

LEGO GEARS

Date: ___/___/___

Period ___

Team members:

1. KEY 2. _____

In this activity you will be learning about how power is transmitted from an input (human or electrical power) to an output such as the wheels of a car. You will be using the Lego 1032 kit (blue box) to build models to demonstrate the principles of power transmission. It is important that you work as a team to complete this activity.

You must fill out your inventory sheet before you begin work each day and have it checked in by your teacher before you return the kit to the cabinet at the end of the period.

Task 1

In this task you will learn how a sprocket and chain drive work using chains and various sizes of gears. You will also see the effect of using different size gears. Build the models on the inside of **Card 7**.

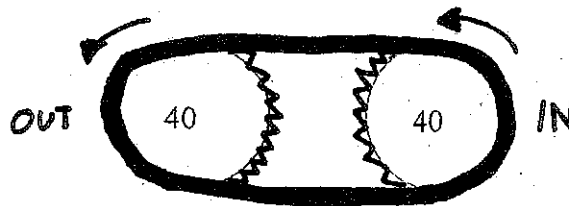
The **white model** uses gears that are both the same size. What do you notice about the speeds of the output gear compared to the input gear?

THEY ARE THE SAME.

How many times does the output gear turn when the input gear is turned once? ONE

$$40 / 40 = 1:1$$

$$40 \overline{)40}$$

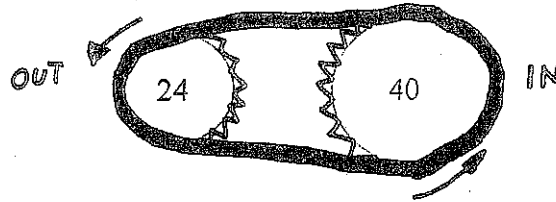


app. []

The yellow model has a smaller output gear. What do you notice about the speed of the output gear compared to the input gear? THE OUTPUT GEAR IS FASTER.

How many times does the output gear turn when the input gear is turned once? 1.66

$$40 / 24 = 1.66$$
$$24 \overline{)40}$$

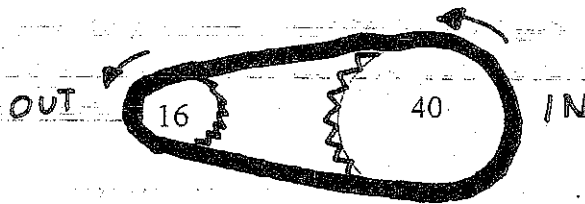


5 app. []

The red model has an even smaller output gear. What do you notice about the speed of the output gear compared to the input gear?

IT IS FASTER

$$40 / 16 = 2.5$$
$$16 \overline{)40}$$



How many times does the output gear turn when the input gear is turned once? 2.5

5 app. []

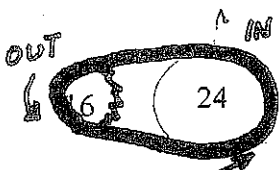
Task 2

In this task you will be building vehicles powered by a chain and sprocket power transmission system. You will discover how various size gears will effect the speed of you vehicle. Build the models on the inside of **Card 8**.

The motor used on the models will turn at about 6000 revolutions per minute, much too fast to power a vehicle. The **white model** is **geared down**, but only a little so it should be a very quick car. The **yellow model** uses two chains and a *lay-shaft* to get even more reduction and a slower speed. A **geared down** car will travel slower, but have more power. A **geared up** car will travel faster but have less power.

Before you get approval for the yellow model you must calculate the final gear ratio and explain the difference between geared up and geared down.

15 White model app. []  $24 / 16 = 1.5$
 $16 \overline{)24}$

10 Yellow model app. []  $24 / 16 = 1.5$
 $16 \overline{)24}$

Final Ratio = 2.25 : 1

Task 3

In this task you will learn how gears can be used to increase or decrease movement and forces. Build the models on the inside of **Card 9**.

The **white model** uses gears to magnify or increase the turning force of the input wheel. A side effect of this increased force is that it will turn much slower at the output end.

What is the function of the floppy grey part at the top of the white model?

THE FLOPPY GRAY PART IS KNOWN AS A PAWL. THE PAWL IS USED TO PREVENT MOTION IN A PARTICULAR DIRECTION.

The floppy gray part is called a PAWL.

What is the gear ratio? 5 : 1

15 white model app. []

Task 4

In this task you will learn more about how gears can be used to increase or decrease movement and forces. The models on the inside of **Card 10** show how reduction gears are used to decrease speed but increase force (*geared down*).

Build the **white model**. The small input gear has 8 teeth, the larger output gear has 24 teeth so the ratio of reduction is 24 : 8 or 3 : 1. Another way to say this is that the output gear will turn at 1/3 the speed of the input gear but with 3 times the force.

If the input gear is turned 9 times how many times will the output gear turn? 3

15 White model app. []

Build the **yellow model**, it is a continuation of the white model and there is no need to start from scratch. This model has more reduction gears and will turn even slower but with much more force.

Can you calculate the reduction ratio for this model? 9 : 1

10 Yellow model app. []

If time permits build the **red model** and then add the motor as in the blue model.

What is the gear ratio of this model? 27 : 1

10 Blue model app. [] (optional)

Task 5

In this task you will learn what a worm gear is and how it is used.

Build the models on the inside of **Card 11**.

Build the **white model**.

Notice that one turn of the **worm gear** moves the large gear only one tooth forward.

The large output gear has 40 teeth, can you calculate the reduction ratio? 40 : 1

10 **White model app. []**

Build the **yellow model**. Is the reduction ratio the same? **YES** NO

If the answer is no, what is the new ratio? _____

Yellow model app. []

Build the **red model**. The output gear in this model has 24 teeth.

The output speed is now **faster/slower** than the previous model.

What is the new gear ratio? 24 : 1

5 **Red model app. []**

If time permits build the **blue model**. Notice how the worm gear can be used to drive two output gears at the same time. These small output gears have 8 teeth, can you calculate the reduction ratio? Be careful, think before you answer. 8 : 1

5 **Blue model app. []**
(optional)

Task 6

In this task you will learn how **bevel gears** or a **crown wheel** and **pinion** can be used to transmit power through a right angle. Use the Inside of **Card 13**.

Build the **white model**. The model on card 11 used a worm gear to move power through a right angle but had a large reduction in speed. This model shows how to "turn a corner" without losing so much speed.

Be prepared to identify the **bevel gears** and the **crown wheels** and **pinions** used in this model. Also use the dictionary to see what the definition of **bevel** is.

10 app. []

Bonus Points

Card Number

Points

app. []

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