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.
  - Magnets, 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

Lever  Wheel & Axel  Pulley

Inclined Plane  Wedge  Screw
**SCREWS**

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

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Fig. 31 The screw as a machine

\[ \text{IMA} = \frac{2\pi L}{P} \]
**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 cannot be touching when they initiate the next action.
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.
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
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
<table>
<thead>
<tr>
<th>No.</th>
<th>Starting Simple Machine</th>
<th>Action/Transfer Description</th>
<th>Ending Simple Machine</th>
<th>Transfer</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>Pull plunger, plunger hits marble into pulley.</td>
<td>Pulley</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Pulley</td>
<td>Pulley lifts marble 10 cm, and spits marble out onto a 1st Class Lever</td>
<td>1st Class Lever</td>
<td>P-&gt; L 1st</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>1st Class Lever</td>
<td>1st Class Lever has a string attached to 2nd Class Lever</td>
<td>2nd Class Lever</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>2nd Class Lever</td>
<td>2nd Class Lever lifts mass up Inclined Plane</td>
<td>Inclined Plane</td>
<td>L 2nd -&gt; IP</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>Inclined Plane</td>
<td>Mass falls off top of Inclined Plane onto 1st Class Lever</td>
<td>1st Class Lever</td>
<td>IP -&gt; L 1st</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>1st Class Lever</td>
<td>1st Class Lever lifts mass up Inclined Plane</td>
<td>Inclined Plane</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...and so on</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>Wedge</td>
<td>Wedge separates counter weight from flag pole, raising flag and signaling end of operation</td>
<td>-</td>
<td>-</td>
<td>250</td>
</tr>
</tbody>
</table>
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
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)
- 0.1 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.
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 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?