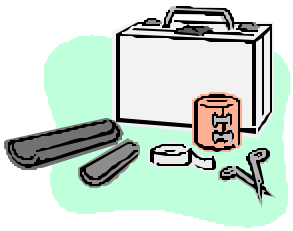
ODYSSEY of the MIND
BALSA TRAINING GUIDE

By George Holcomb - Vermont Association Director

It is important that a team understands the problem thoroughly and brainstorms options before settling on the way to proceed. Then throughout the year, revisit this brainstorming to see if their ideas need reconsideration. It is very common for inexperienced teams to settle on a single set of materials and design, ignoring some of the more innovative ideas as they progress.

- **TOOLS AND SAFETY**



The most important thing to keep in mind is **safety**.
Young teams/builders should always work with adult supervision.
Nearly all tools used are made to cut and are thus VERY sharp.
- Sharp edges should ALWAYS be directed away from flesh.
- Stay focused and no horseplay.
- Wear eye/hearing protection when these dangers exist.

- **OUTSIDE ASSISTANCE**

It is not OA to have a coach to purchase a selection of glues or other materials for teams to experiment with.
It is not OA to attend meetings like this, to bring in a guest to talk about general engineering principals, or research publications or search the WWW for test results with glue and balsa.

An invaluable web site all Odyssey of the Mind structure teams should visit is:
www.zimsweb.com/balsa/index.htm, with more information available at:
www.odyssey-world.org

If it is available to everyone or is general knowledge, it is not OA to use.
The final decision on; design, glue, size balsa to use, sequence and construction procedure is that of the team members.
If the way the team wants to cut the balsa is too "scary" or dangerous, then the team needs to find another way.

"Are you checking your glue joints? Yes! Are you sure".
It is not OA to have a carpenter discuss their favorite glue for woodworking joints.
It is not OA to have this carpenter discuss jigs they have used on their wood projects.

- **CUTTING AND SHAPING**

Teams should determine the right tool for the job.
Sandpaper, Razor blades, X-Acto tools, cutting jigs and even power miter boxes are tools.
Some saws are used in conjunction with miter boxes to keep the cuts square.
(Slats on louver door example at yacht co. – tape/rubberband example of jigs).
Razors work well in softer materials like balsa wood.
Use magnifying glass to look for "local" effect, (crushing).
Shaping is different than cutting.
Shaping removes a small amount of material at a time.
Cutting separates material into distinct pieces.
Sanding and filing are examples of shaping.
Shaping is often used in conjunction with cutting to leave ends of material in the best condition.

- **WORKSPACE CONSIDERATIONS** OR "AREN'T SAW CUTS, RAZOR MARKS AND GLUE ON THE TABLE WONDERFUL MOMENTOS?

However, anyone who won't treasure these momentos should consider a "sturdy but expendable" table, (some teams use a folding card table).
Cover or protect your work surface. I have guided teams to use multiple layers of newspaper at the cutting point and plastic covers for the glue, so I don't have these momentous!
Space should be well lit.
Plastic cutting boards are expendable and consistent, (flat). Some types of glues do not stick to them.
Graph paper, calculator, squares, protractors, pencils or white boards are good to have around to help a team plan out design ideas.
A scale or balance able to measure to 0.1 gram is extremely helpful, but not necessary most pharmacies will weigh structures if asked . *It is good to ask politely and ask the druggist what times are better.*
A first-aid kit probably will be needed at some point.
A trash can – plenty of trash will be generated.

- **GLUE SELECTION** (a sticky subject)

The coach should review any safety considerations on the glues that are being considered.
It is not outside assistance for a coach to say, "this glue is too dangerous".
Though there are many glues available - the team ultimately will have to decide on which to use.
Temporary glues, like hot glue sticks, might be used in the quick assembly of early designs.
Some glues are instant and can glue skin, "debonder" should be purchased with these, (acetone, nail polish removers and others work well also). Always read and follow the safety precautions on the container.

As said before, it is not outside assistance to have an expert woodworker come and discuss which glues they prefer in their woodworking projects or have the team research in publications or the WWW for information on glue, (LITERATURENOTES – pg. 5 & 6).

Again, the team makes the final decision on what type of glue to use and should consider the following:

- Can it be used safely?
- How strong is the joint that is created?
- How easy is it to create the joint?
- How consistent are the joints created by the glue?
- How long does it take for the glue to "set"?
- Does the glue add to the weight of the structure?

A team won't be able to decide which glue works best for them until they have gained some experience through building simple 2-dimensional structures.
Once a team decides on glue or a couple of glues have a "build off" of simple identical structures.
Have the team members evaluate the "build off" structures and devise a way of testing them.
This will help in their final decision on glues.

Once the team can make consistent glue connections, next they should be able to reproduce a simple structure to a plan, have it weigh about the same and be able to hold similar weight. Once this level is achieved, and it takes a lot of work, then a team can determine performance differences between different structures and not be concerned with skill or construction differences.

Some teams will have only 1 – 3 team members build the structure, while others work on the skit and props.
The focus of these early structures is SIMPLE and focuses on consistency, not on weight held.
Teams should celebrate their learning of tool and glue usage and consistent building of anything in the early parts of the season. These early successes build a solid foundation for the future.

- **GLUING TECHNIQUES**

This may sound trivial, but a team wants consistently strong joints and weight of glue. Consider these examples.
- 2 billiard balls contact at one point, as you move them apart, it would be difficult to get a solid glue connection, no matter how much glue was used, but …
- 2 glass sheets are almost impossible to pull apart with a drop of water.
Try to glue two pieces together that still have irregularities and it is like gluing 2 billiard balls together.
Oil from hands and sawdust from shaping balsa could be on the structure and compromise the glue from penetrating the wood and making a stronger joint.
Pressure on the joint being glued is also important.
(Wet sponge/dry sponge analogy).
Glue adheres to 2 pieces of material, not by simply forming a layer between the two, it can actually penetrate the materials, therefore the right amount of pressure to apply during glue setting and drying is important to learn.
Since gluing expertise is key to building stronger structures, it is good to develop this early on simple structures, without crushing components of the structure.
They should bend, push and pull these simple structures and see how they fail.
A well-glued joint is often stronger than the material being glued and the material around the joint will fail before the joint (LITERATURENOTES pg. 5).

- **MATERIAL SELECTION**

Mail order balsa, tools and glue suppliers versus purchasing locally

Local hobby shop or hardware store
- Products may be mixed i.e. size, species etc…
- Allows team to hand select
- More costly

Mail order – for balsa and specialty tools
- Consistent quality
- Less costly
- Loose opportunity to hand select
- "Bad balsa" used for test structures, some discarded.

Sources for mail order:

www.odysseyofthemind.com
www.sigmfg.com www.micromark.com
www.superiorbalsa.com www.nationalbalsa.com
www.balsausa.com www.lonestar-models.com

Use only the materials allowed in the structure problem (type of wood and sizes specified).
Some balsa will be stronger than others, some will be heavier than others (brainstorm why?)
Structure is only as strong as it's weakest part.
2 seemingly identical structures can differ by hundreds of pounds of "weight held".
Understanding the properties of balsa will help a team build stronger structures.
Equally important is it will allow the structure to be rebuilt and hold a similar amount of weight.
Have the teams:
- Feel, and look at differences in the balsa.
- Bend, pull, twist and compress the structure.
- Drop pieces of balsa and note the differences in sound.
- Weigh different pieces.
- Look at pieces with a magnifying glass for grain (open discussion).

This exercise will help teams generate ideas on strengths and properties of different samples (test these ideas).
Density chart (HAIRYLUNCH's Creative problem solving web pages pg. 2).

- **BUILDING A PLAN**

Stability of the structure is important

A pencil balanced on its point could support a moderate load. However, it would be almost impossible to apply that load without keeping the pencil from falling over. Many structures fail because they start to lean. If one part of the structure starts to fail chances are the entire will also in a domino effect.

(Framed wall description and compression and torsion).

The first requirement for building is to have a plan.
Quick sketches are good for brainstorming.
It is not OA to drive the team around to observe electrical tower and bridge construction.
Similarly, it is not OA to invite an engineer to give a talk and answer questions about structures in general.
For most structures, enough symmetry exists so that a "side" view is enough to describe the structure.
A "top" view, (looking down on the structure) shows how the individual side views go together.

Isometric views and detail views are others.

Date your drawings/sketches.
Give designs a name, which will be easier when talking about them in the future.
Photocopy the drawings for records and reproduction by different team members (some distortion may occur).
Have the team guess/decide where they think their structure will fail.
With safety glasses have the team members watch as the structure collapses.
Sometimes videotaping the testing will allow the collapse to be view over and over, and maybe at slow speeds.
Make changes in designs at minor amounts to isolate whether or not the change was a real factor.
Many teams use a template or "jig" to construct their structure.

- Cardboard with photo copy with small clamps.
- Metal sheet with magnets to hold the wood.
- Cork board with wax paper.

The team must build and design all construction aids, other than "off the shelf" tools used to build their structure.
It would be OA for a coach to insist the team use a "jig".
A Jig does not have to be complicated, a rubberband is a "jig".

- **CONSTRUCTION ORDER and MANUFACTURABILITY**

Part of building to a plan is planning out the order the structure will be assembled, (construction example).
It is common for an inexperienced team to assume there is only one way to assemble a structure.
It is appropriate for a coach to encourage the team to brainstorm alternative assembly procedures.
An elegant design that is very difficult or impossible to build is of little value.
The team's design should be a balance between; holding as much weight as possible and being something they can build, test and learn from in the shortest amount of time.
Simple at first and more complex as they develop and improve their construction techniques.

- **FINISH DETAILS**

One of the keys to building really strong structures is to spend time on "follow through details", for an example a wonderfully constructed structure could turn into a "leaning tower of Piza" unless it is checked for plumb.
Similarly, the team should check to make sure that all parts expected to carry the load actually contact the upper and lower surfaces of the tester. Overlooking this could detail could leave one leg "hanging in mid-air".
Water can become trapped in the structure within its pores and many teams try to remove this excess moisture from the structure before weigh – in using desiccant, hair dryers, or "hot boxes".
(See HAIRYLUNCH CPS pg. 3 & 4).

- **WEIGHT PLACEMENT ISSUES**

Very important to practice; school gym – maybe build your own tester (see diagram at right, schematics on original problem, and the photo below to get a better idea of what a crusher is)
Paper plates can be substituted for weights for "motor" and timing practice.
Team member strength, how placement relates to the skit, finger and hand position all determine in what order a team will place weight.
Coaches help, Division I – more than 20 pounds, Division II – more than 40 pounds, however the team members must select the weight and assist in handling the weight at all times.
Have a contingency plan in case structure breaks early or team member is sick.

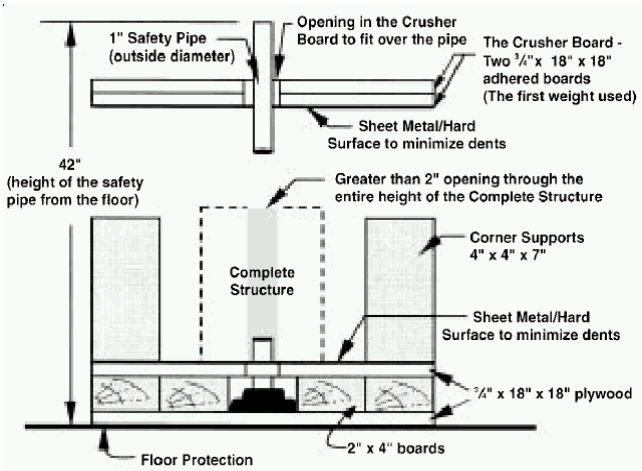
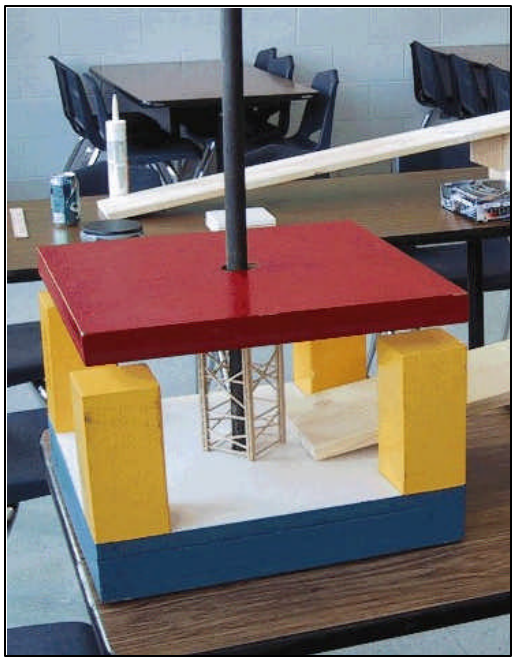


Figure B - Tester Design

- **TOURNAMENT PROCEEDURE**

Forms.
Only material used in the performance needs to appear on cost form.
Often teams bring 2 structures (one for competition and one as a backup)
Weigh-in procedures – leave plenty of time.
"Snap" in place, the title – but what are the requirements of the problem?
Protect the structure in transport and handling (a box?).
The structure tester actually used for competition is supplied by Tournament Director.
8 minutes (includes set-up time).



An Odyssey of the Mind "Crusher" or Structure Tester. The ramp at the right was used in the 2000-2001 Balsa Long-Term Problem and is not part of the normal Structure Tester in most years.

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