Purpose of a throw. A throw can be ...

- for max speed
- for max distance (shot put, discus)
- for min travel time (baseball, softball)
- for precision (basketball, darts)
- for large speed and precision (football pass, bowling)

Phases of a throw:

- preparatory phase
- double-support delivery phase → where projectile gets most of its speed
- follow-through phase

Giving large speed to projectile requires a large force on projectile over a long time ...

... equivalent to a large force over a long range of motion.
Patterns for throwing:

- “simple push” (shot put) ← (it’s not that simple)
- “straight sidearm throw” (discus throw)
- “underarm throw” (softball, bowling)
- “overarm throw” (baseball pitch, football pass, javelin throw)

The overarm throw does not look like most people would think.

It involves:

- external rotation at shoulder
- elbow extension
- stopping of elbow extension
- internal rotation at shoulder
- ball release

Position at release:
Why different patterns?

- underarm: Use it when rules say so.
  
  (NOTE: specialists can reach very large speeds with it.)

- simple push: Use it for very massive objects. Allows to make large force on projectile.

- straight sidearm, overarm: Use for lighter objects.

  **straight sidearm** involves:
  
  - bad leverage ← bad
  
  - long range of motion ← good – with light objects, this more than compensates for the bad leverage.

  **overarm** is similar to straight sidearm, but with extra range of motion. Requires use of different muscles and good grip of object.
In **preparatory** phase, projectile gains some speed, but not much. Most of the speed gain occurs in **double-support delivery** phase.

**Preparatory phase**

Goals:

- give some momentum to projectile by start of double-support
- put body at start of double support in a position that will allow long range of motion of projectile during double-support

**Double-support delivery phase**

Goals:

- give a lot of speed to the projectile. This requires:
  - large force on projectile
  - over a long time (=over a long range of motion)

- Leg and trunk muscles are the most important
- Arm muscles are less important
A thrower can be compared to a ship firing a cannon:

Legs need to provide momentum for the “throwing platform” (the thrower).

More specifically: Legs need to move shoulder of throwing arm in direction of throw.

This:

- provides longer range of motion for the projectile
- helps arm muscles to make larger forces
Sequencing

In throwing, muscles normally come into play in the following order:

- leg muscles → trunk muscles → arm muscles

New findings

So ...

Preparatory phase

A third goal:

- provide most of the momentum for the thrower+projectile system