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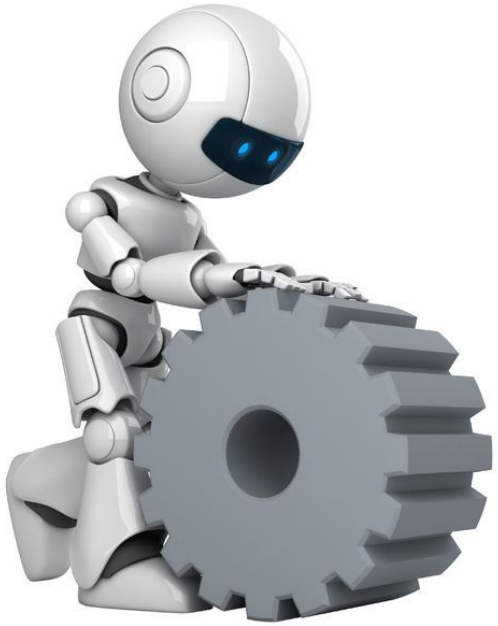
ROBOTICS CLUB

Today in Robotics: Actuation and Motor Mechanics

Fun With Robots
Spring 2026

What is “Actuation”?

- “To put into mechanical action or motion - to move into action”
- Your robot will move a servo and influence the outside world.
  - In previous labs, your robot acted using information from the outside world but did not influence it.



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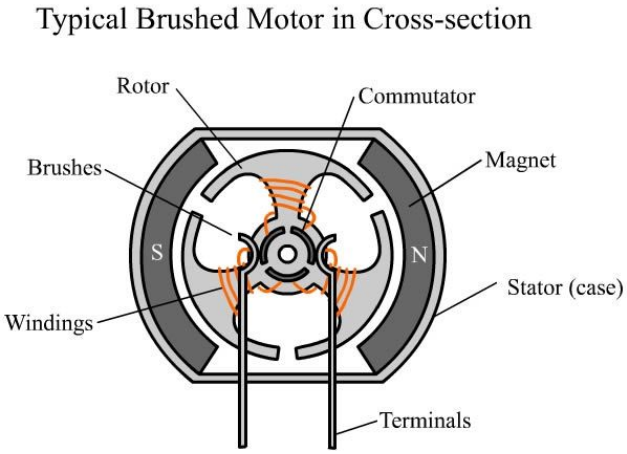
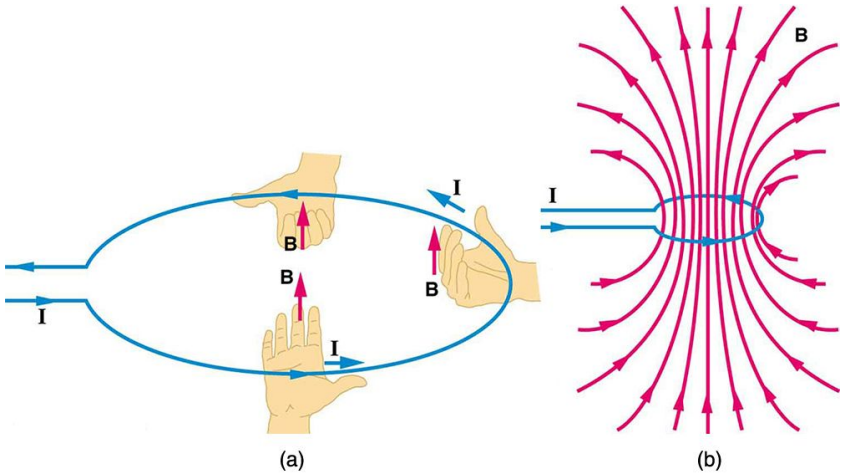
How Do Things Move?

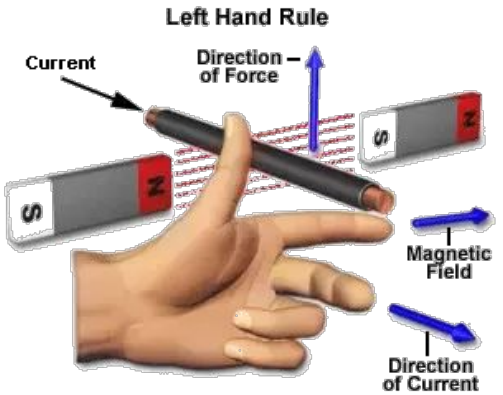
- **Motors!**
- Pneumatics
- Hydraulics
- Solenoids

How Do Motors Work?

- In a motor, a current through a wire loop in a magnetic field creates a torque, which can spin that wire loop.
- This can be controlled using brushes or a controlled electrical impulse.
- In conjunction with permanent magnets, makes the motor shaft turn.







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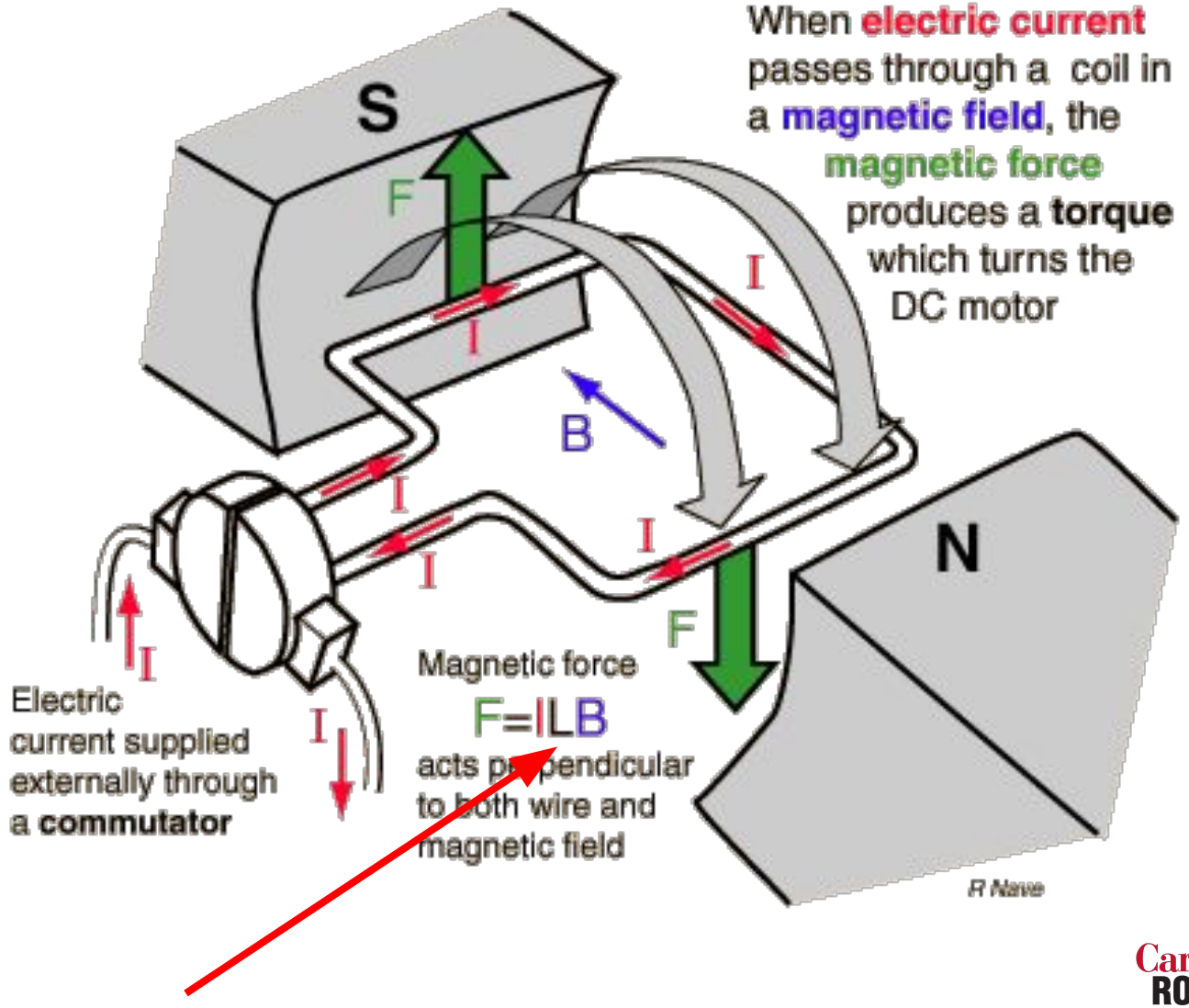
More Diagrams:



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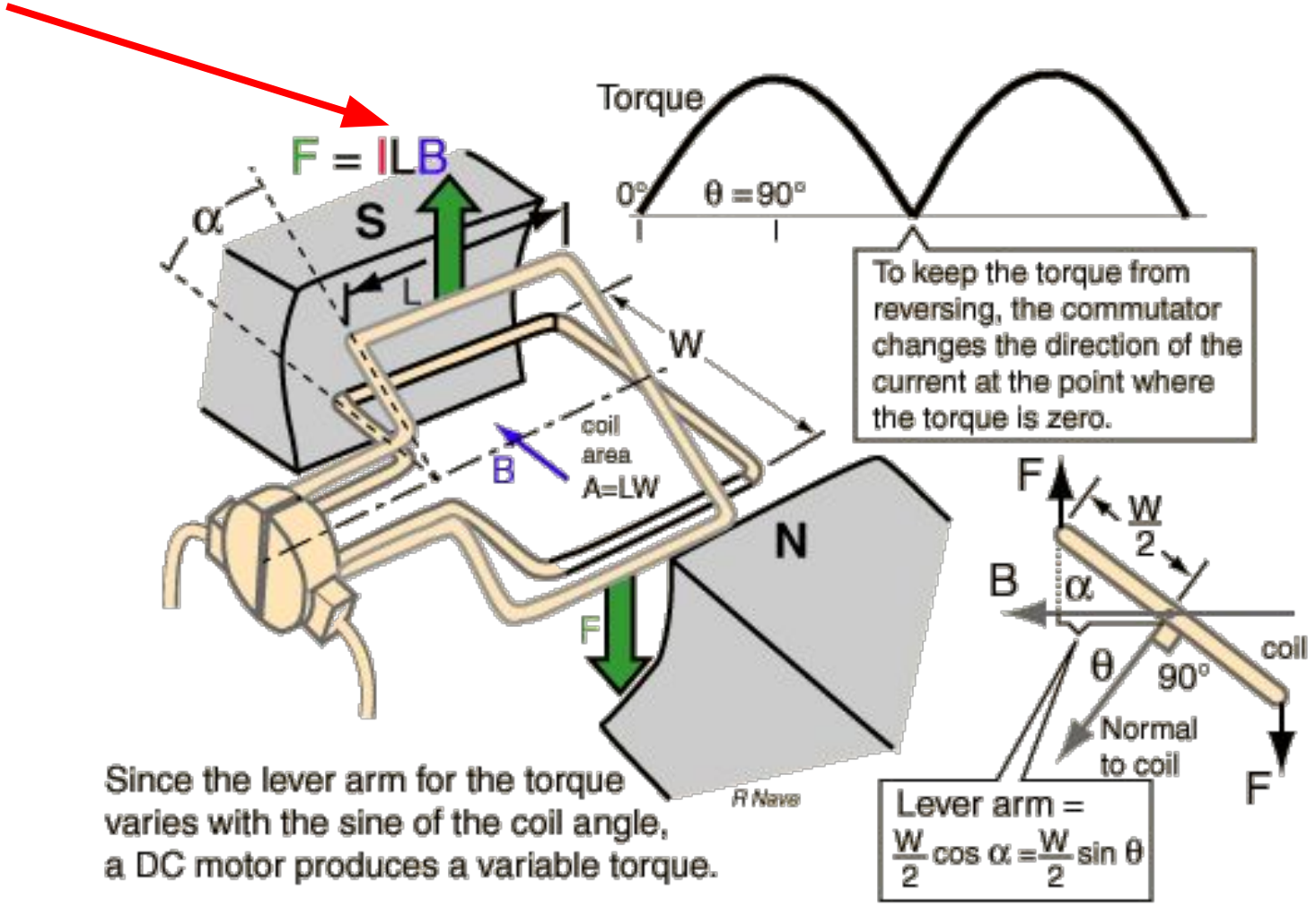
More Diagrams!



Since the lever arm for the torque varies with the sine of the coil angle, a DC motor produces a variable torque.

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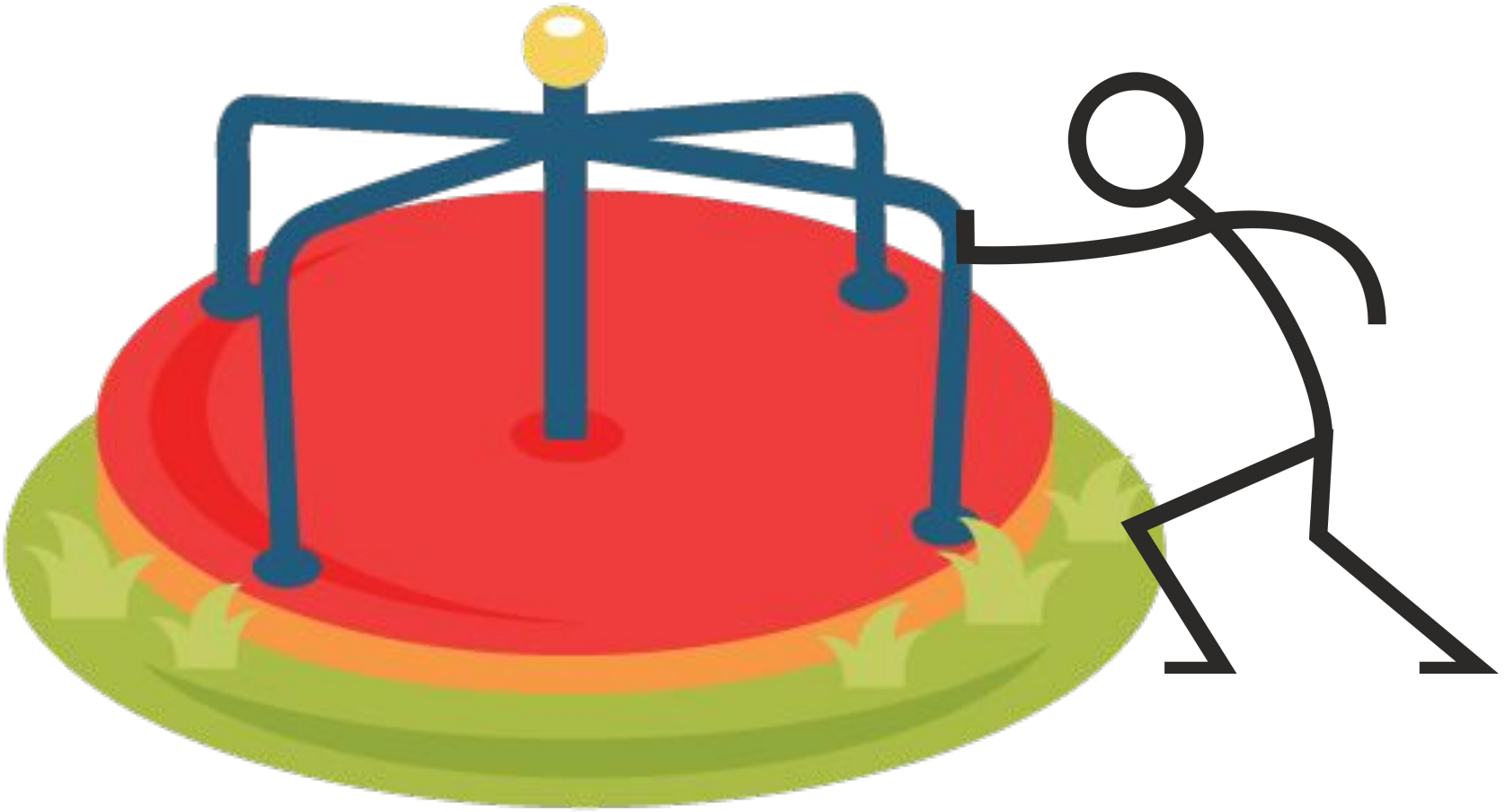
Analogy!



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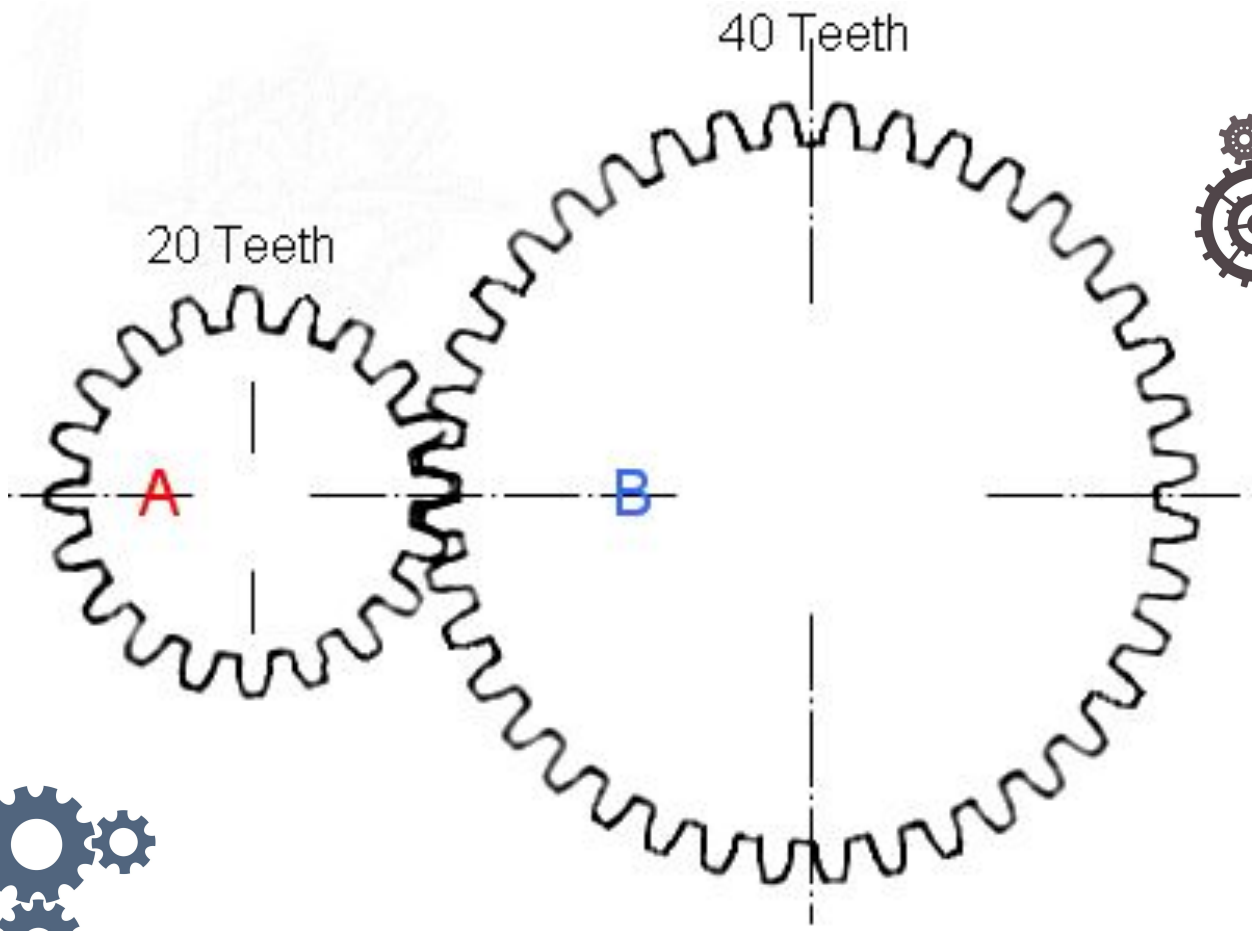
Gearing



Your robot has a 120:1 gear (reduction) ratio for increased strength!

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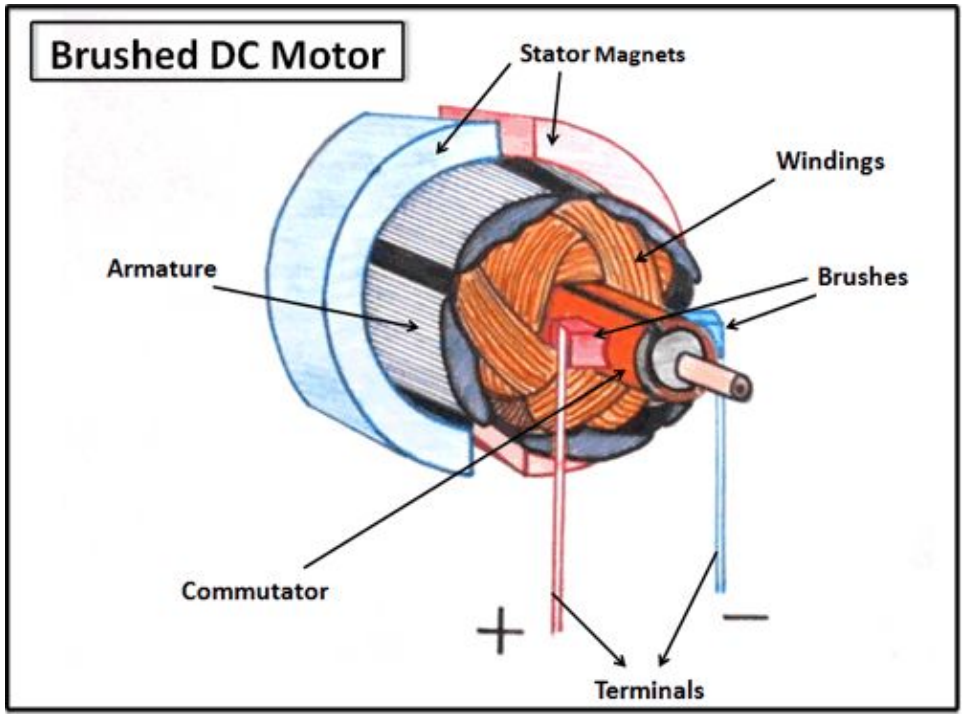
Actuation: Types of Motors

- DC vs AC
- Brushed vs Brushless
- Stepper
- Servo

Basic Motor: Brushed DC

- Current flowing in coil generates electric field
- Interacts with permanent magnets and spins
- Requires commutation and brushes



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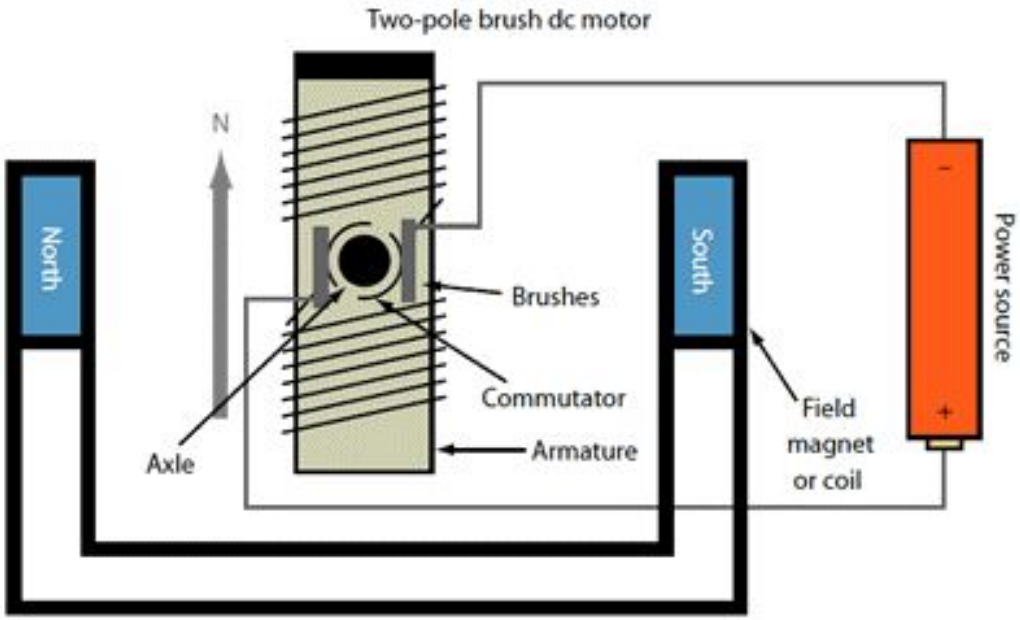
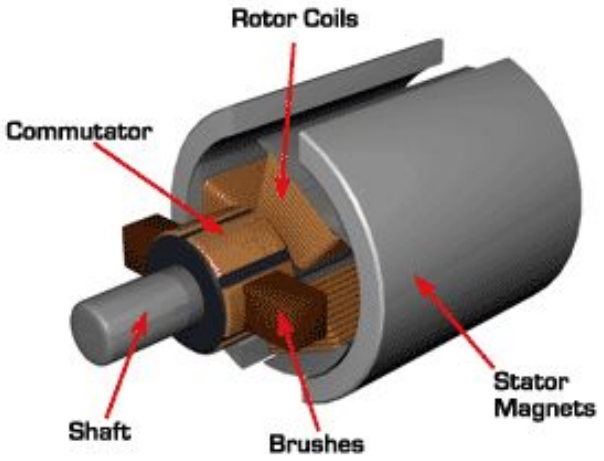
Basic Motor: Brushed DC

- The brushes control the orientation of the current.
- When the motor spins 90 degrees, the brushes connect to different parts of the commuter bar and different coils, changing which coils are powered and magnetic.
- The motor continues to spin in the same direction rather than reversing.





Basic Motor: Brushed DC

- Speed ~ Voltage
- Simple control
- Cheap
- Very fast, not powerful
- **Needs gearing!**