



Mechanisms

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Overview

Manipulating Game Objects

● Collection Systems

- Intake Rollers
- Conveyors
- Claws
- Fixed, passive devices

● Positioning Methods

- Arms (rotating)
- Telescoping lifts
- 4-bar mechanisms

Look at your object!

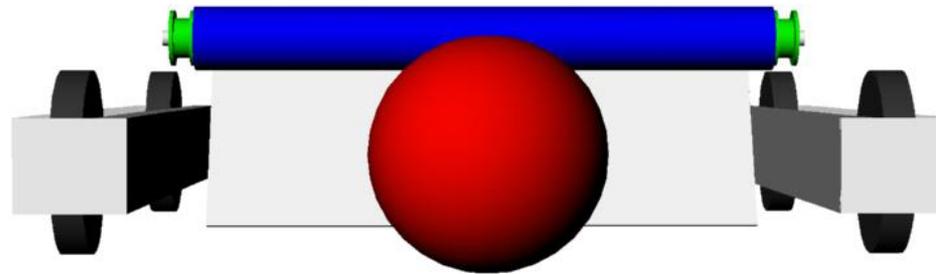
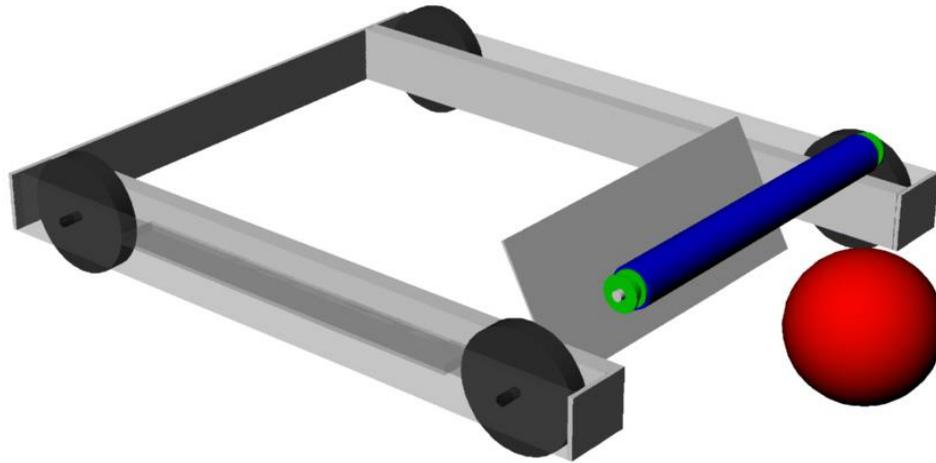
- Answer these questions *first*
 - Is it heavy?
 - Does it take up a large space?
 - Is it fragile?
 - Does the orientation matter?
 - Where is it? (floor, platform, human player)

Intake Rollers



- Rotating cylinders designed to contact and move your game object
- Commonly used to pick up balls from the floor
- Horizontal or vertical

Intake Rollers



Intake Rollers

● Advantages

- Lightweight
- Pickup multiple objects quickly
- Large room for driver error
- Simple
 - Few parts to break

● Disadvantages

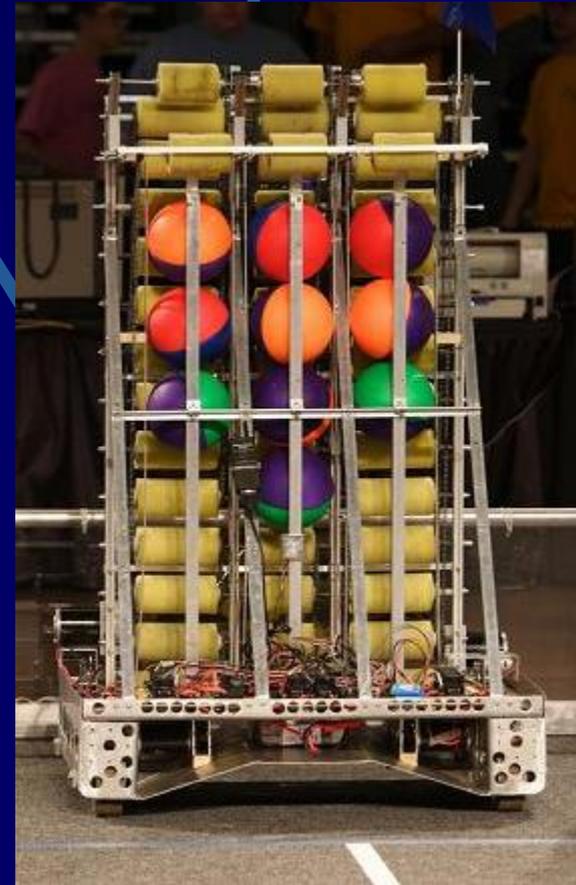
- Works best for balls
- Conveyors difficult to stay on reliably
- Can cause jamming
- Requires chassis space near floor

Conveyors

- Effective with rollers at picking up and MOVING objects
- A flat, wide, moving belt
- Series of smaller belts in parallel



Examples

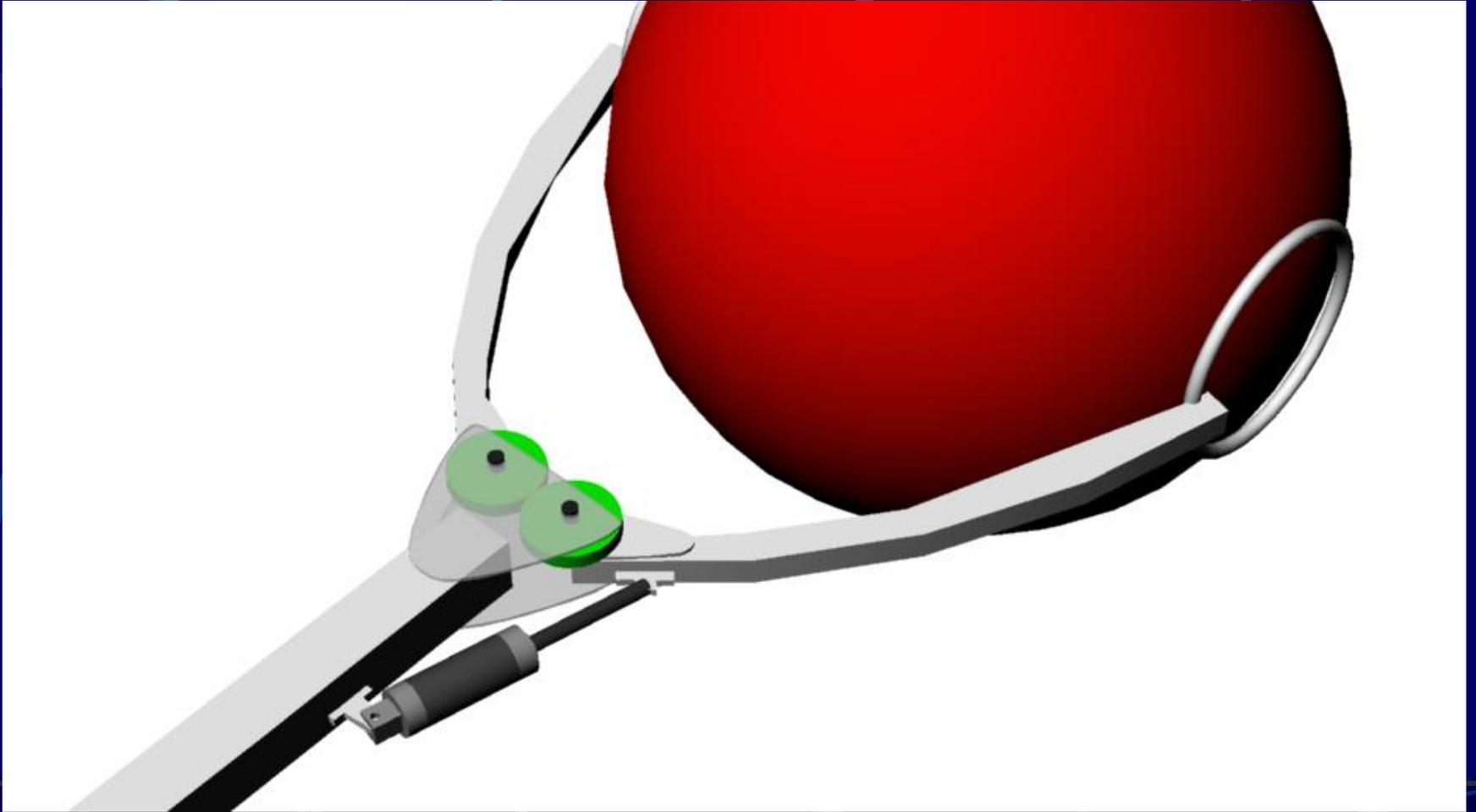


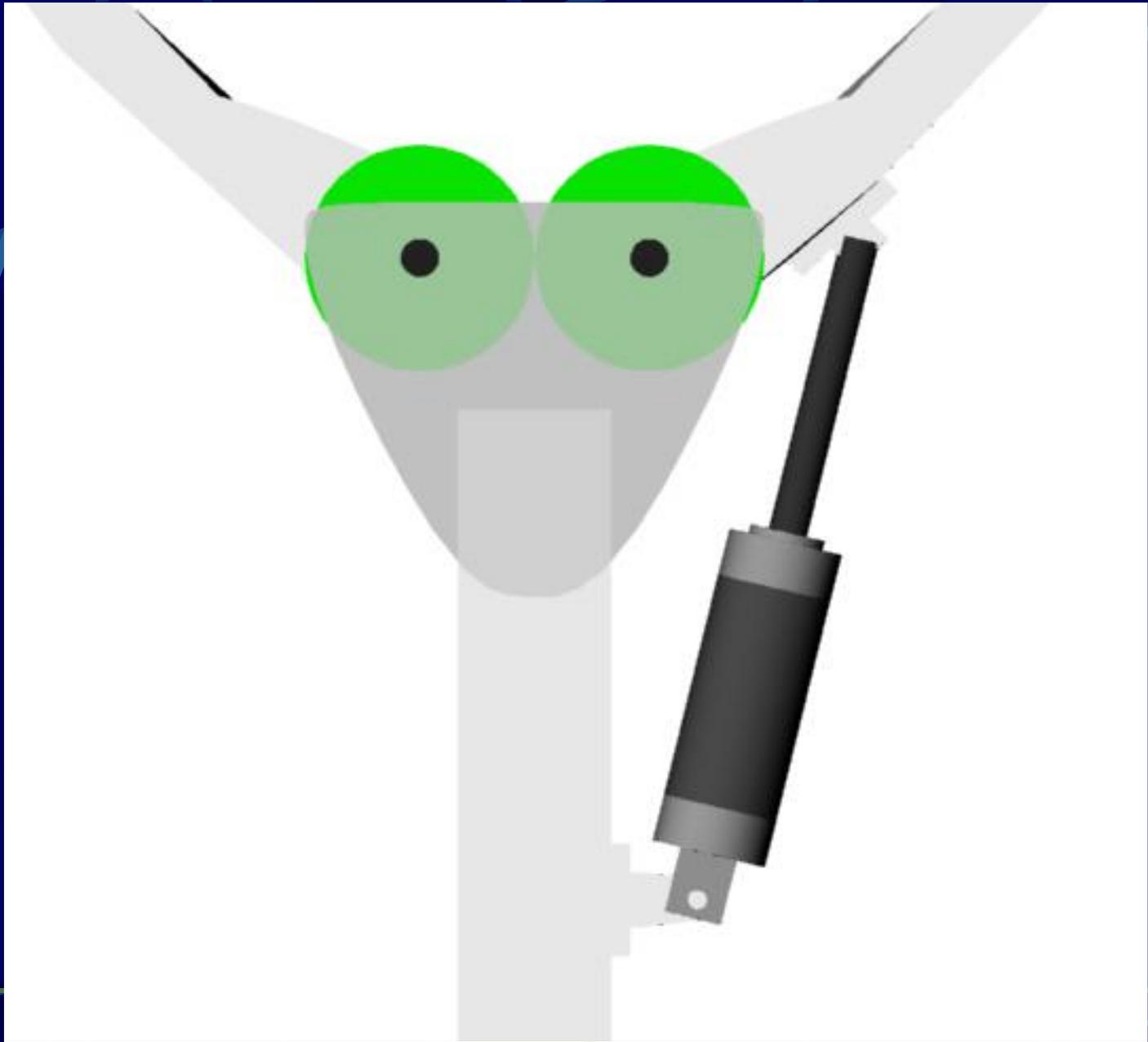
Claws



- Appendages which open and close to grasp onto an object
- “fingers” rotating to close around an object
- “fingers” move towards each other to clamp onto an object
- Any orientation, can pick up almost everything

Claws





Claws



Claws

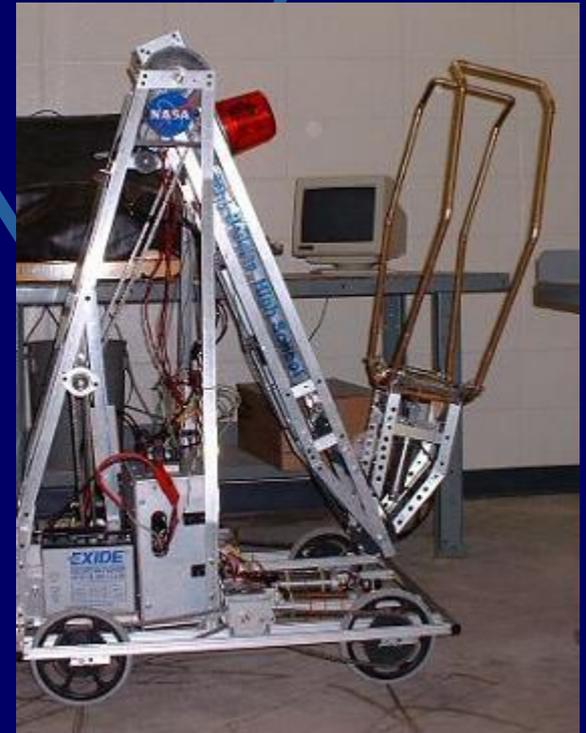
● Advantages

- Lightweight
- Grab very large objects
- Grab strangely shaped objects
- Easiest to build without machine tools

● Disadvantages

- Work best with pneumatics
- Take up large volume often
- Require good drivers and careful positioning
- Only pick up one object at a time

Examples



Fixed Devices



- KISS!
- A simply shaped device that interacts with the object
- Useful only if object has something to grasp onto

Fixed Devices

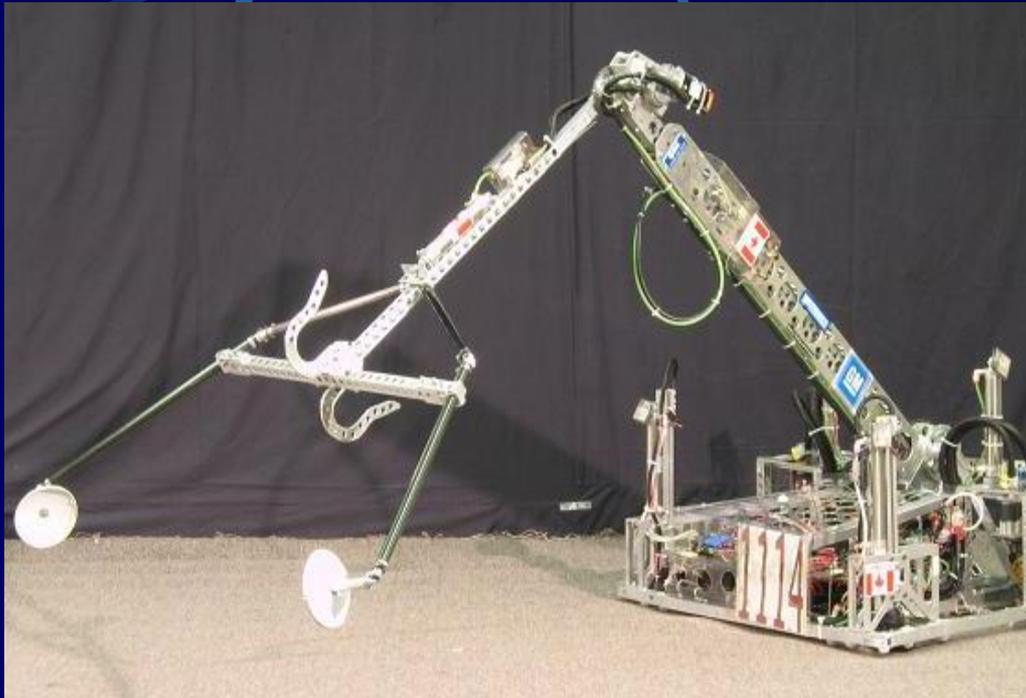
● Advantages

- Lightweight!
 - More weight to make other parts work better
- Reliable
 - No moving parts break
- Cheapest and easiest to manufacture

● Disadvantages

- Only work with certain objects
- Limited ability
 - Relies upon skill of driver and specific setups
- No room for adaptability in a match

Arms (rotational lift)

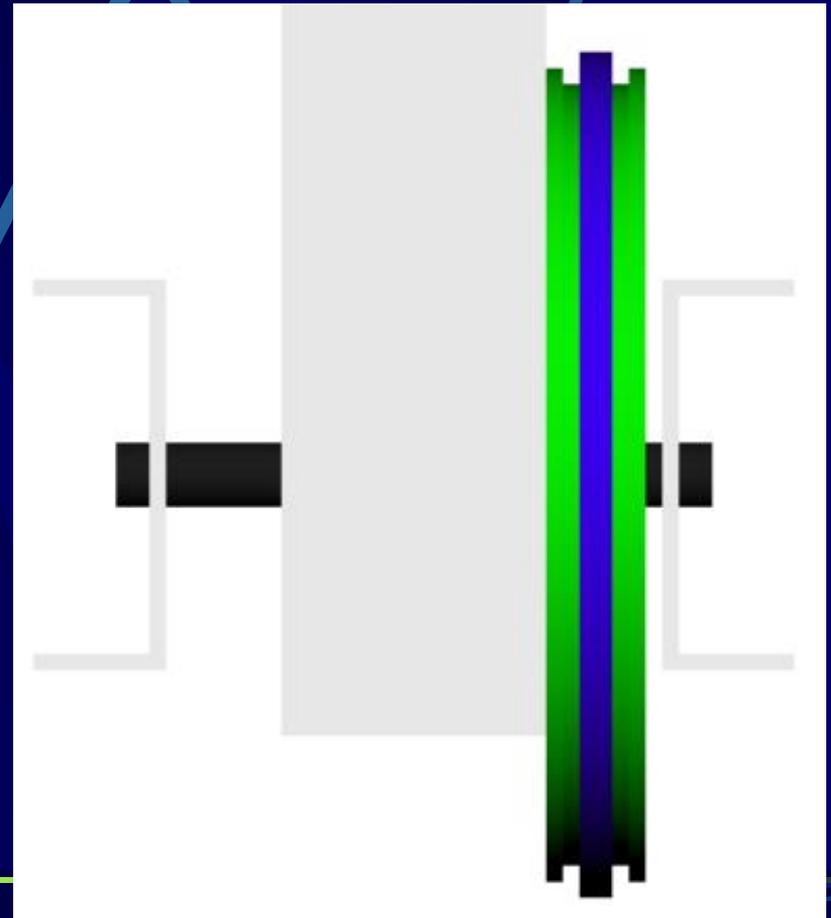
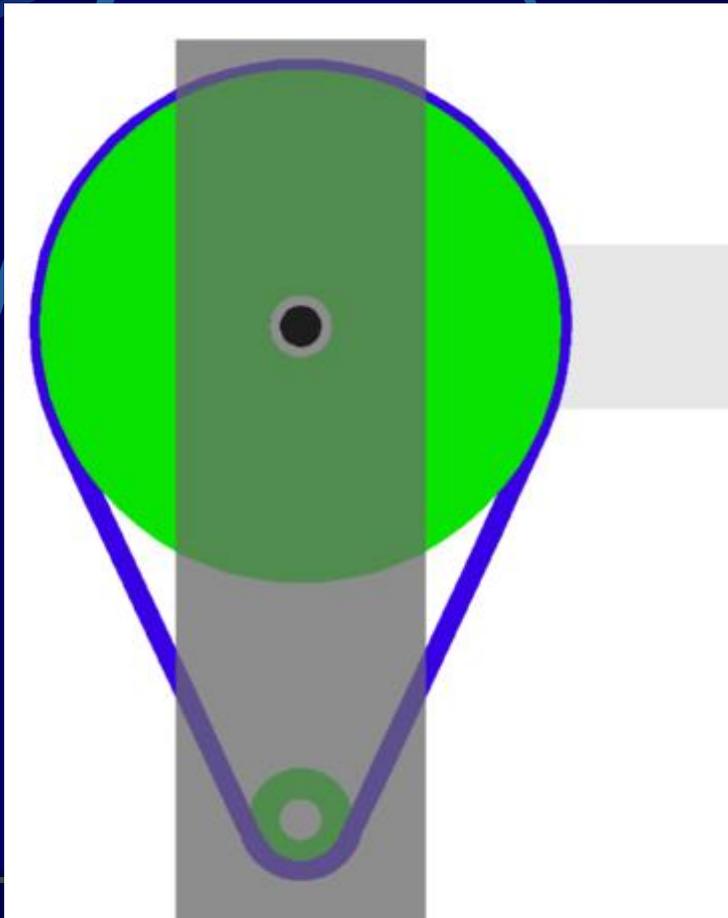


- Consist of one or more points of rotation
- Manipulator on the end of an arm
- Versatile and effective
- Lift objects high simply

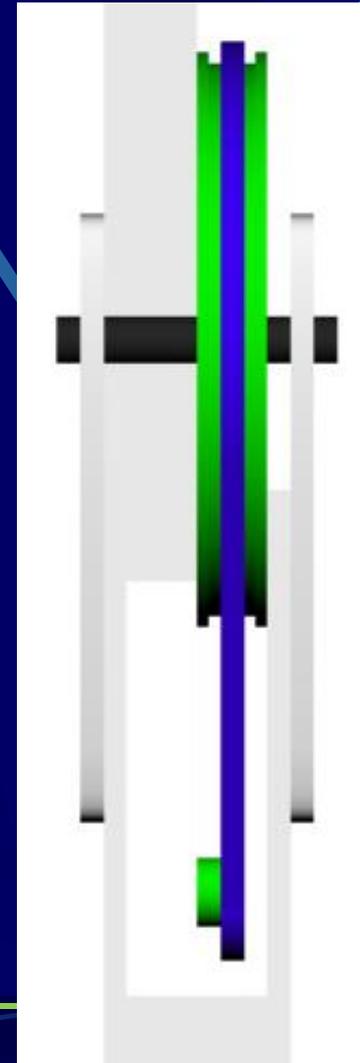
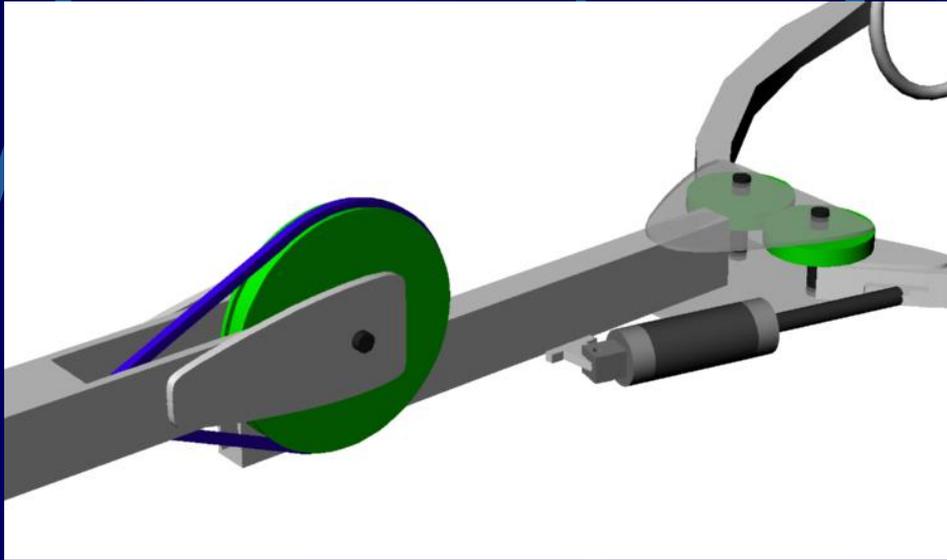
Arms (rotational lift)

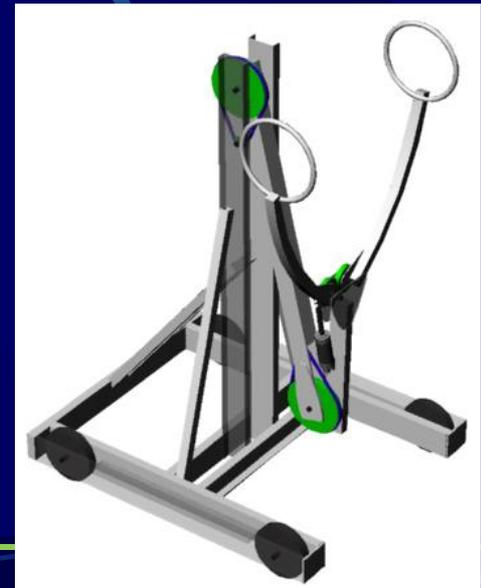
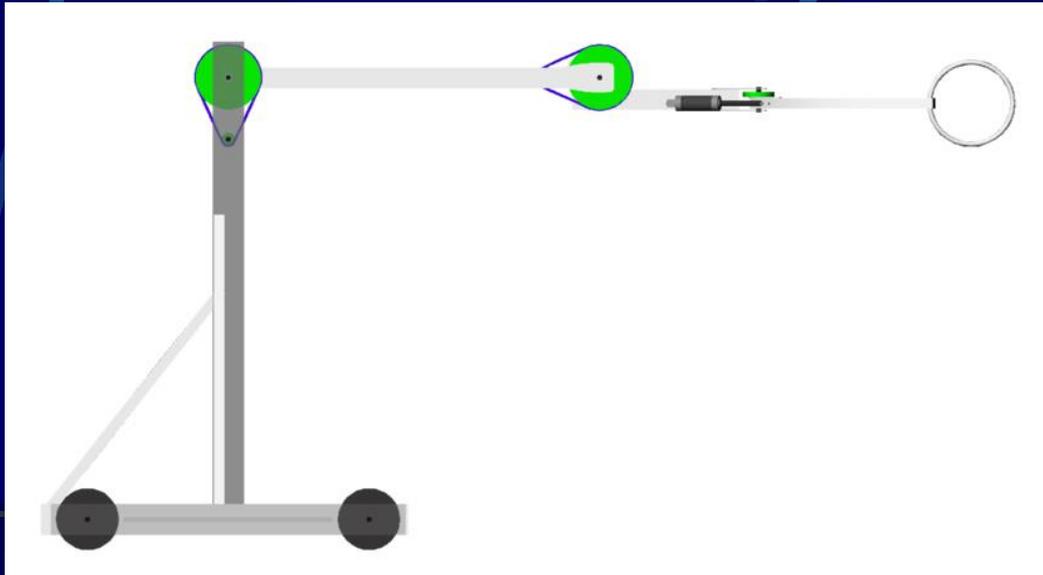
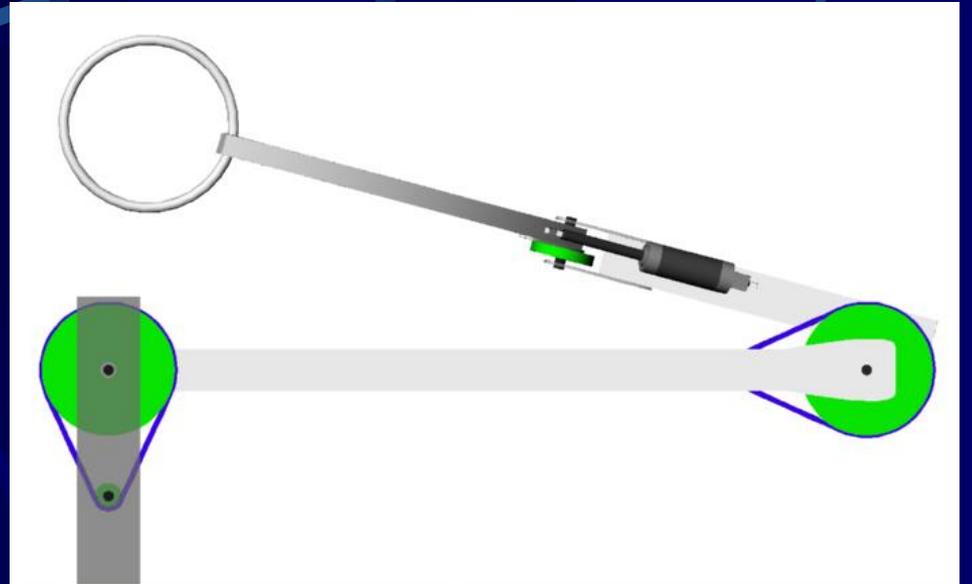
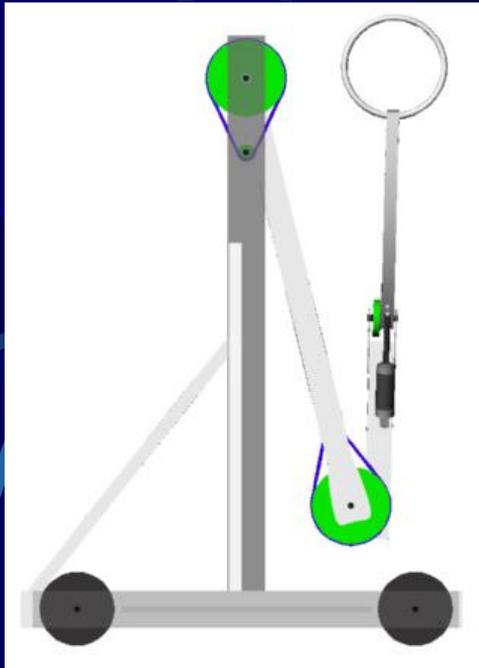


Shoulder Joint



Adding a Wrist





Arms (rotational lift)

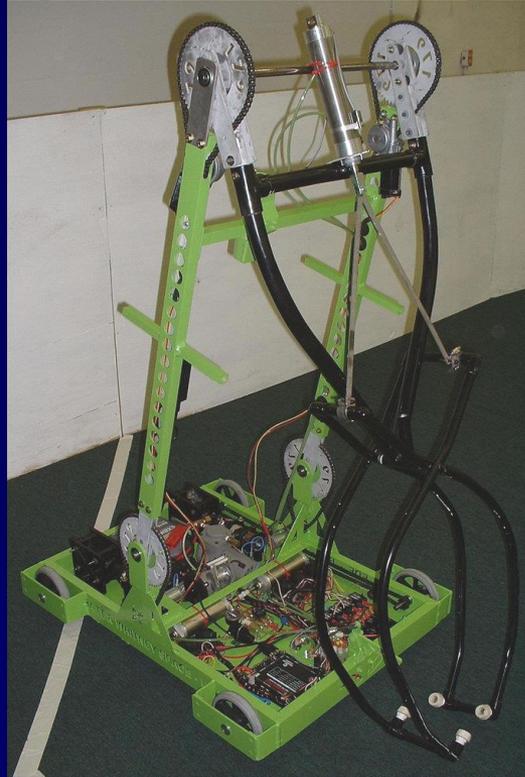
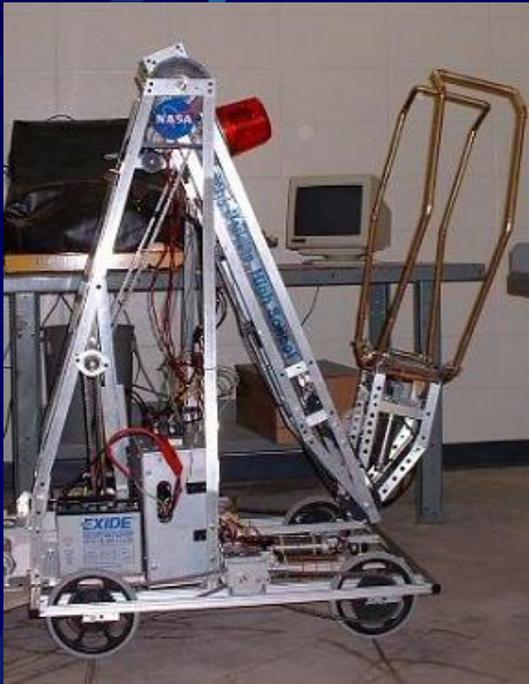
● Advantages

- Mechanically reliable for most heights
- A shoulder and wrist provide excellent control
- Can reach over robots and still fold up
- Multiple functions
- Can be built simply!
 - Capstans
 - Sprocket and chain

● Disadvantages

- Requires high strength parts
- Can raise CG too high
- Must fit into starting size limit
- Can require careful strategy not to hurt other robots

Examples

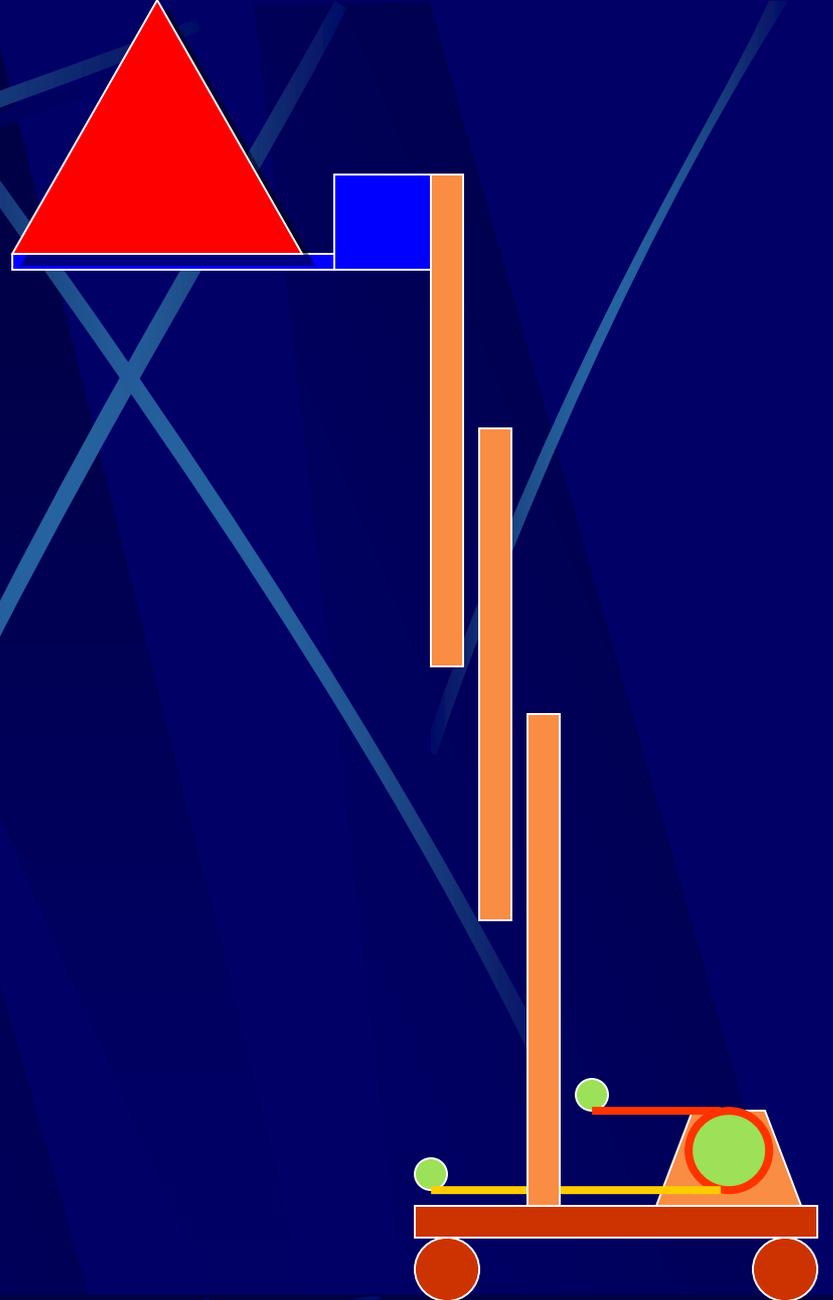
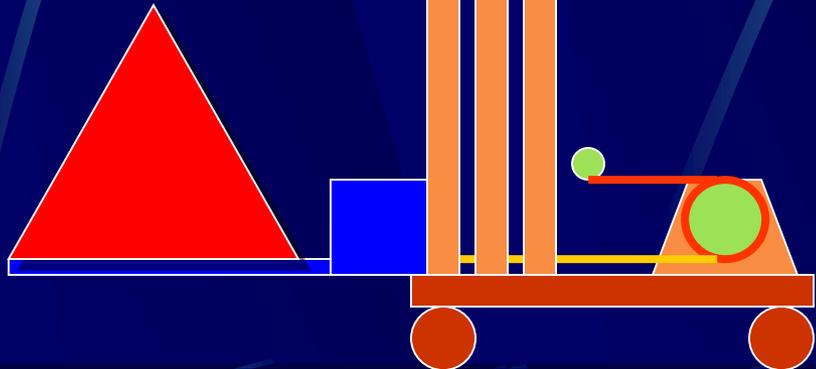


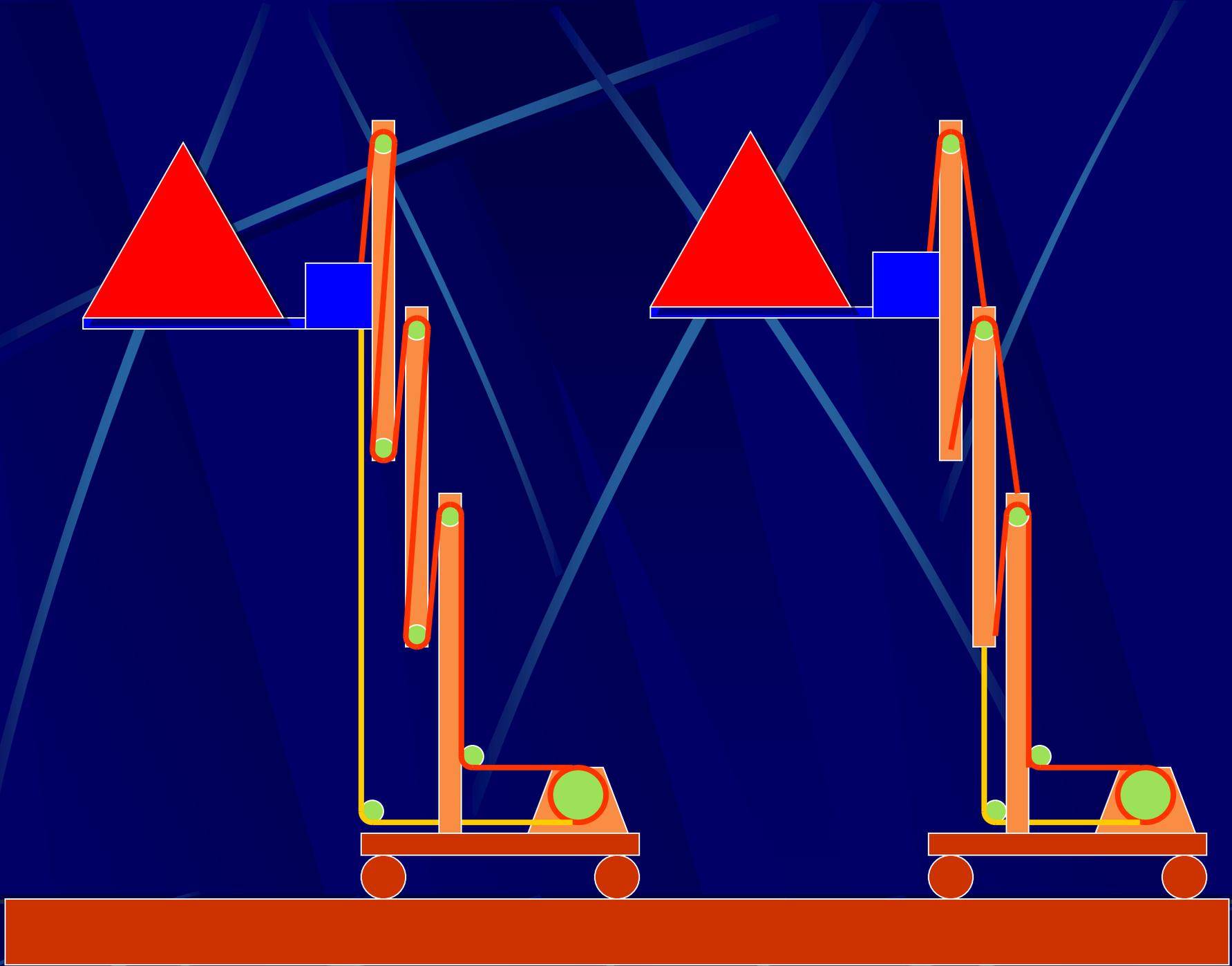
Telescoping



- Sliding sections that move linearly
- Mostly powered by a winch pulling on a cable
- Similar to the front of a forklift

**(images from Greg Needel's
presentation on the FIRST
website)**





Telescoping

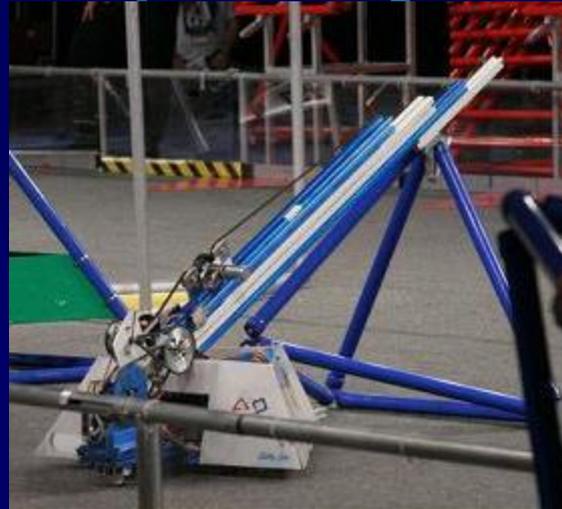
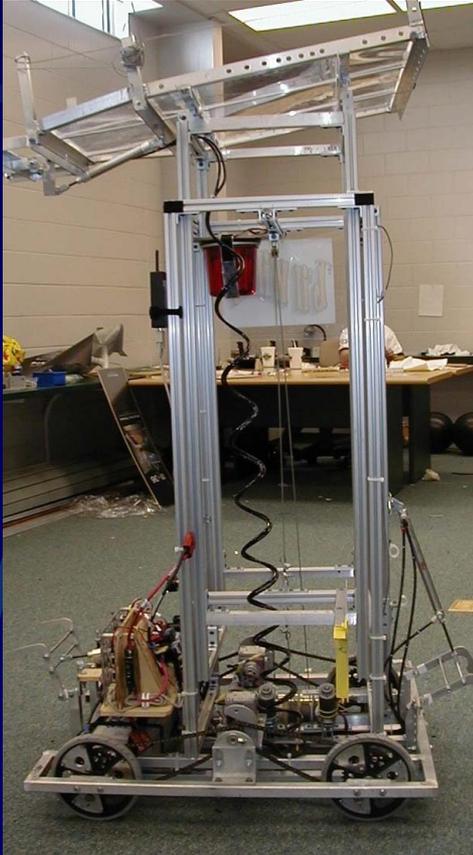
● Advantages

- Able to extend very far with little space consumed
- Stable linear path
- Less for driver to think about
- Simply powered by a winch

● Disadvantages

- Jamming, they jam, and jamming too.
- Hard to repair
- Require being stored in a long straight area
- Do not handle bending loads well

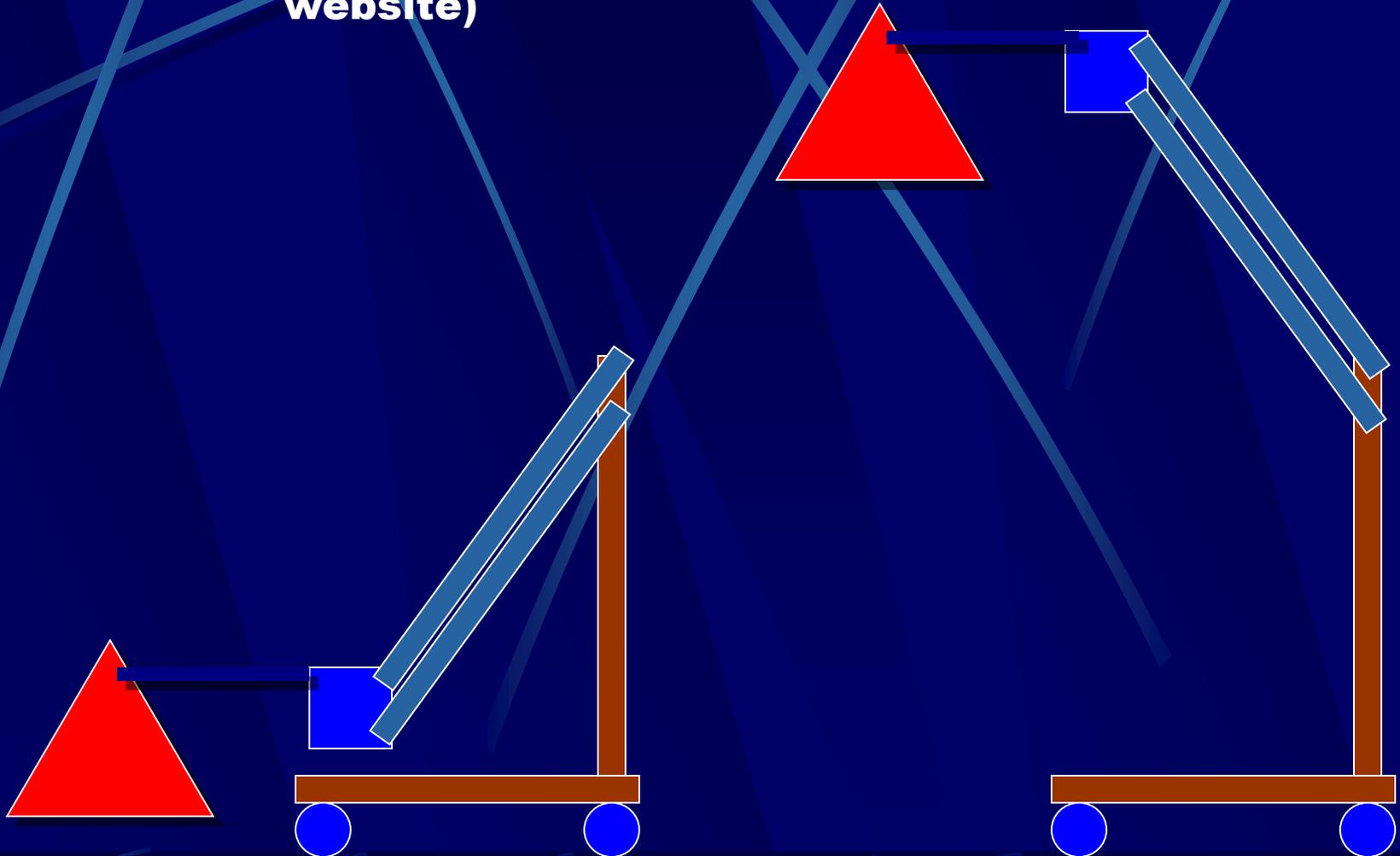
Examples



4-Bar linkages



**(images from Greg Needel's
presentation on the FIRST
website)**



4-Bar (rotational lift)

● Advantages

- Controls orientation of arm and object
- Complex motion from a simple input
- Simple to implement

● Disadvantages

- Limited range of motion
- More moving parts
- Over center toggling
- Certain links can require lots of torque

Design Selection

- How high does the object need to be lifted?
 - Arm with 1 joint vs. elevator with 1 section, etc
- Does the robot need to fit under an obstacle?
 - Arm folded down vs. telescoping arm with a pivot
- How much weight and space is there for it?
 - A conveyor system blocks half the robot vs. must weigh less than 10lbs and lift 10ft high
- *Prioritize first!*

Materials

- Steel
 - Axles, pins, bolts
- Aluminum
 - Structural shapes, plates, axles
- Plastics
 - Lighter parts, complex shapes, covers

Transmission

- Sprockets and chain
 - #25, #35
- Gears
 - ~20 pitch to ~12 pitch
- Urethane round belts
- Timing belts and timing pulleys
- Capstans

Vendors

- McMaster.com
 - All transmission parts and materials
- Onlinemetals.com
 - Aluminum structural
- Sdp-si.com
 - transmission
- Banebots.com
 - Gearboxes
- Robotmarketplace.com
 - Gearboxes
- Home Depot
 - Small amounts of aluminum tubing

Questions?

(super excited about mechanism building)

