Name: _____ Date: _____

Why Your Car Wheels Need to Disagree in a Turn

Circle group

Think about driving around a sharp corner. The car goes along a curve. The wheels on the outside travel along a bigger circle than the wheels on the inside. So the outer wheel goes farther than the inner wheel in the same time. If both wheels were fixed to one solid axle, they would have to turn at the same speed. One tire would have to skid on the road. That would wear out the tires and make steering hard.

The fix is a set of gears called a differential. On most cars, the engine turns a shaft, and the shaft turns a big ring gear. A small cage is bolted to the ring gear. Inside the cage are a few little gears that spin freely. Each drive wheel has its own half of the axle. Each half ends in a gear that fits with the little gears.

On a straight road, the little gears just ride along, and both wheels turn together. In a corner, the road holds the inner wheel back a little. The little gears start to turn. The outer wheel can turn faster, and the inner wheel can turn slower. The wheels share the power, but they do not have to share the speed.

The design has one weak spot. If one tire is on ice, it can spin fast while the other tire gets almost no push. Engineers made limited-slip differentials to fix this. They stop big speed gaps between the wheels.

Questions

1. Why does the outer wheel go farther in a turn?

_____

_____

2. What would happen if both wheels were fixed to one solid axle?

_____

_____

3. Where are the little gears of a differential?

_____

_____

4. What do the little gears do on a straight road?

_____

_____

5. Why can a plain differential be a problem on ice?

_____

_____

6. How does a limited-slip differential help?

_____

_____

Words to know

differential: a set of gears that lets two wheels turn at different speeds
axle: the rod that a pair of wheels turns on

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

Why Your Car Wheels Need to Disagree in a Turn

Triangle group

Imagine driving around a tight corner. The car follows a curved path, so the wheels on the outside of the curve must travel along a bigger circle than the wheels on the inside. That means the outer wheel covers more ground than the inner wheel in the same amount of time. If both wheels were locked to a single solid axle, they would be forced to turn at exactly the same speed. One tire would have to skid or hop across the pavement, which would wear the tires and make steering harder.

The solution is an ingenious arrangement of gears called a differential. On most cars, the engine's power reaches the drive wheels through a shaft that turns a large ring gear, and bolted to that ring gear is a small cage holding a few little gears that can spin freely. Each drive wheel has its own half of the axle, and each half ends in a gear that meshes with the little gears inside the cage.

On a straight road, the little gears simply ride along with the cage, and both wheels turn together. In a corner, the road holds the inner wheel back slightly. The little gears begin to rotate, which lets the outer wheel turn faster while the inner wheel turns slower. The power is shared between the wheels, but their speeds are free to differ.

The design does have one weakness. If one tire rests on slippery ice, it can spin rapidly while the other tire, on dry ground, receives almost no push. To correct this, engineers created limited-slip differentials, which resist large differences in speed between the two wheels.

Questions

1. Why does the outer wheel travel farther in a turn?

_____

_____

2. What would happen if both wheels were locked to one solid axle?

_____

_____

3. Where do the little gears of a differential sit?

_____

_____

4. What do the little gears do on a straight road?

_____

_____

5. Why can a plain differential be a problem on ice?

_____

_____

6. How does a limited-slip differential improve the design?

_____

_____

Words to know

differential: a set of gears that lets two wheels turn at different speeds
axle: the rod that a pair of wheels turns on
mesh: to fit together, as the teeth of gears do
pavement: the hard surface of a road
resist: to work against or hold back

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

Why Your Car Wheels Need to Disagree in a Turn

Square group

Imagine steering a car around a tight corner. The vehicle follows a curved path, so the wheels on the outside of the curve must travel along a considerably bigger circle than the wheels on the inside. That means the outer wheel has to cover more ground than the inner wheel in exactly the same amount of time. If both wheels were locked to a single solid axle, they would be forced to turn at an identical speed, and one of the tires would have to skid or hop across the pavement. The result would be accelerated tire wear and steering that felt stiff and unwilling.

The solution is an ingenious arrangement of gears called a differential. On most cars, the engine's power reaches the drive wheels through a shaft that turns a large ring gear. Bolted to that ring gear is a small cage holding a few little gears that are free to spin. Each drive wheel has its own half of the axle, and each half ends in a gear that meshes with the little gears inside the cage.

On a straight road, the little gears simply ride along with the cage, and both wheels turn together. Around a corner, however, the road holds the inner wheel back slightly. The little gears begin to rotate, which lets the outer wheel turn faster while the inner wheel turns slower. The power is shared between the wheels, but their speeds are free to differ.

The design does have one notable weakness. If one tire rests on slippery ice, it can spin rapidly while the other tire, on dry ground, receives almost no push. To correct this problem, engineers created limited-slip differentials, which resist large differences in speed between the two wheels.

Questions

1. Why must the outer wheel cover more ground in a turn?

_____

_____

2. What would happen if both wheels were locked to one solid axle?

_____

_____

3. Where do the little gears of a differential sit?

_____

_____

4. What do the little gears do on a straight road?

_____

_____

5. Why can a plain differential be a weakness on slippery ice?

_____

_____

6. How does a limited-slip differential improve on the basic design?

_____

_____

Words to know

differential: a set of gears that lets two wheels turn at different speeds
axle: the rod that a pair of wheels turns on
mesh: to fit together, as the teeth of gears do
pavement: the hard surface of a road
resist: to work against or hold back

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

For the teacher: Why Your Car Wheels Need to Disagree in a Turn

Each student sheet carries a shape, not a level. The same topic and facts, written three ways.

Circle: Why Your Car Wheels Need to Disagree in a Turn

Easier · 248 words · Flesch-Kincaid grade 3.2

1. It travels along a bigger circle than the inner wheel.
2. One tire would have to skid on the road.
3. Inside a small cage bolted to the ring gear.
4. They ride along, and both wheels turn together.
5. The wheel on ice spins freely while the wheel with grip gets little push.
6. It stops big speed gaps, so the wheel with grip still gets power.

Triangle: Why Your Car Wheels Need to Disagree in a Turn

This passage · 275 words · Flesch-Kincaid grade 7.4

1. It follows a bigger circle than the inner wheel.
2. One tire would have to skid or hop across the pavement.
3. Inside a small cage bolted to the ring gear.
4. They ride along with the cage, and both wheels turn together.
5. The wheel on ice spins freely while the wheel with grip gets little power.
6. It resists big differences in wheel speed, so the wheel with grip still gets power.

Square: Why Your Car Wheels Need to Disagree in a Turn

Harder · 291 words · Flesch-Kincaid grade 7.9

1. It travels along a considerably bigger circle than the inner wheel.
2. One of the tires would have to skid or hop across the pavement.
3. Inside a small cage bolted to the ring gear.
4. They ride along with the cage, and both wheels turn together.
5. The wheel on ice spins rapidly while the wheel with grip receives almost no push.
6. It resists large speed differences, so the wheel with grip still gets power.