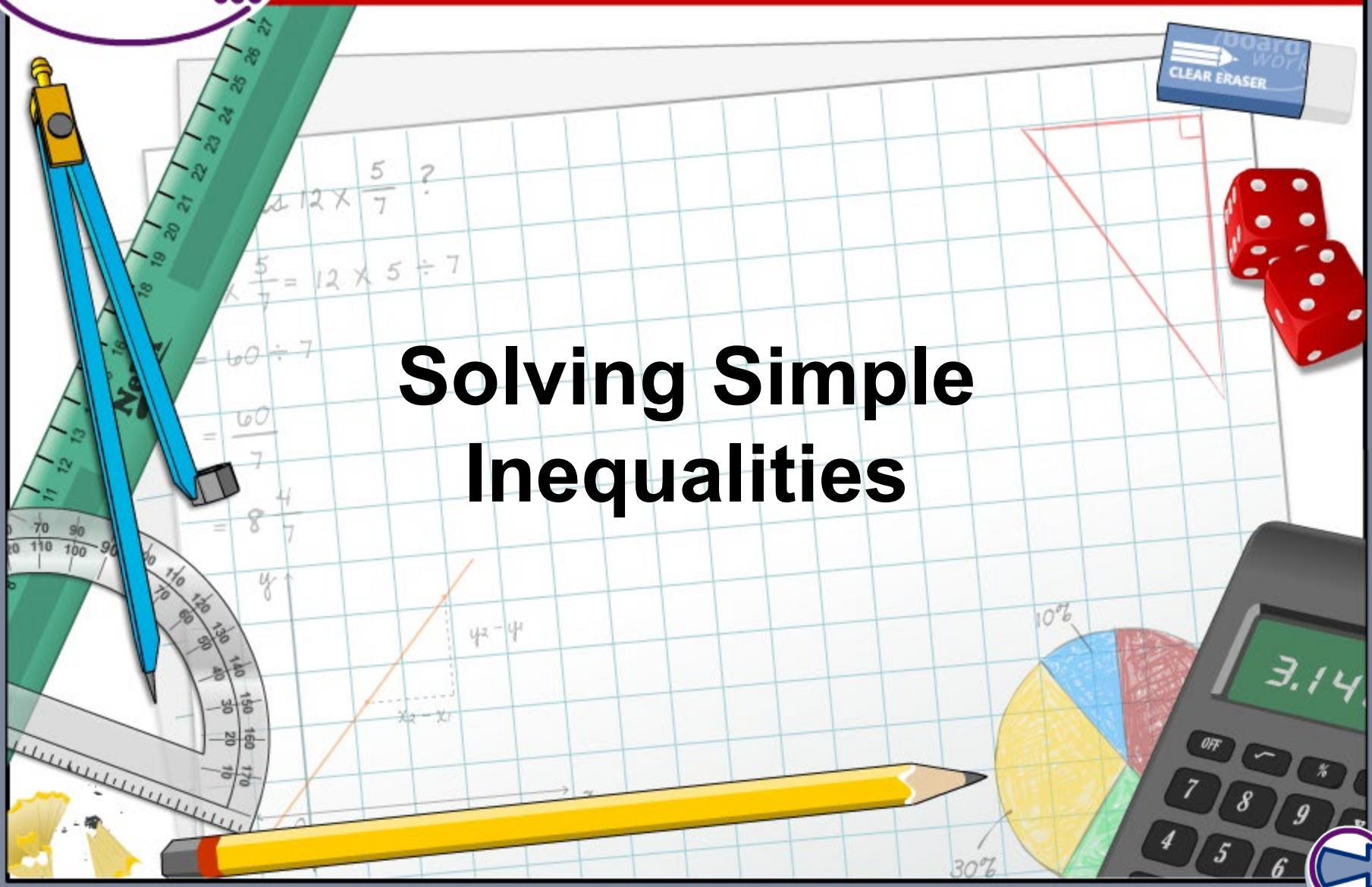


Solving Simple Inequalities

Information

Common core icons

This icon indicates a slide where the Standards for Mathematical Practice are being developed. Details of these are given in the Notes field.

Slides containing examples of mathematical modeling are marked with this stamp.

This icon indicates an opportunity for discussion or group work.

The **Standards for Mathematical Practice** outlined in the Common Core State Standards for Mathematics describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

These are:

1) Make sense of problems and persevere in solving them.

2) Reason abstractly and quantitatively.

3) Construct viable arguments and critique the reasoning of others.

4) Model with mathematics.

5) Use appropriate tools strategically.

6) Attend to precision.

7) Look for and make use of structure.

8) Look for and express regularity in repeated reasoning.

This icon indicates that the slide contains activities created in Flash. These activities are not editable.

This icon indicates teacher's notes in the Notes field.

Introducing inequalities

What is an inequality?

An **inequality** is an mathematical statement that says whether two expressions are **bigger** or **smaller** than each other.

$>$

What do you think this “>” symbol means?

Hint: The elephant is **greater than** the mouse!

Inequalities

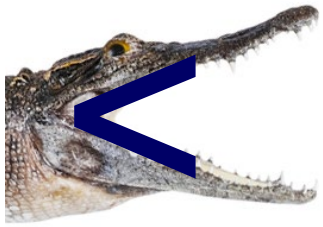
There are four different inequality symbols: >, <, ≥ and ≤.

Can you guess the meaning of each symbol in words?

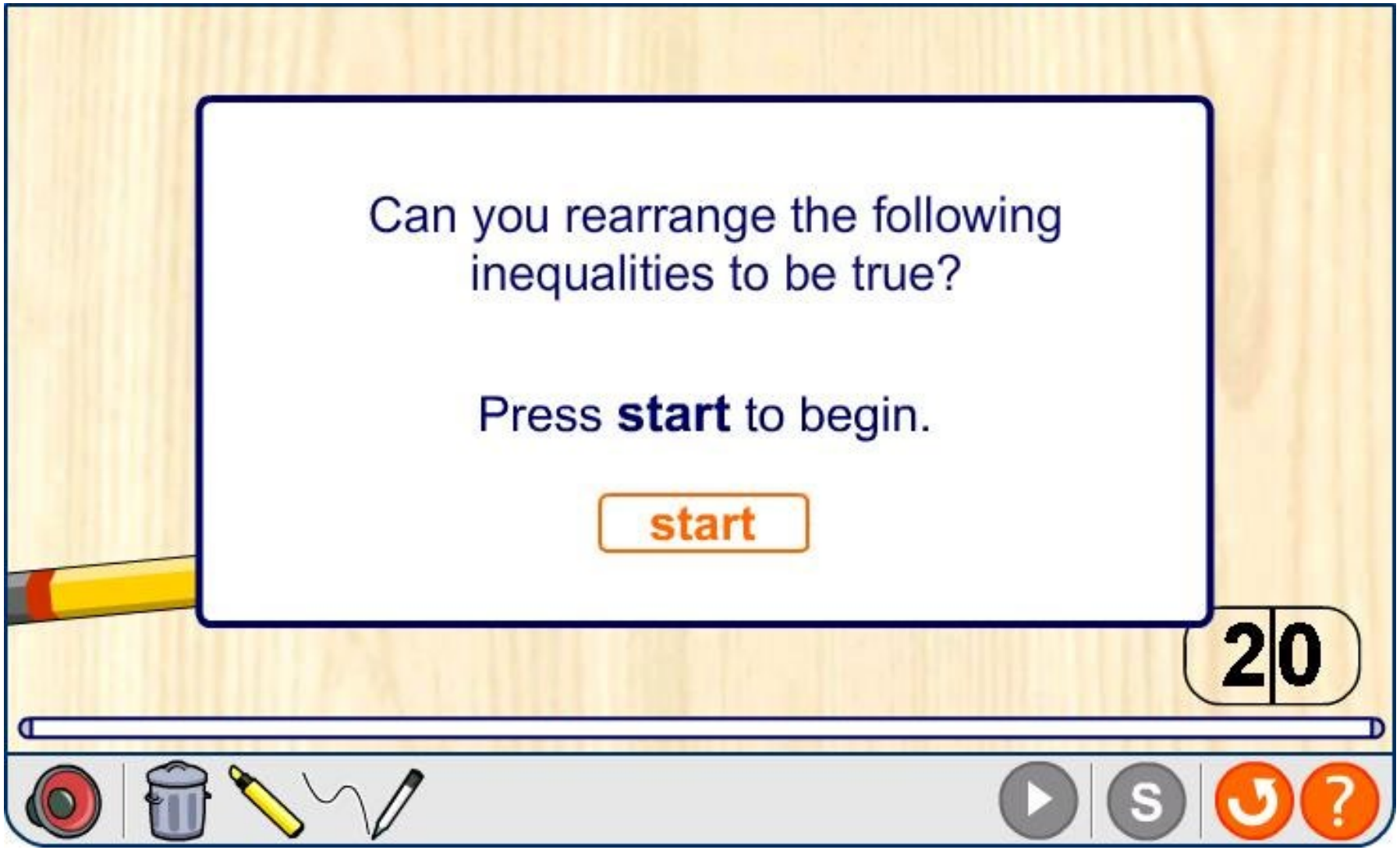
$x > 3$	means	"x is **greater than** 3."
$x < -6$	means	"x is **less than** –6."
$x \geq -2$	means	"x is **greater than or equal to** –2."
$x \leq 10$	means	"x is **less than or equal to** 10."

Think of the symbols as a crocodile's mouth. The crocodile will always eat the **bigger** number.

$3 < 5$



Inequality symbols



Integer solutions

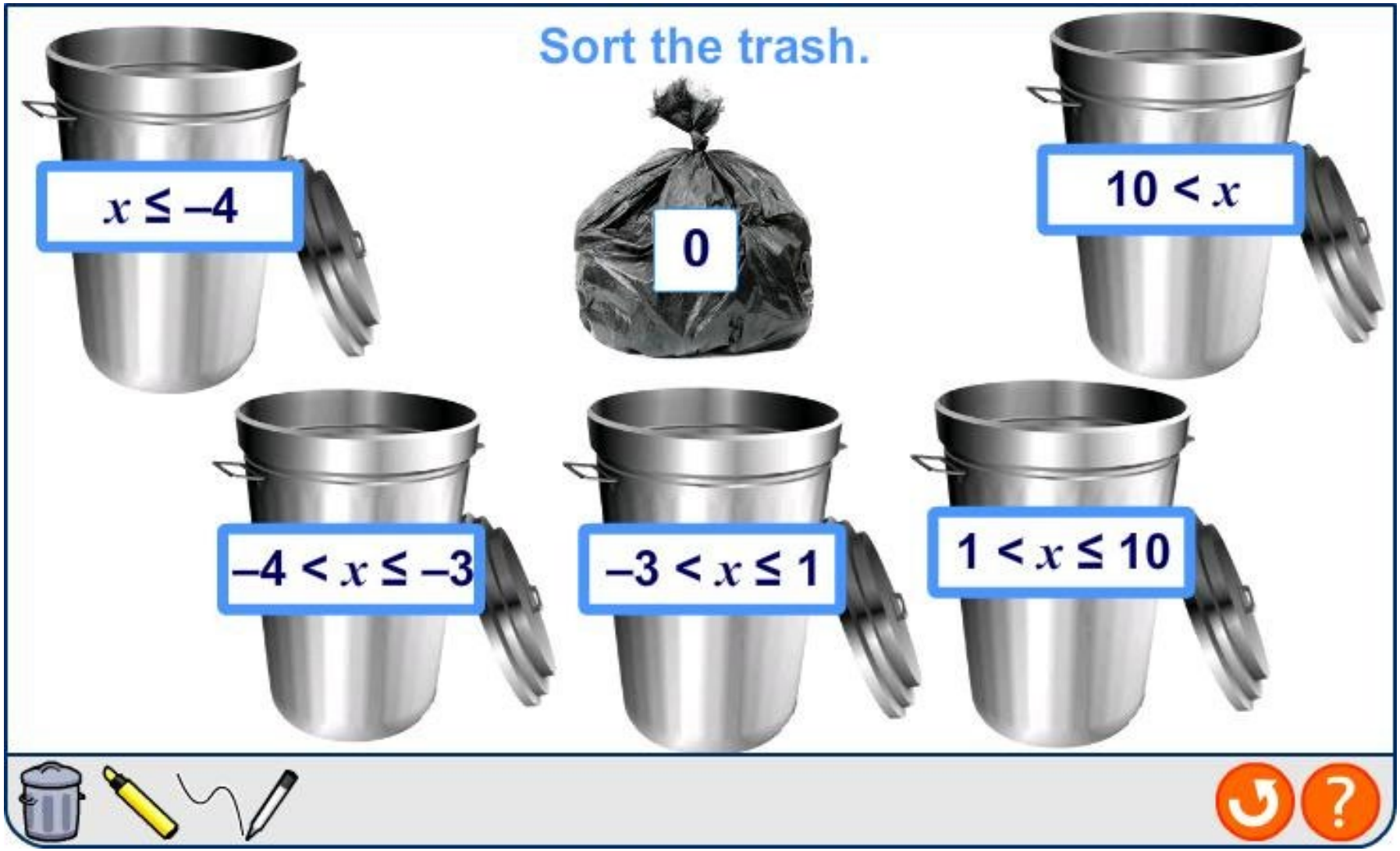
x can be any real number. In some problems, however, x must come from a specified set, for example, the set of integers.

List the integer values that satisfy this inequality:
$-3 < x \leq 5$

The integer values that satisfy this inequality are:

$-2, \quad -1, \quad 0, \quad 1, \quad 2, \quad 3, \quad 4, \quad 5.$

Sorting practice



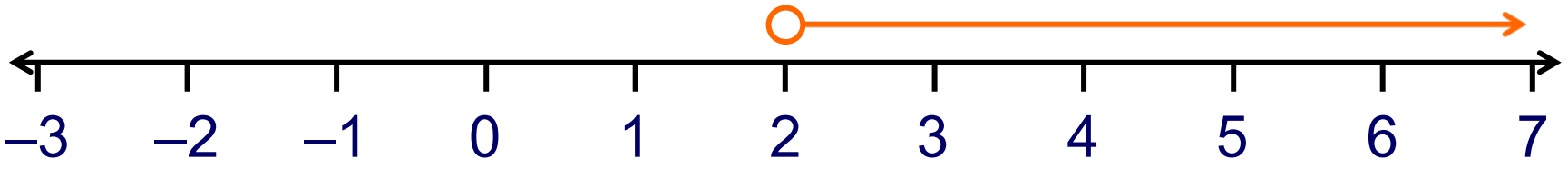
Inequalities and number lines

If $x > 2$, there are an infinite number of values that x could have.

x could be equal to: 3, 7.3, $54\frac{3}{11}$, 18463.431…

It would be impossible to write every solution down.

We therefore represent the **solution set** using a number line:

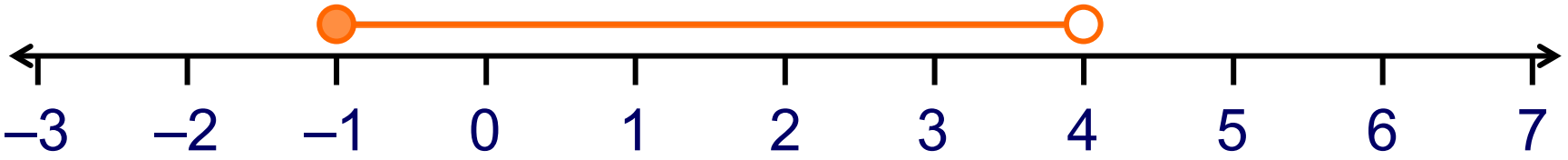


The arrow at the end of the line shows that the solution set extends in the direction shown.

Inequalities and number lines

What if $-1 \leq x < 4$? How would you represent this inequality using a number line?

Although x is between two values, there are still an infinite number of values that x could have.



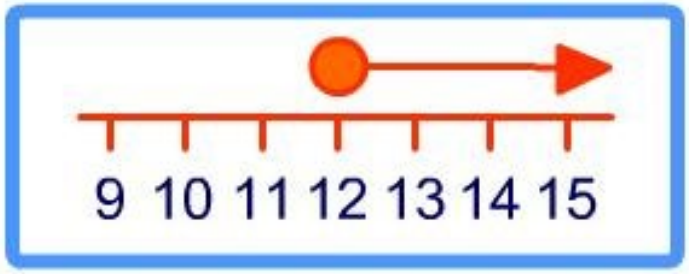
We represent the solution set using two circles.

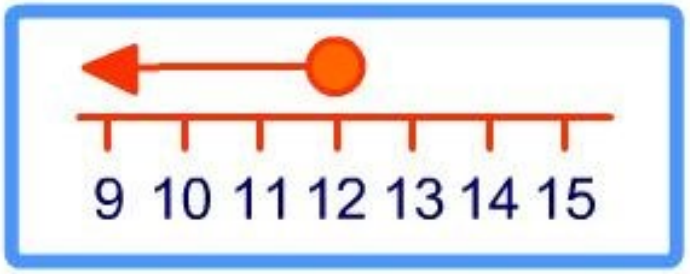
- A closed circle, ●, means this number **is included**.
- An open circle, ○, means this number is **not** included.

Number line practice

Choose the number line that represents the inequality described below.

I can fit at least 12 marshmallows in my mouth.





Solving linear inequalities

What values of x would make $x + 3 \geq 7$ true?

We can solve this inequality the same way as we would solve an equation.

$$x + 3 \geq 7$$

Subtract 3: $x + 3 - 3 \geq 7 - 3$

$$x \geq 4$$

Any value of x greater than or equal to 4 would solve this inequality.

The solution has the variable on one side of the inequality sign and a number on the other.

How could we check this solution?

Checking solutions

Check that $x \geq 4$ is the solution to $x + 3 \geq 7$.

1. Substitute a value just **above 4** into the inequality.

If we substitute $x = 5$ into the inequality we have:

$$5 + 3 > 7$$

$$8 > 7$$

This is true.

2. Substitute a value just **below 4** into the inequality.

If we substitute $x = 3$ into the inequality we have:

$$3 + 3 > 7$$

$$6 > 7$$

This is not true.

Multiplying or dividing by negatives

What happens when we multiply or divide both sides of an inequality by a negative value?

This inequality is true: $-3 < 5$

Multiply both sides by –1: $-3 \times -1 < 5 \times -1$

$3 < -5$ ✗

3 is not less than –5.

$3 > -5$ ✓

When we multiply or divide by a negative number, we have to **reverse** the inequality sign.

Multiplying or dividing by negatives

Solve $4 - 3x \leq 10$.

subtract 4 from both sides: $-3x \leq 6$

divide both sides by –3: $x \geq -2$

The inequality sign is reversed.

How else could we solve this type of inequality?

$$4 - 3x \leq 10$$

add $3x$ to both sides: $4 \leq 10 + 3x$

subtract 10 from both sides: $-6 \leq 3x$

divide both sides by 3: $-2 \leq x$

$$x \geq -2$$

Solving inequalities practice

Solve the inequality and check your answer.

Question 1: $2x + 1 > x + 6$

Click the "=" button to show the solution step by step.

- $x > 5$
- $x < 5$
- $x \leq 5$
- $x \geq 5$

Shopping example

I have $100 in my wallet. I want to buy two pairs of shoes for $29 each, and as many pairs of socks as possible for $4 each.

How many pairs of socks can I buy?

Let's call the number of socks "s."

$$2 \times 29 + 4s \leq 100$$

$$58 + 4s \leq 100$$

$$4s \leq 42$$

$$s \leq 10.5$$

I cannot buy 0.5 of a pair of socks, so s must be the highest **integer** that is less than 10.5.

How many pairs of socks could I buy if I had $80?

Party example

I have $50 to spend on a party. I buy 3 bottles of soda for $1.28 each, and as many bags of chips as possible for $2 each.

How many bags of chips can I afford?

$$3 \times 1.28 + 2c \leq 50$$

$$3.84 + 2c \leq 50$$

$$2c \leq 46.16$$

$$c \leq 23.08$$

I can buy 23 bags of chips.

The store is having a sale: if you buy two bags of chips, you get a third bag free.

How many bags of chips can I afford now?