

Mission Possible

Division B

Georgia Tech Event Workshop Series
2024-25



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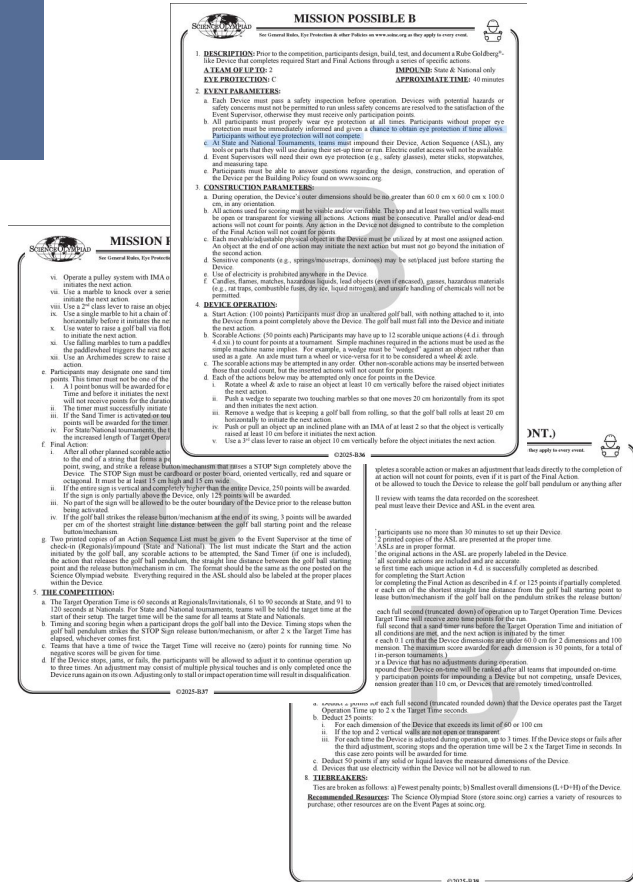
The Rules Sheet

- **What is Mission Possible**

- Students must design, build, test & document a Rube Goldberg-like device
- Device made up of a series of actions
- Device must run autonomously
- Must complete a specific start and end task

- **What to bring to competition**

- Your device
- Eye Protection
- Action Sequence Log (ASL)
- Any tools you need to setup or run the device
 - No outlet provided for power tools



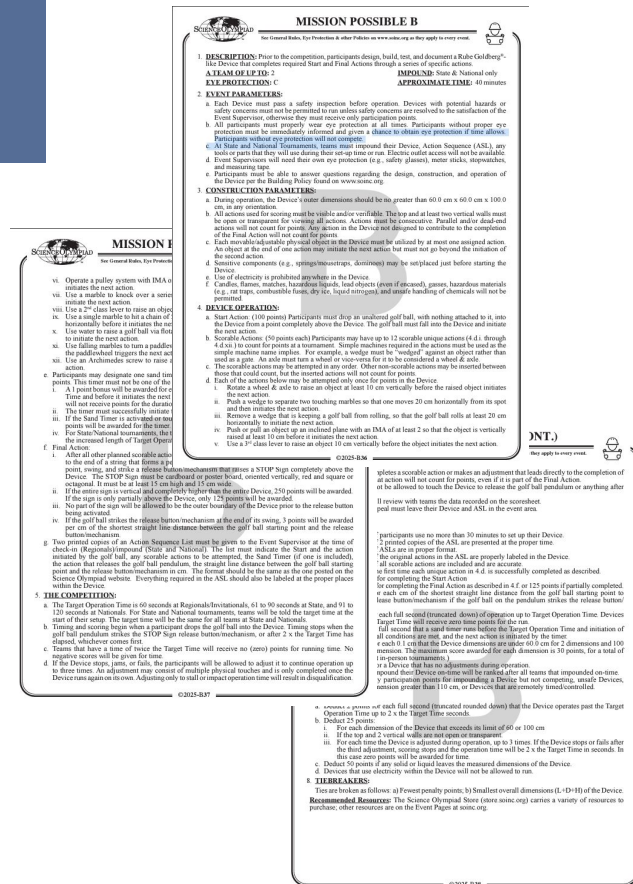
The Rules Sheet (Cont)

● Important Construction Parameters

- Must fit within a bounding box of 60 x 60 x 100 cm
- All actions must be visible
 - Top and 2 walls visible (at least)
- Only consecutive actions will be counted
- Each moveable object can only be used by 1 action
 - If the object initiates another action it cannot go further after that
- NO ELECTRICITY of an kind can be used
- No hazardous items allowed
- Nothing may leave the bounding box while the device is running except the final action stop sign




- **Easy Points**
 - 50 points for setting up within 30 minutes
 - 100 point for having 2 printed ASL's in proper format with all actions included and actions labeled on the device
 - 2 points for every second up to the target operation time.
 - If you go past the target time it starts deducting 2 points per second
 - 0.1 points for every 0.1 cm under the bounding box dimensions
 - max 90 (30 for each dim)
 - 75 points for not adjusting while device is running



The Rules Sheet (Cont)

● Scorable Actions

- 12 possible actions outlined in the rulebook
- Each can only count for points once
- All actions specifically listed on the ASL must contribute to the Final Action
- Additional non scoring actions can be put in between scored actions
- Must also be on ASL.
- Actions can be in any order



MISSION IMPOSSIBLE

Use General Rules, For Protection & other Policies on www.sos.org or apply to your event.

DESCRIPTION: Prior to the competition, participants design, build, test, and document a Robo Goldberg® that the Device that completes required Start and Final Actions through a series of specific actions.

TEAM OF 1-2: **INDIVIDUAL** State & National only

EYE PROTECTION: C **APPROXIMATE TIME:** 40 minutes

2. EVENT PARAMETERS:

- a. Each Device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor; otherwise they must receive only participation points.
- b. Participants must wear eye protection at all times. Eye protection must be immediately informed and given a chance to obtain eye protection if they allow.
- c. Participants without eye protection will not compete.
- d. At State and National Tournaments, teams must inspect their Device, Action Sequence (ASL), any tools or parts that they will use during their set-up time or run. Excess tools and parts will not be available.
- e. Event Supervisors will need their own eye protection (e.g., safety glasses), motor oils, impawatches, and measuring tape.
- f. Participants must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy found on www.sos.org.

3. CONSTRUCTION PARAMETERS:


- a. During operation, the Device's plane dimensions should be no greater than 60.0 cm x 60.0 cm x 100.0 cm, in any orientation.
- b. All actions used for scoring must be visible and/or verifiable. They be and at least two vertical walls must be in place to support the target ball action. Actions must be verifiable. Parallel drive dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
- c. Each movable/independent physical object in the Device must be actuated by at most one assigned action. An object at the end of one action may initiate the next action but must not go beyond the initiation of the second action.
- d. Sensitive components (e.g., springs/sensors, servomotors) may be actuated just before starting the Device.
- e. Use of electricity is prohibited anywhere in the Device.
- f. Candles, flames, matches, heat-seeking liquids, food objects (such as meatballs, gummy, licorice), hazardous materials (e.g., rat traps, combustible fumes, dry ice, liquid nitrogen) and unsafe handling of chemicals will not be permitted.

4. DEVICE OPERATION:

- a. Start Action: (100 points) Participants must drop an uncluttered golf ball, with nothing attached to it, into the Device from a point completely above the Device. The golf ball must fall into the Device and initiate the next action.
- b. Scorable Action: (50 points each) Participants may have up to 12 scorable unique actions (4.1, through 4.4) to complete the game. Scorable actions must be verifiable. Simple machines (e.g., pulleys) must be used to complete machine simple machines. For example, a wedge must be "wedged" against an object rather than used as a guide. An axle must turn a wheel or vice-versa for it to be considered a wheel & axle.
- c. The scorable actions may be attempted in any order. Other non-scorable actions may be inserted between those that could count, but the scored actions will not count for points.
- d. Each of the actions below may be attempted only once for points in the Device.
 - i. Release a wheel & axle to raise an object at least 15 cm vertically before the raised object initiates the next action.
 - ii. Push a wedge to separate two touching materials so that one moves 20 cm horizontally from its spot and then initiates the next action.
 - iii. Remove a wedge that is keeping a golf ball from rolling, so that the golf ball rolls at least 20 cm horizontally to initiate the next action.
 - iv. Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm before it initiates the next action.
 - v. Use a 1° class lever to raise an object 10 cm vertically before the object initiates the next action.

5. THE COMPETITION:

- a. The Target Operation Time is 60 seconds at Regional/State/National, 61 to 90 seconds at State, and 91 to 120 seconds at National. For State and National tournaments, teams must be told the target time at the start of their set-up. The target time will be the same for all teams at State and National.
- b. Timing and scoring begins when a participant drops the golf ball into the Device. Timing stops when the golf ball pendulum strikes the STOP Sign release button/mechanism, or after 2 x the Target Time has elapsed, whichever comes first.
- c. Teams that have a safe set-up, the Target Time will receive at least one point for set-up time. No negative scores will be given for time.
- d. If the Device stops, jams, or fails, the participants will be allowed to adjust to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device starts again in its motion. Adjusting only to add or repeat operation time will result in disqualification.



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RECOMMENDED RESOURCES: The Science Olympiad Store (www.sos.org) carries a variety of resources to purchase, other resources on the Event Pages at www.sos.org.



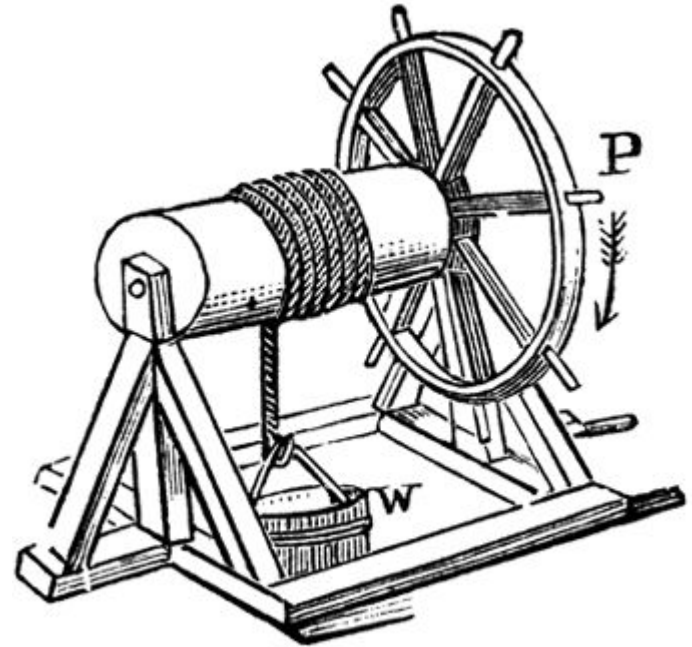
DIFFICULT TOPICS

Topic 1: Initiating Action

- Before triggering the next action, a scorable action must complete its own action. Meaning before making any contact with the trigger for the next action.
- For example:
 - A lever raises a an object 10 cm vertically before initiating the next action.
 - If the object raised by the lever makes contact with the next action before moving 10 cm, then the lever does not count as a scorable action.

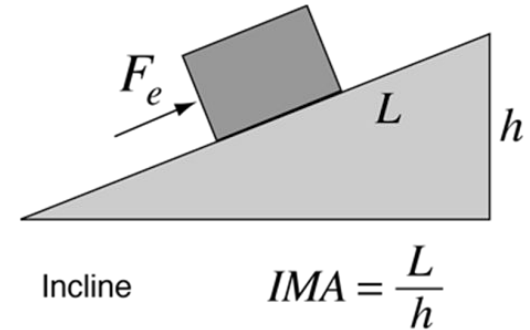
Topic 2: Wheel & Axle Action

- Section 4.d.i.
- Rotate a wheel & axle to raise an object at least 10 cm vertically before the raised object initiates the next action
- More difficult than it looks
 - Vague description
 - Open to many different possibilities
- Possible action:
 - Drop an object into a cup with a string to rotate the axel which in turn turns the wheel and can lift something on spokes.



Topic 3: IMA of Inclined Plane

- Section 4.d.iv
- Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm before it initiates the next action.
- IMA stands for Ideal Mechanical Advantage
 - For an inclined plane it is the ratio between the length and vertical height that the incline raises the object. ($IMA=L/h$)
 - With an IMA of 2 we want the incline to provide twice the advantage in force. Meaning it will cut the required force to pull the object in half.
- This means the incline must be at least 20 cm long and at an angle where it is 10 cm tall.



Topic 4: 2nd and 3rd Class Lever

- Section 4.d.v and 4.d.viii
- Use a 3rd/2nd class lever to raise an object 10 cm vertically before the object initiates the next action
- On a third class lever the input is in the same direction as the output.
 - The effort is between the load and the fulcrum (pivot point)
 - Meaning a redirect or pulley will be required to carry out this action
- On a second class lever the input is also in the direction of the output but the load is between the effort and fulcrum.
 - Redirect or pulley is still needed
- If you use a pulley it will not count as a separate action.

Class 1 Lever



Class 2 Lever

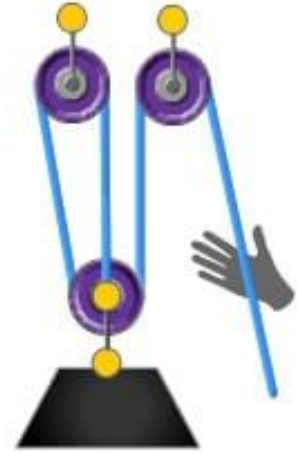


Class 3 Lever

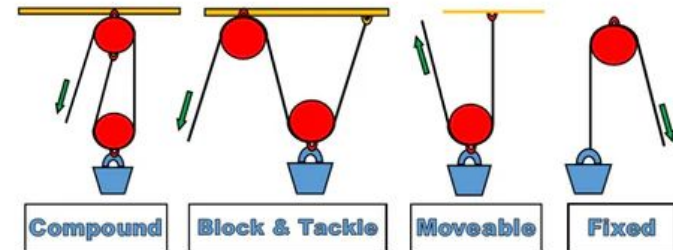


Topic 5: Pulley System

- Section 4.d.vi
- Operate a pulley system with IMA of 3 to raise an object at least 10 cm vertically before the object initiates the next action
- IMA for a pulley system is determined by the number of ropes directly lifting the load.
 - An IMA of 3 implies there are 3 segments of rope
- There are many types of pulley systems where you can get an IMA of 3.
 - Which one you choose depends on the application

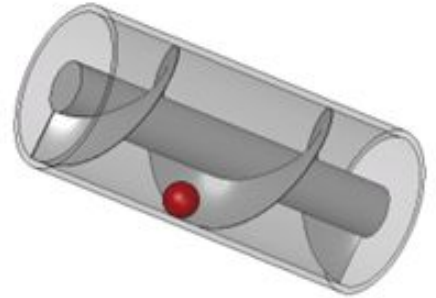


TYPES OF PULLEYS



Topic 6: Archimedes Screw

- Section 4.d.xii
- Use an archimedes screw to raise a marble 20 cm vertically before the marble trigger the next action.
- This can be done by rotating the screw in a cylindrical pipe.
 - The pipe needs to be angled so the marble doesn't roll down the screw.
- Note: The tighter the blades, the higher the angle the screw can be.
- Good way to move an action from a lower height back to the top



Topic 7: Sand Timer

- The sand timer must not be a scorable action and must take at least 10 seconds for bonus points.
 - It must also initiate the next action in the sequence.
- A 1 point bonus is awarded for every second the sand timer runs up to the Target Operation Time or until the next action is initiated.
 - If it runs past this time no additional points will be awarded.
- Possible method
 - Have a funnel of sand fill a cup sitting on a lever.
 - Once a certain weight has been added into the cup the lever moves and initiates the next action
 - Can vary the timer by using counterweights or changing the amount of sand initially in the cup.





COMMON PROBLEMS

Connecting actions together

- Connecting actions that don't go together often results in the need for intermediate actions.
- This is why it is imperative that once you figure out how you will do each of your actions, you plan out the order in which to execute them.
- More than likely you can't avoid using some intermediate actions but you can make the job much simpler if you have less of them.

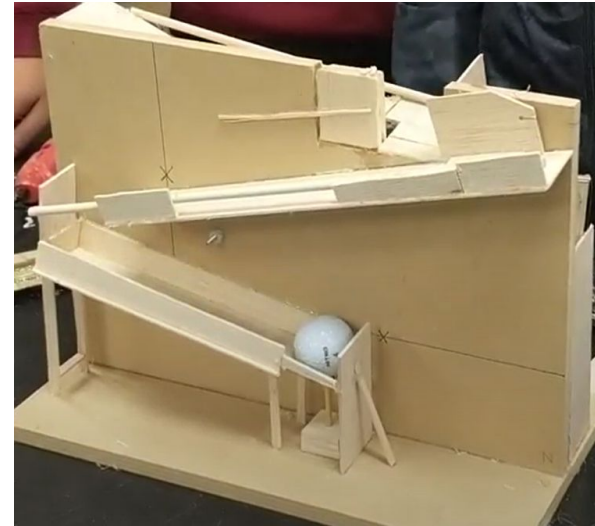
Designing an Action

- It may seem difficult to design an action from scratch.
- The key to success is to take inspiration from others.
- People have been making Rube Goldberg-like device for a long time and chances are someone has already made exactly what you're looking for.
- Do your research and find the method that best suits your needs.
- Don't forget to keep it simple.

Tips from a Veteran

<https://www.youtube.com/watch?v=dQganIHJyBk>

- ALWAYS go for reliability over looks
 - Consistency is key
- Make every action run as smoothly as possible
- Make a highly reliable, consistent sand timer
- Make all distances easy to measure!
 - Go a little long, don't cut it too close.
- Go back and check the rules often
 - Don't want to get penalized or disqualified for a small error.
- When designing an action, plan out and experiment with the action first. Then implement it into your build.

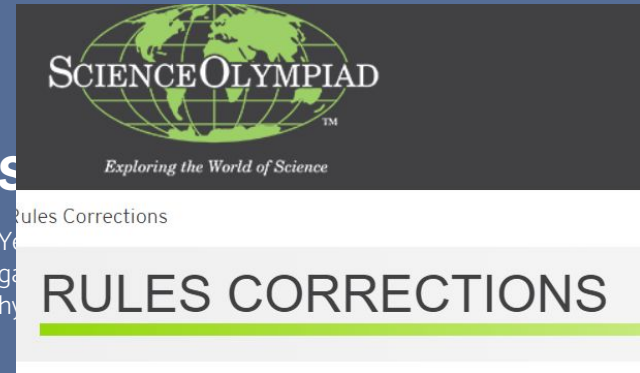


Additional Resources

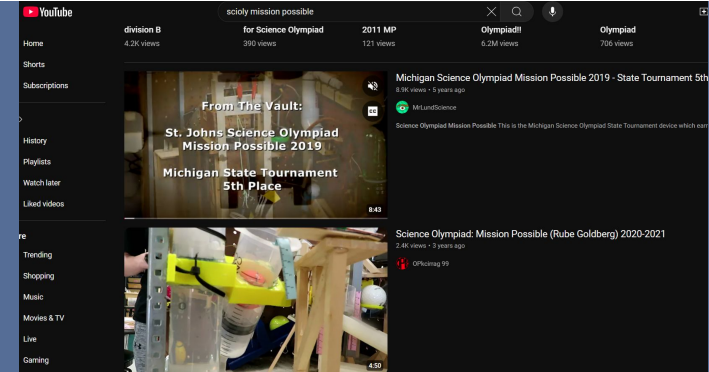


MISSION POSSIBLE

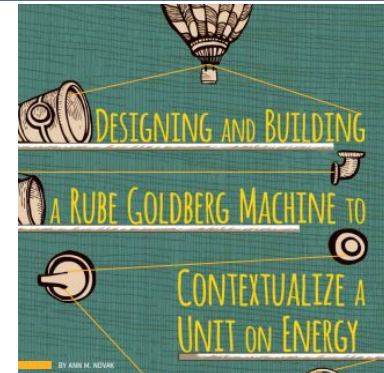
<https://www.soinc.org/mission-possible-b>



<https://www.soinc.org/events/rules-corrections>



https://www.youtube.com/results?search_query=sciol+y+mission+possible



<https://www.proquest.com/scholarly-journals/designing-building-rube-goldberg-machine/docview/1844174852/se-2?accountid=11107>

THANKS!

