yes
		★ No
		
		★ [3, +infinity)
		★ (3, +infinity)
		★ (3, +infinity]
		★ [3, +infinity]
		★ NS
		★ (-infinity, +infinity)

Evaluation: Estimated Time: _____0 min, (will be completed during next lesson)_____

Critical questions that ask students to demonstrate their understanding of the lesson's performance objectives.

Formative Assessment(s): *In addition to the pre- and post-test, how will you determine students' learning within this lesson: (observations, student responses/elaborations, white boards, student questions, etc.)?*

★ Pre-test (Engage)

★ Thumbs up/ down questions (Engage)

★ Fist to five (Engage, Explain)

★ Observations of group work (Explore, Elaborate)

★ Student explanations of work (Explain)

★ Checking student work (Elaborate)

Summative Assessment: *Provide a copy of the key to the post-test in the interview paper.*

★ Post-test that will be given after Special Solutions and Compound Inequalities are taught.

Name: _____

1. **Solve for the variable and write in interval notation. Then, circle if the inequality does not have a special solution, has no solutions, or has infinitely many solutions**

    a) $3r \leq 9$

Interval notation: _____

Not a special solution   No solutions   All real numbers

    b) $5s - 3 \geq 5s - 1$

Interval notation: _____
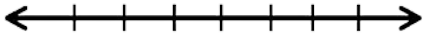
Not a special solution   No solutions   All real numbers

c) 8z +3 ≥ 8z -5

Interval notation: _____

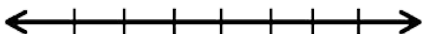Not a special solution   No solutions   All real numbers
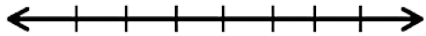
2. Graph the inequalities

a) x ≥ -1 *and* x < 3

←——+——+——+——+——+——+——+——→

b) x ≤ -1 or x > 3

←——+——+——+——+——+——+——+——→

3. Solve inequality for the variable and graph

    a) $-1 \leq 2m - 1 < 7$

Pre/Post Test Key

1a. 7 points possible
   ★ 2 points for solving for variable
      ○ r ≤ 3
   ★ 4 points for interval notation
      ○ (-∞, 3]
   ★ 1 point for circling correct answer
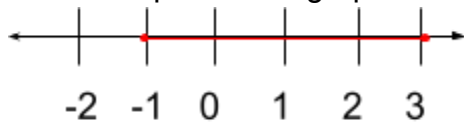   ○ Not a special solution

1b. 7 points possible
   ★ 2 points for solving for variable
      ○ -3 ≥ -1
   ★ 4 points for interval notation
      ○ No Solutions / NS
   ★ 1 point for circling correct answer
      ○ No solutions

1c. 7 points possible
   ★ 2 points for solving for variable
      ○ 3 ≥ -5
   ★ 4 points for interval notation
      ○ (-∞, ∞)
   ★ 1 point for circling correct answer
      ○ All real numbers

2a. 4 points possible
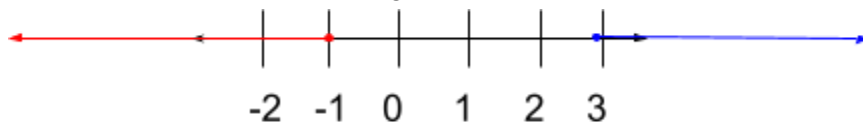   ★ 2 points for each part of the graph

-2 -1 0 1 2 3

      ○

2b. 4 points possible
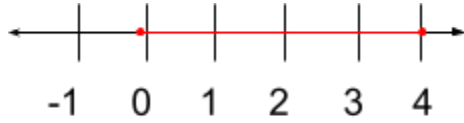   ★ 2 points possible for each part of the graph

-2 -1 0 1 2 3

      ○

3a. 5 points possible
- ★ 3 points possible for solving for the variable
  - ○ $0 \leq m < 4$
- ★ 2 points possible for graph

-1 0 1 2 3 4

  - ○

Unit 2 Inequalities

2.5 Special Solutions

Multi-Step Inequalities

Concept Checklist:

☐ Identify special solutions when solving an inequality.

Warm-up: Solve each equation for the variable. Check your answers, if possible.

$6(f + 3) - 1 = 6f + 20 - 3$ $10 + 6y = 3(5 + 3y - y)$

Notes:

Steps to solve an inequality:

Step 1: Isolate the variable on one side of the inequality sign using the steps to solve an equation.

- Distribute to simplify any parentheses.
- Combine like terms on the same side of the equal sign.
- Move variables to the same side of the equal sign.
- Inverse operations (add or subtract)
- Inverse operations (multiply or divide)
  * Remember to **flip the inequality sign direction** when **multiplying or dividing by a negative number.**

Step 2: Graph the solutions on a number line.

- Decide whether to use an open or closed circle.
- Shade the side of the open or closed circle where the solutions are larger or smaller.

Step 3: Write the solutions in interval notation.

No Solution:

All Real Numbers:

Examples: Solve each inequality for the variable. DO NOT GRAPH. Write the solutions in interval notation, if possible.

1. $4 - 2m > 7 - 3m$ 2. $4k - 2 + 6k < 10k$

3. $8f - 5f - 3 \le -4 + 3f$

4. $4\left(\frac{1}{2}r - 2\right) \ge 2(r - 3)$

5. $9w - 6 + 6w \ge 3(5w - 2)$

6. $15\left(\frac{1}{3}c + 3\right) < 6(c + 9)$

2.5 Special Solutions Practice

Directions: Solve each inequality for the variable. DO NOT GRAPH. Write the solutions in interval notation, if possible.

1. $6m - 5 < 2m + 11$

2. $7 - 3n \leq -2n + 3 - n$

3. $-4c + 7c - 4 > 3c + 11$

4. $3(2y - 11) \geq 6y - 33$

5. $5(-h + 8) > -5h - 10 + 30$

6. Describe and correct the error in solving the inequality.

✗ $-2(1 - x) \leq 2x - 7$

    $-2 + 2x \leq 2x - 7$

    $-2 \leq -7$

All real numbers are solutions.

Name: _____

You need $500 to buy a new laptop and you currently have $150. A job at an ice cream shop pays $10 an hour.
    a) Set up an inequality to represent this situation, then solve for how many hours you would need to work to afford the laptop.

150 + 10x ≥ 500

x ≥ 35

Need to work at least 35 hours to afford the laptop

    b) A job at the movie theater pays $15 an hour. Set up an inequality to represent this situation, then solve for how many hours you would need to work to afford the laptop.

150 + 15x ≥ 500

x ≥ 23.33

Need to work at least 24 hours to afford the laptop

    c) Is there a certain number of hours you could work so that the pay for both jobs was equal?

No, the job at the movie theater will always pay more.

You are planning a big party and can spend up to $400 on food. You are choosing between two restaurants. Restaurant A has a flat fee of $100 and charges $12 per person. Restaurant B has a flat fee of $300 and charges $2 per person.
    a) Set up an inequality to represent how many people you can invite if you choose Restaurant A and solve.

100 + 12x ≤ 400

x ≤ 25 ; 25 or fewer guests
   b) Set up an inequality to represent how many people you can invite if you choose Restaurant B and solve.

$300 + 2x \leq 400$

x ≤ 50; 50 or fewer guests

   c) How many guests would you need to invite for the cost of either restaurant to be the same?

$100 + 12x = 300 + 2x$

x = 20; 20 guests

   d) If you decided to have 50 guests, what restaurant should you choose? Why?

You would want to choose restaurant B, because it would be in your budget, restaurant A would be too expensive.

Phone company A charges a one-time fee of $200 and monthly fee of $70. Phone company B charges a one-time fee of $100 and a monthly fee of $70.
   a) Represent this situation with an inequality

$200 + 70x > 100 + 70x$