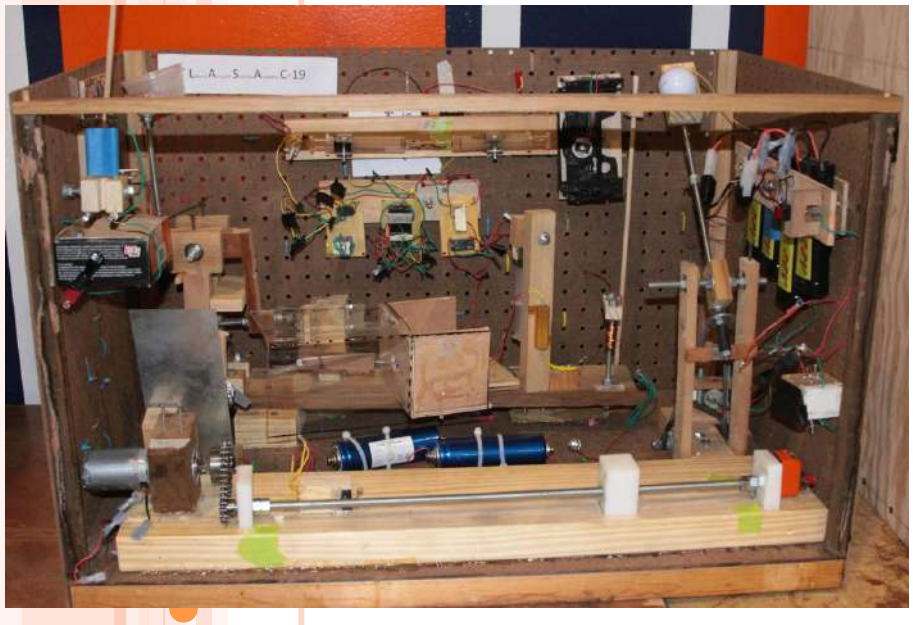
SCIENCE OLYMPIAD



Mission Possible – B 2016-17

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What is Mission Possible?

- Students design, build, test & document a Rube Goldberg-like device
- Device made of a series of simple machines
- Device must run autonomously
- Specific Start and End Task

General Tips

- ALWAYS go for reliability over "cool factor"
- Make every simple machine run as smoothly as possible
- Make a highly reliable, consistent timer
- Use as high-quality materials as you can afford

Safety Requirements/Inspection

- Students must wear at least safety spectacles with side shields
- Items not allowed
  - Electrical components
  - Flames
  - Remote controls or Remote timing
  - Hazardous items

Other Potential Hazards not Allowed

- Rat traps
- Model rocket engines
- Fireworks, explosives, lighters
- Flammable substances, matches
- Uncontrolled projectiles
- Any other hazardous materials

Potential Energy

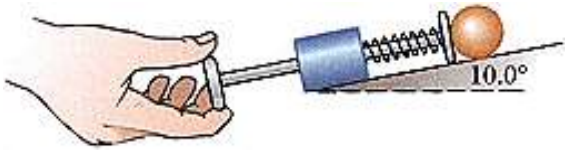
- No potential energy may be stored in an object.
  - Magents, springs, stretched objects
  - 1 EXCEPTION!! In the start task!!
- The only potential energy allowed is that of position due to gravity

BUILDING PARAMETERS

- Max. Size of Device **(60 cm x 60 cm x 60 cm) Points for smaller devices!**
- Top & at least one vertical wall must be open or transparent
- All scoreable transfers must be visible
- Designed to begin with the Start Task and end with the Final Task

START TASK – 100 PTS.

- **Plunger-**



  - A team member reaches into the device, and pulls a plunger. The action of releasing the plunger must start the sequence of events.
    - The entire plunger must return into the boundaries of the device.
  - One spring is allowed in the device, only to be used in the start task.
  - 100 points

Simple Machine Transfers

- Up to 18 scoreable unique transfers for points
- Must be from one Simple Machine Type to a different Simple Machine Type

Simple Machine Transfers

Transfers: A successful transfer of energy from one type of simple machine to a different type of simple machine.

- Receive points only if successful
- Listed on the Transfer Sequence List (TSL)
- All Transfers must contribute to the completion of the Final Task
- Must contribute to only one scoreable Transfer
- No parallel sequence of Transfers allowed

Scoreable Transfers

- Each Simple Machine Type may be used to score points up to three (3) times based on specific criteria
- Scoring is based on the initial type of machine in the transfer
  - Ex. 1 –
    - Pulley to a screw is a Pulley Transfer
  - Ex. 2 –
    - Screw to a Pulley is a Screw Transfer

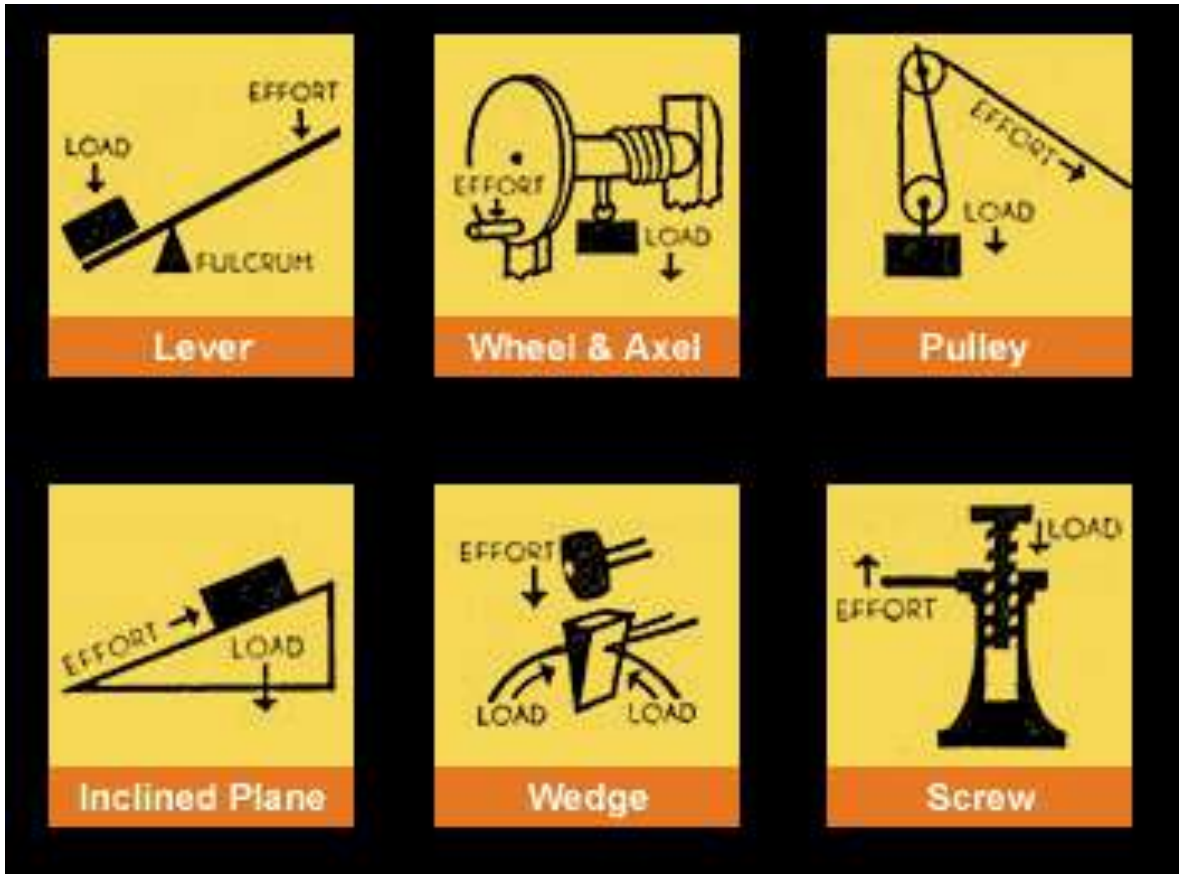
SCOREABLE TRANSFERS – CONT'D

- Each Scoreable Type of transfer must be Unique
- Transfer Types may be repeated but only one instance is scoreable
  - Ex. –
    - Device has 2 instances of Pulley -> Screw, only one would count for points.
  - Ex. –
    - Device has 2 instances of Lever -> Inclined Plane, with different classes of Levers in each instance.
      - **Only one would be counted for points.**

Additional Details

- Transfers between the Start Task and Final Task may be in any order.
- Each moveable/adjustable/physical object in the device can only be utilized by one transfer.
- Additional transfers may be built into the device between the scoreable tasks but will not earn points.
- Additional transfers must contribute to the completion of the final task.
- Additional non scoreable tasks must be listed on the Transfer Sequence List (TSL)

Simple Machines



SCREWS

- Must complete at least two full rotations before causing the next action
- Must have a clearly visible mark to show both full rotation

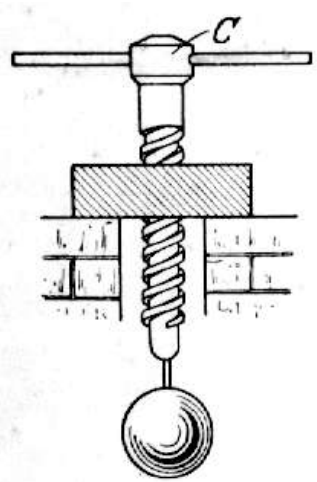
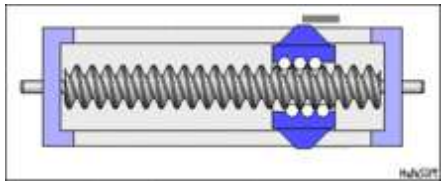
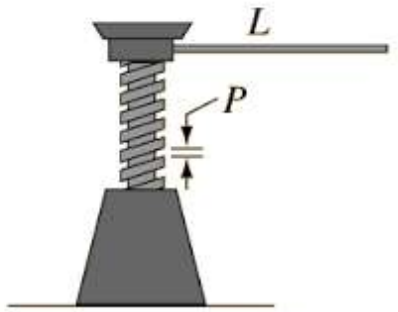


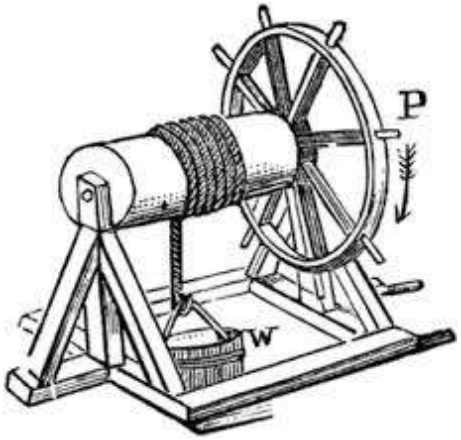
Fig. 31 The screw as a machine



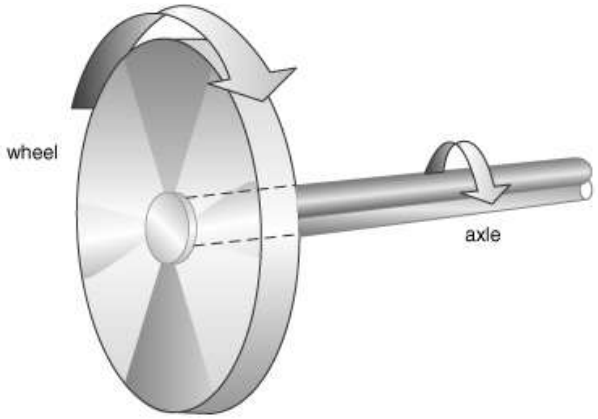


Screw $IMA = \frac{2\pi L}{P}$

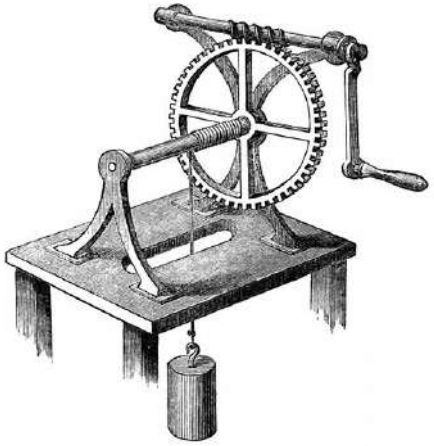
Wheel & Axle



- Must lift an object 10 cm before the object causes the next action
- Must be used as a Simple Machine, input on axel/output on wheel or vice versa
  - Energy applied to the wheel must be transferred to the axle, or vice versa.



THE WHEEL AND AXLE IS A WHEEL CONNECTED TO A RIGID POLE.



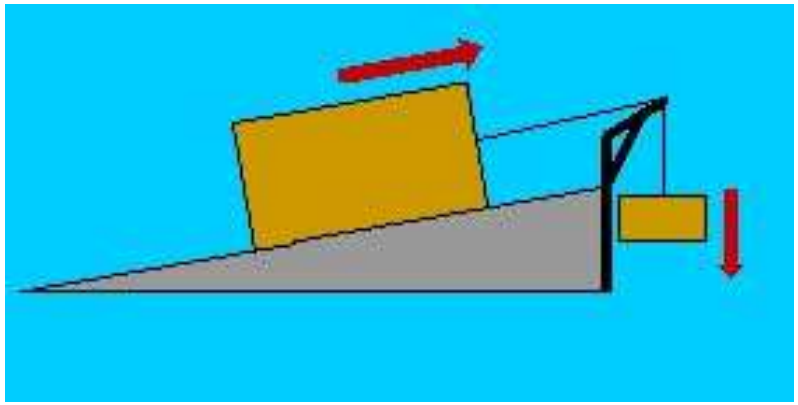
WEDGES

- Must be used to separate and go between two touching objects
- The objects can not be touching when they initiate the next action.

Wedge $IMA = \frac{L}{t}$

Inclined Planes

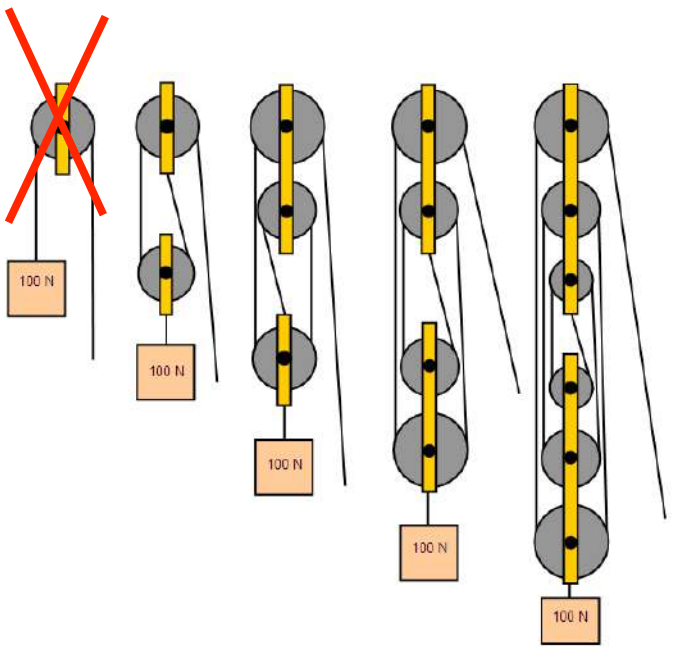
- Must be stationary
- Object must be pushed or pulled at least 10 cm vertically up the Inclined Plane before the object initiates the next action
- Objects must be continuously push or pulled up the plane

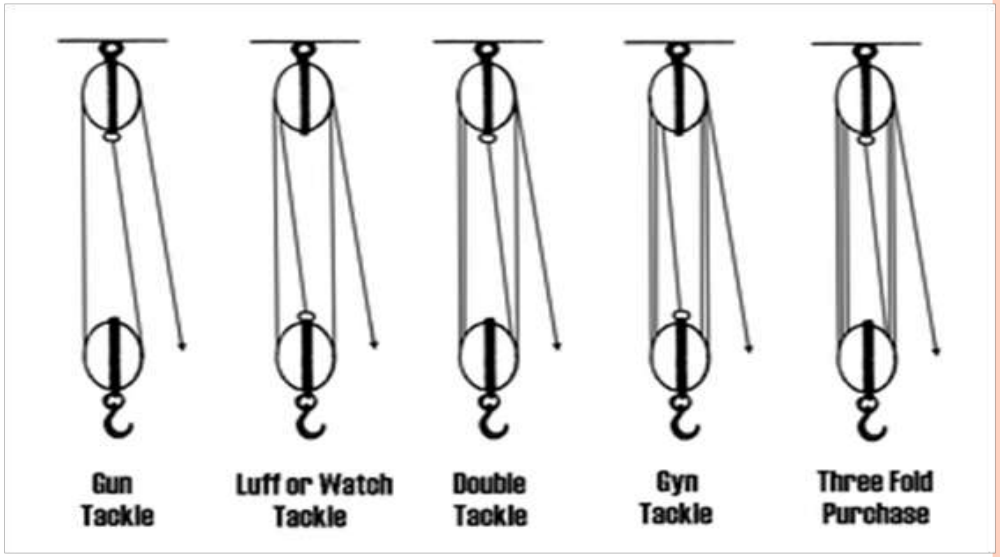


PULLEYS

- Must have an Ideal Mechanical Advantage (IMA) >1
- Pulleys must lift an object 10 cm, before the object initiates the next action.

1 2 3 4 6

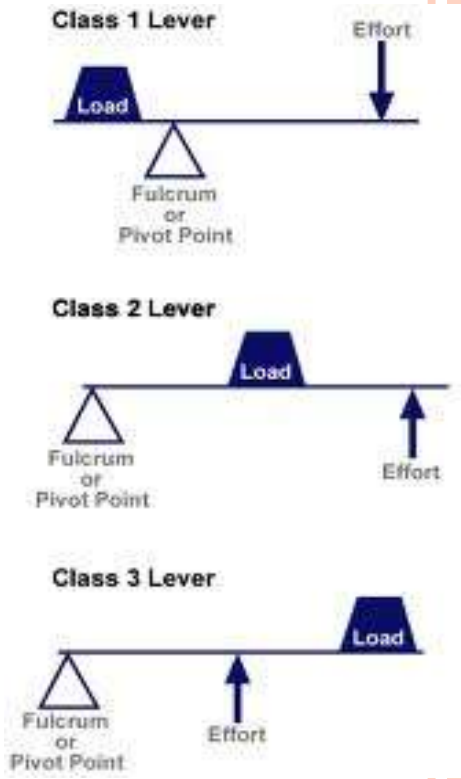




2 3 4 5 6

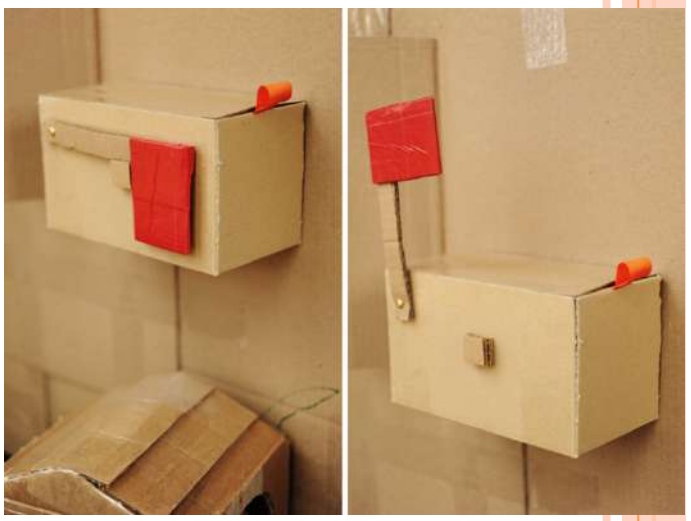
LEVERS

- Any class of lever can be used to count for points.
  - 1st Class
  - 2nd Class
  - 3rd Class
- 50 points if all three Classes of Levers initiate different successful scoreable transfers



FINAL TASK – 250 POINTS

- **Raise a cardboard flag**
  - Rectangular flag made of corrugated cardboard, which can be easily removed from the flag pole
  - All parts of the flag must be below the top of the device in the ready to run position
  - The flagpole must start parallel to the ground.
  - Timing stops when the flag stops moving



Transfer Sequence List - TSL

- What is listed?
  - ***All transfers in operation sequence***
- Follow Specific Format on NSO website
- All Transfers must be numbered and listed on the TSL and numbered in the Device
- Must be Accurate
- Submitted at Impound or Check-in
- Coaching hint - Have several copies of TSL

SAMPLE TSL

No.	Starting Simple Machine	Action/Transfer Description	Ending Simple Machine	Transfer	Points
1	-	Pull plunger, plunger hits marble into pulley.	Pulley	-	100
2	Pulley	Pulley lifts marble 10 cm, and spits marble out onto a 1st Class Lever	1st Class Lever	P-> L 1st	50
3	1st Class Lever	1st Class Lever has a string attached to 2nd Class Lever	2nd Class Lever	-	-
4	2nd Class Lever	2nd Class Lever lifts mass up Inclined Plane	Inclined Plane	L 2nd -> IP	50
5	Inclined Plane	Mass falls off top of Inclined Plane onto 1st Class Lever	1st Class Lever	IP -> L 1st	50
6	1st Class Lever	1st Class Lever lifts mass up Inclined Plane	Inclined Plane	-	-
		…and so on			23
10	Wedge	Wedge separates counter weight from flag pole, raising flag and signaling end of operation	-	-	250

Device Operation - Timing

- **Timing begins** when Student releases the plunger into the device
- **Timing stops** when:
  - The cardboard flag stops moving for the Final Task

    or
  - 3 minutes have elapsed (180 seconds)
  - Transfers completed after the flag has raised or after 3 minutes will not be scored

DEVICE OPERATION – IDEAL OPERATION TIME

- The Ideal Operation Times for State & Nationals will be announced after impound
  - Regional – 60 seconds
  - State – from 61 – 90 seconds
  - Nationals – from 91 – 120 seconds

SCORING – GENERAL POINTS

- 2 pts - each full second of operation up to the "ideal" time.
- 100 pts – Start Task
- 250 pts - Final Task completed in 3 mins.
- 50 pts – no more that 30 min. setup
- 50 pts – each successful unique Simple Machine Transfer (max 900 pts)
- .1 pt for each .1 cm that the dimensions of the device are under 60.0 cm x 60.0 cm x 60.0 cm

SCORING – TSL POINTS

- 25 pts – TSL submitted at Impound
- 25 pts – TSL correct format
- 25 pts – TSL & device labels correspond
- 25 pts – TSL 100% accurate documentation of device operations

DEVICE OPERATION – PENALTIES

- -25 pts – each dimension of the device that exceeds 60 cm
- -1 pt – each full second device operates beyond the ideal time until Final Task completion or the 180.0 s time limit
- -15 pts - for each time the device is touched, adjusted, or restarted.
- -50 pts - for anything that leaves the measured dimensions of the device. One time penalty

POINTS NOT AWARDED

- Points will not be awarded for transfer completion when touches or adjustments lead directly to the transfer completion
- Transfers skipped or completed out of sequence on the TSL will not earn points
- Points will not be awarded for task completion after time as elapsed
- Stalling can lead to DQ

Tiers

Teams are ranked by the highest score within each Tier

- Tier 1 – Devices without violations
- Tier 2 – Devices with construction or competition violations
- Tier 3 – Devices impounded after the deadline
- Unsafe devices must not run and teams receive participation points

Tie Breakers

- Fewest Penalty Points
- Number of scorable Simple Machines successfully used
- Smallest overall dimension (L+W+H) of the device

TOURNAMENT DAY

- Impound
- Set up
  - Only 30 mins. Before you plan or are scheduled to run device
- Be able to explain device to judges
- Go through TSL
- Run Device
- Remove from testing location

Parallel & Dead End Paths

- Parallel tasks have no direct relationship to one another and if one of the two tasks fails, the overall sequence of events can still continue or lead to a “dead-end” path.

- Parallel tasks are not measured in a chronologic manner but in a **causality** manner. That is to say, if one task causes the next task, then they are not parallel.

Parallel Paths Examples

- **Example #1 Parallel Task**: Two different levers hit a single switch and only one or the other is required to activate the switch.

- **Example #2 Tasks that may appear to be parallel or simultaneous tasks but are not parallel or simultaneous tasks:** A latch releases a spring attached to a third class lever. The spring pushes the lever, which then moves an object 15 cm and continues the chain of events.

Things to Consider

- Avoid questionable components
- Device may not be timed or controlled by any remote method
- Final Task – the team may not complete the task themselves
- Obvious stalling will be a DQ

Costs & Time Commitment

- Look for Inexpensive available materials
- Avoid the "Black Hole" phenomenon
  - Where does the money go?
- Use a Long Term Project approach
- Consider what's best for your team –
  - In your classroom vs. in a student's garage or basement
- Parent involvement –
  - Can be a life saver or a headache.
  - Who's project is this?