Name: …… Date: ……..

Thinking with Models _ Linear Inequality

Investigation Task: Lighting the Classroom Efficiently

Assessment Criterion: B and C

Key concept : Relationships, Change , Form	Related Concept : Pattern, Model and Representation	Global context: Orientation Time and Space

Inquiry Question:

How can we use linear inequalities to model and make decisions about real-life situations with limitations — such as optimizing the number of tube lights to achieve proper brightness within set conditions?

Objective: Students will select and apply appropriate algebraic techniques to solve inequalities. Represent and interpret solutions using number lines and contextual reasoning. Discover and justify patterns between algebraic solutions and real-world requirements (e.g., lighting efficiency).

Context: A school is replacing old bulbs with new **tube lights** to brighten up a classroom. The brightness of a room depends on both **the number of tube lights installed (x)** and **the light intensity per tube**.

The school sets a condition: “The total brightness from all tube lights should be greater than the current standard lighting requirement.” However, due to energy limits, brightness also depends on how much power each tube uses.

Command Terms:

Solve | Interpret | Represent | Explain | Compare

ATL Skills:

Thinking Skills: Analyse complex problems and apply logical reasoning.

Trasnfer Skills: Use algerbaic reasoning to make real world decisions.

Communication Skills: Use mathematical language and representations to present findings clearly.

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Context:

A school is replacing old bulbs with new **tube lights** to brighten up a classroom.
The brightness of a room depends on both **the number of tube lights installed (x)** and **the light intensity per tube**.

The school sets a condition: "The total brightness from all tube lights should be greater than the current standard lighting requirement."

However, due to energy limits, brightness also depends on how much power each tube uses. The relationship between **brightness (in lumens)** and **number of tube lights (x)** can be modeled by the inequality:

$$3x-5<x+7$$

Here:

- $3x-5$ represents **the current brightness** (in hundreds of lumens),
- $x+7$ represents **the standard brightness requirement** (in hundreds of lumens).

Your goal is to determine **how many tube lights are needed** so that the classroom lighting meets the requirement.

Task Instructions:

1: Explore the relationship:
Solve for x $3x-5<x+7$.**Interpret** the solution in the context of the number of tube lights needed.

$3x-5 < x+7$

$3x-x < 5+7$

$2x < 12$

$x < 6$

For any $x<6$, the current brightness is less than the requirement, it shows that insufficient lightning.

2: Model and represent:

Represent the inequality on a number line. **Explain** what the solution means for the school's lighting decision.

To meet or exceed the required brightness, the school must use fewer than 6 tubelights.

3: Extend your model:

Suppose each new tube light produces slightly less brightness due to age or dust, and the model changes to $2x-4<x+6$

a. **Solve** this new inequality.

$$2x-4<x+6$$
$$2x-x<6+4$$
$$x<10$$

For $x<10$, the current brightness is less than required therefore it is insufficient lightning.

b. **Compare** both results — what happens to the number of tube lights required?

For original model

test $x=5$.

$3x-5<x+7$

$3(5)-5<5+7$

$10<12$

It is insufficient

test $x=6$

$3(6)-5<6+7$

$18-5<13$

$13<13$ is false

at $x=6$, the brightness equals requirement

so $x\geq 6$ meets condition.

For adjusted model

test $x = 9$

$2(9) - 4 < 9 + 6$

$18 - 4 < 15$

$14 < 15$

It is insufficient

test $x = 10$

$2(10) - 4 < 10 + 6$

$20 - 4 < 16$

$16 < 16$ is false

So $x = 10$, the brightness equals requirement

So $x \geq 10$ meets requirement.

4: Communicate and reflect

- Describe how inequalities help in making real-life decisions about cost, safety, or efficiency.

*In this investigation, the inequality $3x-5<x+7$ represents a real-life situation where **x** is the number of tube lights needed to provide sufficient brightness in a classroom while keeping costs and energy use under control.*

*Inequalities help in making decisions because they show a **range of possible solutions**, not just one exact value. This reflects real-world conditions where we often have limits or constraints.*

- ***Cost:** The inequality helps determine how many tube lights can be installed without exceeding the school's budget. For example, $3x-5<x+7$ can represent balancing light cost against budget limits.*
- ***Safety:** It ensures there is **enough brightness** for safe visibility without causing glare or excessive energy load.*
- ***Efficiency:** It helps planners find an **energy-efficient range** of lights showing when adding more lights becomes wasteful or unnecessary.*

*Thus, solving the inequality supports **practical decision-making** by identifying the **feasible number of tube lights** that meet the requirements for **cost, safety, and efficiency**.*

Curriculum Framework

Key Concept	Definition	Relevance to Task
Relationships	The connections and associations between variables or quantities.	Students explore how the number of tube lights (x) relates to brightness and cost through inequalities.
Logic	The process of reasoning and applying rules systematically.	Students use logical reasoning to solve inequalities and verify solutions in context.
Form	How mathematical expressions and representations are structured and organized.	Students express relationships between quantities using algebraic form (e.g., $(3x - 5 < x + 7)$).
Related Concept	**Definition**	**Relevance to Task**
Modeling	Representing real-world situations using mathematical expressions or equations.	The brightness and cost of tube lights are modeled through inequalities.
Representation	The use of symbols, graphs, and diagrams to communicate mathematical ideas.	Students represent solutions using number lines and written reasoning.
Simplification	Reducing complex expressions or situations to a simpler, more understandable form.	Students simplify inequalities to find general rules and make decisions effectively.
Global Context	**Description**	**Connection to Task**
Scientific and Technical Innovation	Exploring the natural world and its laws, the interaction between people and the environment, and how humans use scientific principles.	The task applies mathematical modeling to design efficient, eco-friendly lighting systems.
Orientation in Space and Time	Understanding spatial reasoning and practical placement of systems in real-world contexts.	Students explore the spatial need for adequate light distribution along a hallway or classroom.
Globalization and Sustainability	Considering global systems and the impact of human decisions on the environment and resources.	The investigation encourages sustainable decisions regarding energy efficiency and lighting.
Global Context	**Statement of Inquiry**	**Explanation / Connection to Task**
Scientific and Technical Innovation	Mathematical models and inequalities help us make logical and efficient decisions in designing energy-saving systems, showing how scientific and technical innovation improves sustainability.	Students use inequalities to represent real-world constraints and make decisions about the number of tube lights needed for brightness and energy efficiency.
Globalization and Sustainability	By representing real-life problems mathematically, we can make sustainable choices that balance human needs, environmental impact, and available resources.	The inequality helps determine an efficient lighting plan that reduces energy waste while meeting classroom standards.
Orientation in Space and Time	Understanding spatial relationships through mathematical form allows us to plan and optimize the use of resources effectively within a specific environment.	Students interpret inequalities in the context of classroom layout and placement of lights to ensure balanced illumination.

Component	Description for This Task
G – Goal	To determine the number of tube lights required to meet brightness requirements in a classroom while considering limitations such as energy efficiency or cost, using linear inequalities.
R – Role	You are a **school facilities planner** responsible for designing an effective lighting setup using mathematical reasoning.
A – Audience	The **school administration** who wants a cost-effective and sustainable lighting plan for classrooms.
S – Situation	The school must ensure each classroom meets a standard brightness level. Each tube light provides a fixed brightness, and there's a cost and efficiency constraint. You must use algebraic inequalities to model and justify your recommendation.
P – Product / Performance	A **mathematical report or presentation** that includes: – Algebraic solution of the inequality (3x - 5 < x + 7). – A number line representation of the solution. – A written explanation linking results to the real-life situation. – Verification of findings and reflection on energy efficiency.
S – Standards for Success	- Correct and logical algebraic solution. - Appropriate mathematical language and notation. - Accurate and labeled graphical representation. - Clear interpretation in real-life context. - Well-organized and coherent communication of findings.