

Mission Possible

Division B

Georgia Tech Event Workshop Series
2024-25



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04

05

RULES SHEET

DIFFICULT TOPICS

COMMON PROBLEMS

TIPS FROM A VETERAN

OTHER FREE RESOURCES



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 any 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



MISSION E

SCIENCE OLYMPIADE

General Rules, Eye Protection & other Policies on www.sone.org as they apply to every event

MISSION POSSIBLE B

Scien... General Rules, Eye Protection & other Policies on www.sone.org as they apply to every event

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

TIME OF USE TO: 12:00

IMPROVEMENTS: State or National only

APPROXIMATE TIME: 40 minutes

EVENT PARAMETERS:

- Each Device must pass a safety inspection before operating. Devices with potential hazards or unsafe construction will be required to make an other safety concern before being allowed to compete. Event Supervisors, otherwise they must receive only participation points.
- At the end of the competition, the Device must be turned off. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
- All State and National Tournaments, teams must imprint their Device, Action Sequence (ASL), any Improvements, and Final Action sequence on the back of the Device. Participants without proper eye protection will not be allowed to imprint their Device, Action Sequence (ASL), any Improvements, and Final Action sequence on the back of the Device.
- Event Supervisors will need their own eye protection (e.g., safety glasses), meter sticks, stopwatches, etc.
- Participants must be able to answer questions regarding the design, construction, and operation of their Device. Questions will be found on www.sone.org.

3. CONSTRUCTION PARAMETERS:

- During operation, the Device's outer dimensions should be no greater than 60.0 cm x 60.0 cm x 100.0 cm.
- All actions used for scoring must be valid & moveable. The top and at least two vertical walls must be visible during the operation of the Device. Actions that are not visible or that are not moveable and actions will not count for points. Any action on the Device not designed to contribute to the completion of the required actions will not be counted.
- Each moveable/adjustable physical object in the Device must be utilized by a move one assigned action. Actions that are not moveable or are not assigned to one action will not be counted for the total number of second actions.
- Any action that uses electricity is prohibited anywhere in the Device.
- Cardio, flamer, matches, hazardous liquids, liquid object (even if encased), gases, hazardous materials (including but not limited to: acids, bases, dry ice, liquid nitrogen), and other handling of chemicals will not be permitted.

4. DESIGN OPERATIONS:

- Up to 100 points (100 points) Participants must drop an unaligned 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 required actions.
- Scoring Actions: (50 points each) Participants may have up to 12 scoreable unique actions of d.i. through d.vi. These actions must be attempted in order. Other non-scoreable actions may be inserted between the simple machine name implies. For example, a wedge must be "wedged" against another rather than "wedged" into another.
- The scoreable actions may be attempted in any order. Other non-scoreable actions may be inserted between the simple machine name implies. For example, a wedge must be "wedged" against another rather than "wedged" into another.
- Each of the actions below may be attempted only once per point in the Device.

 - If the ball is dropped vertically, it must be raised vertically before the object initiates the next action.
 - If the ball is dropped horizontally, it must be raised horizontally before the object initiates the next action.
 - If the ball is dropped diagonally, it must be raised diagonally before the object initiates the next action.
 - If the ball is dropped from a height, it must be raised from a height before the object initiates the next action.
 - If the ball is dropped from a distance, it must be raised from a distance before the object initiates the next action.
 - If the ball is dropped from a height and a distance, it must be raised from a height and a distance before the object initiates the next action.
 - If the ball is dropped from a height and a distance and a vertical angle, it must be raised from a height and a distance and a vertical angle before the object initiates the next action.
 - If the ball is dropped from a height and a distance and a horizontal angle, it must be raised from a height and a distance and a horizontal angle before the object initiates the next action.
 - If the ball is dropped from a height and a distance and a vertical and horizontal angle, it must be raised from a height and a distance and a vertical and horizontal angle before the object initiates the next action.

5. FINAL ACTION:

- After the last of a string forms a circle, the string must be cut to release the ball. The Device must be able to drop the ball from the string and have the ball fall into the Device.
- The STOP Sign must be cardboard or poster board, oriented vertically, red and square or rectangle.
- If the entire sign is vertical and completely higher than the entire Device, 250 points will be awarded.
- If the entire sign is horizontal and completely wider than the entire Device, 250 points will be awarded.
- No part of the sign will be allowed to be outside the outer boundary of the Device prior to the release button mechanism.
- If the ball falls onto the release button mechanism at the end of its swing, 3 points will be awarded for each point the ball falls onto the release button mechanism.
- If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for each point the ball falls onto the release button mechanism.

6. Two-prime sequence: A Action Sequence (ASL) must be provided to the Event Supervisor as part of the check-in (Regionals/International). The list must indicate the State and the actions initiated by the golf ball, any scoreable actions to be attempted, the Start Time (if one is included), the Target Time, and the Final Action. The ASL must be provided in the Device.

- The Start Time is the time the device begins to move. The Target Time is the time the device must stop. The Final Action is the action that ends the sequence. The ASL must be provided in the Device.
- Participants use no more than 30 minutes to set up their Device.
- ASLs are proper for the competition.
- The original actions in the ASL are properly listed in the Device.
- ASLs are not to be altered after the competition begins.
- ASLs are to be submitted to the Event Supervisor for first time each unique action in 4.0 is successfully completed for the first time.

7. TIME OF OPERATION:

- The Target Operation Time is 60 seconds at Regionals/International, 61 to 90 seconds at State, and 91 to 120 seconds at National. The target time will be the same for all teams. The target time at the start of the competition.
- Timing and scoring begins when a participant drops the golf ball into the Device. Timing stops when the golf ball is dropped from the Device or when the ball has stopped rolling for 10 seconds after the ball has stopped, whichever comes first.
- Teams that exceed the Target Time will receive no (000) points for running time. No negative scores will be given for time.
- If the Device is not running, participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device runs again on its own. Adjusting only to stop or impact operation time will result in disqualification.

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- occurs & passes w/ each full second (measured round down) that the Device operates the Target Operation Time up to 2 x the Target Time seconds.

8. DEVICE:

For each dimension of the Device that exceeds its limit of 60 or 100 cm.

i. For each dimension of the Device that exceeds its limit of 60 or 100 cm, 1 point will be deducted.

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The Rules Sheet (Cont)

• 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 POSSIBLE

SCORING
General Rules, Eye Protection & other Rules on www.ewrc.org if they apply to every event.

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

TIME OF UP TO: 12 minutes

IMPROVED TIME: State or National only

APPROXIMATE TIME: 40 minutes

EVENT PARAMETERS:

- a Each Device must pass a safety inspection before operating. Devices with potential hazards or unsafe operating conditions will be required to make an other safety concern known to the Event Supervisor, otherwise they must receive only participation points.
- b Participants must be 14 years of age or older to compete. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
- c All State and National Tournaments, teams must implement their Device Action Sequence (ASL), any deviation from the ASL will result in a 10% deduction of the total score.
- d Event Supervisors will need their own eye protection (e.g., safety glasses), meter sticks, stopwatches, etc.
- e Participants must be able to answer questions regarding the design, construction, and operation of their Device. Questions can be found on www.ewrc.org.

3. CONSTRUCTION PARAMETERS:

- a During operation, the Device's outer dimensions should be no greater than 60.0 cm x 60.0 cm x 100.0 cm.
- b All actions used for scoring must be valid & achievable. The top and at least two vertical walls must be able to support the weight of the Device. The Device must be able to move in all directions and actions will not cause for points. Any action on the Device not designed to contribute to the completion of the ASL will not be scored.
- c Each moveable/adjustable physical object in the Device must be utilized by a move one assigned action. The Device must be able to move in all directions and actions on the Device must not go beyond the limit of the second action.
- d Use of electrical power is prohibited anywhere in the Device.
- e Cardiac, flamer, matches, hazardous liquids, lead objects (even if encased), gases, hazardous materials (including but not limited to: acids, bases, dry ice, liquid nitrogen), and other handling of chemicals will not be permitted.

4. DESIGN & OPERATION:

- a **Start Action:** (100 points) Participants must drop an unaligned 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 first action.
- b **Scorable Actions:** (50 points each) Participants may have up to 12 scoreable unique actions (i.e. d.i. through d.xii.) that must be completed in sequence. The actions must be completed in the order of the simple machine name implies. For example, a wedge must be "wedged" against an object rather than the object being wedged against the wedge.
- c The scoreable actions may be attempted in any order. Other non-scoreable actions may be inserted between the scoreable actions.
- d Each of the actions below may be attempted only once per point in the Device Action Sequence (ASL). The actions must be attempted in the order of the simple machine name implies.
- e The Device must be able to move in all directions and actions will not cause for points.
- f If the Start is activated or not point will be awarded.
- g For State/National tournaments, the first 10 points will be awarded for the ASL.
- h Final Action:

 - i After the last of the planned sequence one card and points. This timer must not be one of the 12 points in the ASL. The timer must start at the time and before it initiates the next action.
 - j The Device must be able to move in all directions and actions will not cause for points.
 - k The Device must be able to move in all directions and actions will not cause for points.
 - l If the entire sign is vertical and completely higher than the entire Device, 250 points will be awarded.
 - m If the entire sign is horizontal and completely lower than the entire Device, 250 points will be awarded.
 - n No part of the sign will be allowed to be outside the outer boundary of the Device prior to the release button mechanism.
 - o If the sign is horizontal and the device boundary is within the Device, 250 points will be awarded.
 - p If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - q If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - r If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - s If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - t If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - u If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - v If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - w If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - x If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - y If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.
 - z If the golf ball strikes the release button mechanism at the end of its swing, 3 points will be awarded for the action.

5. TIME OF UP TO:

- a The Target Operation Time is 60 seconds at Regionals/Internationals, 61 to 90 seconds at State, and 91 to 100 seconds at National. The target time will be the same for all teams, and the target time at the start of the competition.
- b Timing and scoring begins when a participant drops the golf ball into the Device. Timing stops when the golf ball has stopped rolling. The target time will be the same for all teams, and the target time at the start of the competition.
- c Timing and scoring begins when the Target Time will receive no (000) points for running time. No negative scores will be given for time.
- d If the Device is adjusted during operation, participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device stops again in its own. Adjusting only to start or impact operation time will result in disqualification.

6. CLOSING:

- a Participants use no more than 30 minutes to set up their Device.
- b Participants are to prepare for the competition as described in the ASL.
- c The original actions in the ASL are properly listed in the Device Action Sequence (ASL).
- d If first time each unique action is 0.4 seconds, it is successfully completed as described for the first time.
- e If second time each unique action is 0.4 seconds, it is successfully completed as described for the second time.
- f If third time each unique action is 0.4 seconds, it is successfully completed as described for the third time.
- g For completing the Final Action as described in 6 of 125 points if partially completed or if the Device is not able to complete the Final Action, the participant will be given a chance to leave button/mechanism of the golf ball or the pendulum strikes the release button/

each full second (truncated down) of operation up to Target Operation Time. Device must be able to move in all directions and actions will not cause for points.

h If each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

i For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

j For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

k For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

l For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

m For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

n For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

o For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

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r For each dimension of the Device that exceeds its limit of 60 or 100 cm, the target time will be the same for all teams and the target time at the start of the competition.

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For more information, visit www.ewrc.org or www.ewrc.org if they apply to every event.

Recommended Resources: The Science Olympiad (Score one score) carries a variety of resources to purchase, other resources are on the Event Pages at www.ewrc.org.



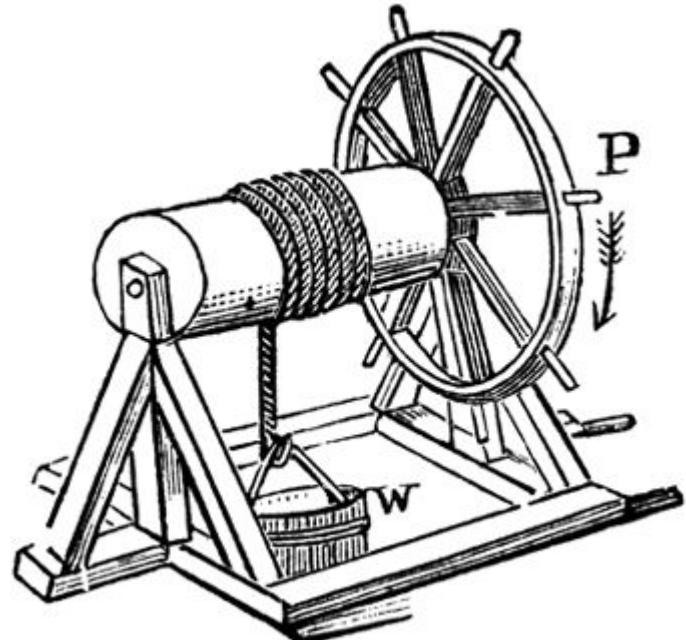
DIFFICULT TOPICS

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.

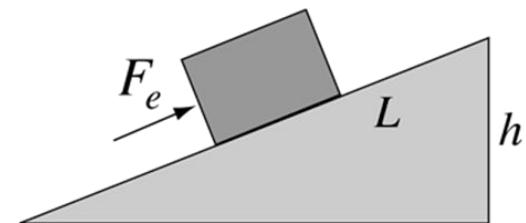
Topic 2: Wheel & Axle Action

- 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 axle which in turn turns the wheel and can lift something on spokes.



Topic 3: IMA of Inclined Plane

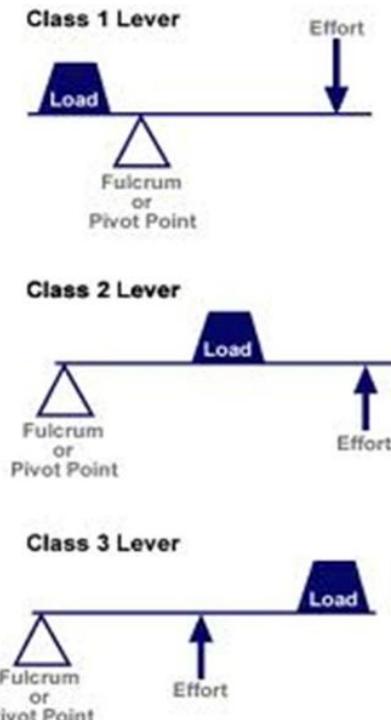
- Section 4.d.iv
- Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm before it initiates the next action.
- IMA stands for Ideal Mechanical Advantage
 - For an inclined plane it is the ratio between the length and vertical height 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.



$$IMA = \frac{L}{h}$$

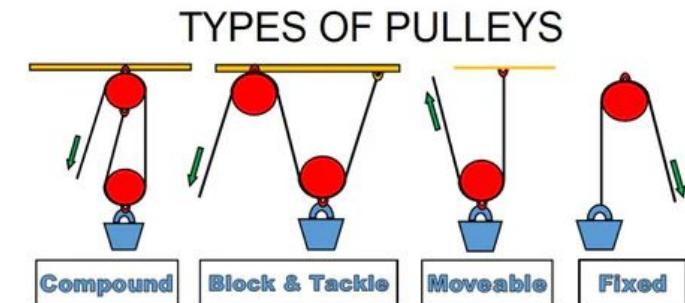
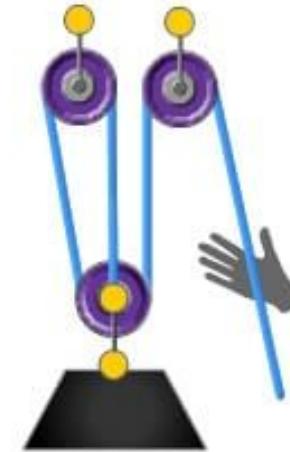
Topic 4: 2nd and 3rd Class Lever

- 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.



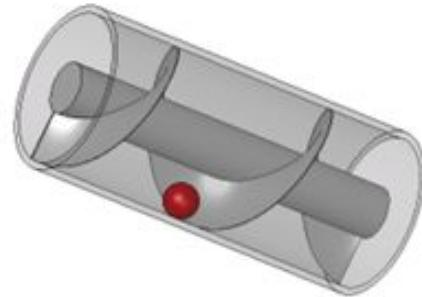
Topic 5: Pulley System

- 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



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.

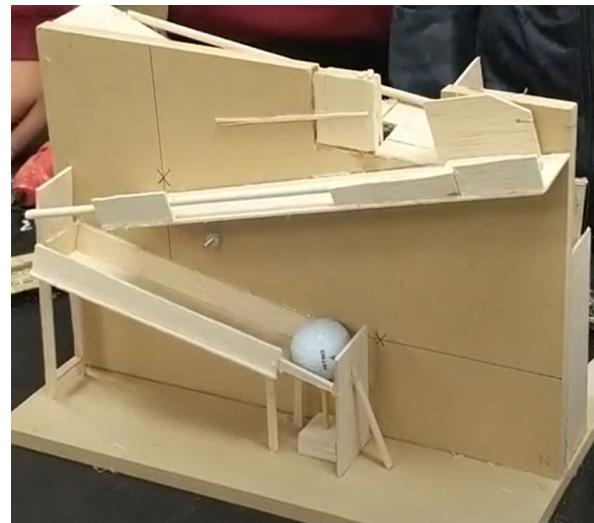
Designing an Action

- 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.

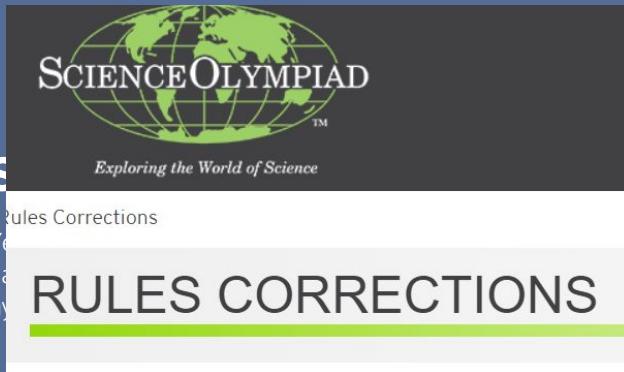


Additional Resources

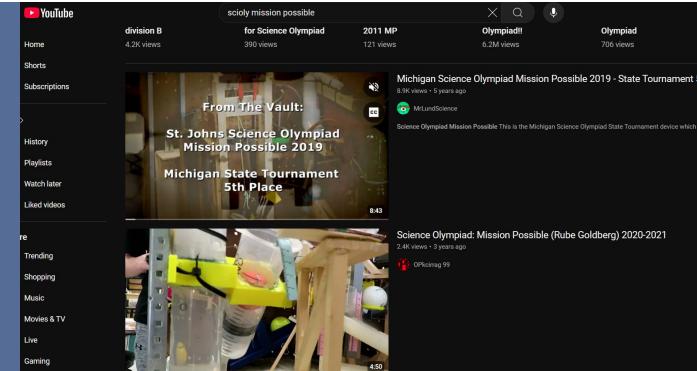


MISSION POSSIBLE

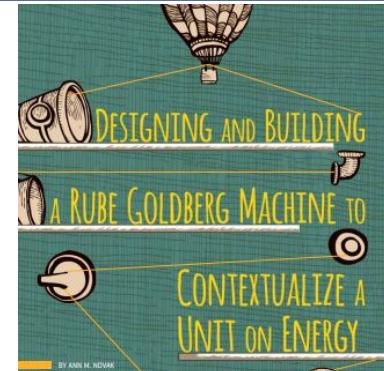
<https://www.soinc.org/mission-possible-b>



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



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



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

THANKS!

