

# PRECESSIONAL MOTION OF A BICYCLE WHEEL GYROSCOPE

MED 09.17



## Material

Item-no.	Qty.	Description
DS101-1G	1	Support base, large, L=500 mm
DM352-1H	1	Clamp socket with bearing cup
DM351-1F	1	Bicycle wheel gyroscope
DM352-2A	1	Cord for spinning with handle

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## Purpose

To demonstrate the precessional motion of a bicycle wheel gyroscope.

## Preparation

Position the clamp socket with bearing cup in the centre of the support base.  
Remove the handle from the axis (at the side with the cord groove).

## Experiment 1

One student holds the bicycle wheel gyroscope in horizontal position.

Insert the end of the cord into the dedicated groove; the cord should be held with a little bit tension and wound up afterwards by turning the bicycle wheel gyroscope by another student.

Now one student holds the bicycle wheel gyroscope firmly at the handle and the metal axis while the other one pulls as fast and strong as possible on the cord so that a large angular momentum is created on the bicycle wheel gyroscope.

Place the rotating bicycle wheel gyroscope (with horizontal axis) in the bearing cup of the clamp socket as shown on the image.

## Result

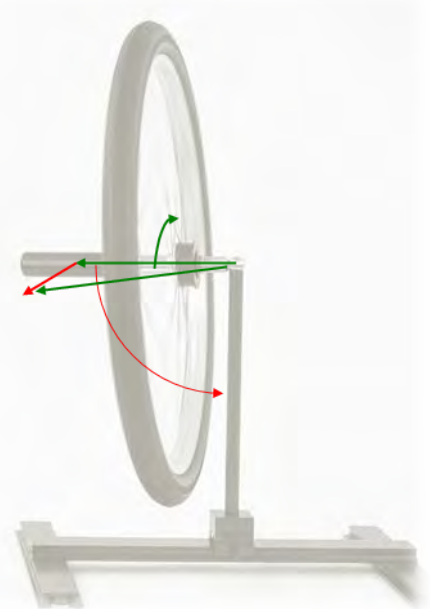
The fast rotating bicycle wheel gyroscope stays in vertical position. Furthermore the axis of the gyroscope rotates around a perpendicular line through the point of support. This slow rotation is called precessional motion.

The **torque** of the rotating gyroscope is changed by the **angular momentum** of the force of weight.

The frequent change (every second) of the angular momentum (vector) is equal to the torque vector.

Its direction is given by the corkscrew rule as it is also the case with the angular momentum vector.

As the weight turns the gyroscope downwards the torque vector lies horizontally and therefore the angular momentum vector also changes horizontally.



## Experiment 2

The axis of the gyroscope is now placed vertically or diagonally on the bearing cup.

If the attacking torque is zero because the centre of gravity of the gyroscope lies exactly above the point of contact then the angular momentum vector does not change.

In the case of the inclined axis the change in angular momentum occurs again in the horizontal. The axis of the gyroscope describes a cone with the tip at the point of support; it is called a precession cone.

## Note

This "reaction" of the gyroscope to the attacking torques plays an important role for stable driving with two-lane vehicles.