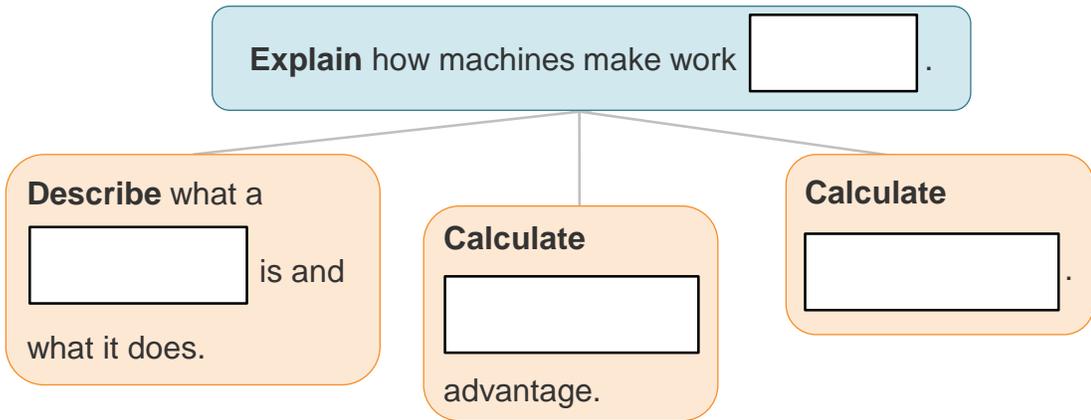




**Lesson Question**



**Lesson Goals**



**Words to Know**

*Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.*

- |                            |   |
|----------------------------|---|
| _____ input                | A. a comparison of two amounts calculated by dividing one amount by the other |
| _____ output               | B. the amount of something put into a machine or system                       |
| _____ ratio                | C. the amount of something that comes out of a machine or system              |
| _____ efficiency           | D. the ratio of output force to input force                                   |
| _____ machine              | E. the ratio of output work to input work expressed as a percentage           |
| _____ mechanical advantage | F. a device that makes work easier  |

**Work**

- Work is done by a  on an object.
- For work to be done, the object must  in the direction of the force.
- The formula for work is .
- Work is measured in  (J).

Slide

2

**Machines and Work**

- A  is any device that makes work easier.
- Machines change the way a force is .
- Machines do not change the amount of  done.

- A machine makes work  by changing:
  - the  of a force.
  - the  of force exerted.
  - the  over which a force is exerted.

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**Inputs and Outputs**

- The force applied to a machine is the  force.
- The force the machine applies on an object is the  force.
- Input work is the amount of work done on a .
- Output work is the amount of work the machine does on an .

Slide

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**Mechanical Advantage**

- The number of times a machine increases the input force is known as its .
- A  is the comparison of two amounts calculated by dividing one amount by the other.
- Mechanical advantage is the  of output force to input force.

$$\text{mechanical advantage} = \frac{\text{output force}}{\text{input force}}$$

**Mechanical Advantage: Example**

Nina pulls on the handle of a hammer with a  of 15 N. The claw end of the hammer exerts a force of 90 N on a nail. What is the mechanical advantage of the hammer?

MA =

Slide

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**Input and Output Forces**

- When mechanical advantage and input force are known, the  force can be calculated.
- When mechanical advantage and output force are known, the  force can be calculated.
- **Example:** A machine has a mechanical advantage of 2.7. What input force is needed to create an  of 1,350 N?  
input force =

10

**Machines and Friction**

- The output work of a machine can never be  than the input work.
- uses some of the input work.
  - The output work can be  by reducing the amount of friction.

Slide

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**Efficiency**

- The ratio of the output work to input work is the machine's .
- Efficiency is expressed as a .
- Some work is always lost to friction, so efficiency is always  than .

$$\text{efficiency} = \frac{\text{output work}}{\text{input work}} \times 100\%$$

**Efficiency: Example**

An Olympic bicyclist does 7,500 J of work on his bike while the bike does 7,350 J of work. What is the efficiency of the bike?

efficiency =

# Summary

## Introduction to Machines



### Lesson Question

How do machines make work easier?



### Answer

Slide

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### Review: Key Concepts

- Machines make work easier by changing the way a  is applied.
- A machine can change:
  - the  of a force.
  - the  of force applied.
  - the  over which a force is applied.
- Machines do not change the amount of  done.

	Definition	Equation
Mechanical advantage	The ratio of a machine's output force to input force	Mechanical advantage = <input type="text"/>
Efficiency	The ratio of a machine's output work to input work expressed as a percentage	efficiency = <input type="text"/>



# Summary

## Introduction to Machines

*Use this space to write any questions or thoughts about this lesson.*