Virginia Science Olympiad
MISSION POSSIBLE
TIPS FOR DESIGNING, BUILDING, AND OPERATING A HIGH-SCORING DEVICE

The Virginia Science Olympiad has prepared and released this document to help participants competing in the Mission Possible event. Others may find these tips and guidelines useful. They **do not** take place of the National Rules, National Clarifications, and/or any changes and revisions that may be made by your state organization. Updates can be found on the Science Olympiad National website (soinc.org) as well as your state webstite.

Plan Before You Build

Know the rules.
- Read them.
- Talk to your teammates about them.
- Look up technical or engineering terms in the rules if you don't understand them. The #1 technical error in the past has been not understanding what is the Ideal Mechanical Advantage (IMA). This year the pulley system must have an IMA of at least 3. Read about IMAs.
- Submit any questions for clarification.
- Design your device on paper.
- Find out from online sources or people you know how similar things have been done before.
- Outline your operational sequence and plan for building each part of the device.
- If your design is too hard to outline and too hard to explain, it's too hard to build.
- Think about tradeoffs. For example, consider whether you should sacrifice size points for additional scorable action elements or easier access.
- Incorporate a timing element. A device with a reliable and reasonably consistent non-electric, non-spring timing mechanism often gets 100 points or more.
- Plan your set-up.
- Find flaws in your design and troubleshoot them before you build.

The Most Common Design Mistakes

Big box. Do not start with a box near the dimensional limit (60 cm x 60 cm x 60 cm) and fill it with things. Start with a functional design (i.e., the scorable actions) and build the most compact structure necessary to accommodate the design. Also, a maximum-sized device often has protruding elements that take the device over the dimensional limit, resulting in penalties. Building a compact device to fit your design is the opposite of starting with a big box and filling it with things.

Large components, large spacing. Do not use unnecessarily large components and leave large gaps in-between them. Determine if smaller components and tighter spacing will do the same thing and be just as reliable and accessible.

Inefficient geometry. Think in three dimensions. Avoid the design mistake of inefficient geometry within an inefficiently big box. For example, there is no reason for horizontal linear elements (e.g., ramps, levers, strings) to be anything other than in-line with each other as opposed to perpendicular to each other. Similarly, there is no reason for devices to be designed primarily in the X and Y axes, with the Z axis as an afterthought.

Inaccessibility. Configure your components so that you can access them during the run. If your device fails during operation, you will need to access the failure point to restart the run. If you must touch the device for a restart, you minimize the loss of points by restarting the failed action rather than manually initiating the subsequent action. The Event Supervisors will not tell you what to do.

Unsuitable materials and unsuitable structural support. Use reliable and robust materials for your device. In decreasing order of robustness, for example, Plywood -> Peg board -> Cardboard; Wooden dowels -> Balsa wood; Two support points -> One support point; and Screws -> Nails -> Duct tape. Use the right materials to attach components so you know exactly how things will move. Levers, for example, should only move up and down, not side to side. Only use tape to secure objects that are subject to little or no force (force = mass x acceleration).

Open pours. Virginia uses the term "open pour" to describe actions occurring in an undefined space, e.g., water or sand being poured from one container to another, marbles rolling off a ramp, or levers flipping things. Eliminate open pours by using components that confine and tightly constrain the action, e.g., funnels, closed tubes, and containers within containers.

Hair Triggers. Ensure that each action is triggered by the preceding action rather than by inadvertent vibrations, touches, or out-of-sequence actions. Avoid precariously balancing items on levers or edges, allowing moving weights to create excessive vibrations, or combining or positioning chemicals in ways that can cause unexpected or out-of-sequence reactions.

Parallel Actions. Only actions that are part of the sequence leading to the final action are scored. An example of a parallel action is when a scorable action and a timing element are operating at the same time. In this case only the sequence leading to the final task (either the scorable action or the timer but not both) will be part of the scorable sequence.

Build and Test Your Device – Then Test It Again and Again

Walk through your device with other team members
- Explain how your device works (action by action) and its anticipated run time.
- Describe the final action.
- Test your device.
- Watch for variability between runs and adjust your device to improve consistency.
- Calibrate your timing element, if you have one.

Complete your action sequence list (ASL) and label your device.
- There are two Event Supervisors and we require two ASLs.
- Your ASL must correspond to the actions labeled on your device.
- Label your device with your team number and school name.
  Check your device against the rules and clarifications.
- Check construction parameters and operational requirements.
- Check for unallowable materials, e.g., rat traps, lead weights, fuses, flammable gases, lasers, electrical or spring timers, over-voltage batteries, and batteries without labeled voltages.
- We have already had problems with lasers and mislabeled batteries / battery packs.

Tournament Day Considerations

Interference. Between the time you arrive at impound and the end of your session, you may not communicate with anyone about MP other than your MP partner. Coaches, parents, other teammates, and outsiders may not communicate with you. We may assess an interference penalty without any warning.

Clean-up. Avoid penalties incurred for not cleaning up or removing your device from the competition area after your scored run. If you plan to leave your device for later retrieval or because you are filing a protest, return it to the impound area