



GETTING STARTED

Tools for Tech Challenge Teams



Tools for The Tech Challenge Teams

Design Journal

A design journal is a collection of notes, drawings, and photos that communicates your work on a project. Design journals are not unique to The Tech Challenge. Scientists and engineers use them all the time to document their projects and experiments.

How to keep a design journal:

- Use a notebook/binder/folder. You don't want to lose any important pages.
- Be creative – use colors, sketches and doodles – include any and every part of your design process.
- Everyone on the team should contribute to the teams' design journal as you work toward a solution to the challenge. But it's OK to have just one "recorder" and to include everyone's personal thoughts, ideas, or feelings (as long as they relate to this project).
- Keep up with new ideas as they come to you – even if you don't pursue them.
- You usually never know at first if an idea will amount to anything – so write all of your ideas down! That way you don't have to worry about "forgetting" any of them.
- Keep a list of your brainstorming ideas – you might use one of these great ideas later. What if another idea comes to mind later tonight? Still write it down and add to the journal at your next meeting.
- The journal should include a project plan, details and analysis of testing, analysis of the test trials, problem solving ideas/steps, etc.
- Keep it organized. It can be chronological, or by subject, that is your choice. You can create a table of contents, or just label sections with sticky note flags.
- It doesn't have to be pretty. Include the actual notes, drawings, and scribbles even if you spilled water all over them while you were testing!
- Include pictures. If words or drawings aren't enough to explain something - take pictures.

What do the judges look for?

We know what you really want is a copy of the judges' score sheet - but you know that that's not going to happen! You just need to make your design journal your own. Every team is going to do things differently. Put your journal together so it best communicates the design process of your team. Judges may ask you:

- How did your team come up with its solution?
- What was something that challenged your team?
- If you had more time, what changes would you make in your design?
- Was there anything unexpected that happened?
- Did you do any research to inform your design? How did it help you?

Other points to remember:

- Include your schedule, budget, and other logistical planning.
- Your journal should include which solution was selected, the others that were seriously discussed, the rationale behind choosing that particular solution, etc.
- Sketches do not have to be works of art, scientifically accurate, to scale, etc. Just a visual description of the idea. Sketches are just a first idea.
- Labels and words often help explain what the quick sketch may not illustrate well.
- Keep your prototypes and/or take pictures of them. They may help give you ideas later and they can also help communicate your process to the judges.
- Keep track of tests, what worked and what didn't, and changes the team makes to try and improve the device. Also, keep track of your other thoughts and ideas that come up – those may come in handy later!
- Be sure to include how you decided on a device, your team name, your costume, the devices decoration, etc.

Brainstorming

Brainstorming is good for generating new concepts, solutions to specific problems, new products, copy and text etc. - but mostly to help you get unstuck. Brainstorming builds enthusiasm around your project. It gets people talking to each other.

Defer Judgment

When someone chirps in and declares “oh you can’t do that because ...”, it kills a whole generation of new ideas. In brainstorming, bad ideas don’t exist because they serve to make good ones better.

Build on the Ideas of Others

- It’s a team effort.
- No one owns an idea -- it’s the teams’.
- Take someone’s idea and add to it making it better.
- Sometimes when you paraphrase someone and re-describe their idea you actually misunderstand it and you come up with a new and better idea.

Stay Focused on the Topic

Keep your minds on the topic you are exploring, not about what you ate for dinner last night...

One Person at a Time

It is easy to get so excited you roll over some quiet brilliance mumbled in the corner. Give everyone a forum to share their ideas.

Go for Quantity

So try for 50 ideas, 100, 150 or a million!...Just Kidding!
Seriously, our motto is: *Build Many – Bring One!*

Encourage Wild Ideas

Make people crack up and roll on the floor!

Be Visual

Don’t be afraid to draw because of what others may think. Who cares if you are not Van Gogh? Draw, draw, draw! Pictures help others; they will help communicate your ideas.

The ingredients to a great brainstorm:

The Set-up

- Put paper everywhere
- Pens, markers, crayons, all different colors.
- Bring relevant materials: pictures of the test rig, etc.
- Scissors, glues, foam core, tape – build relevant stuff on the spot.
- Food: you may think better with food

Pick a Facilitator

- Pick someone on your team to be a facilitator, someone who will only document the ideas discussed in your brainstorming sessions.
- Try not to brainstorm for longer than 1 hour; take breaks to get fresh ideas.
- Remind everyone of the rules, especially defer judgment.
- List ideas, number, or sketch quickly. Be aware to list everybody’s ideas! (whether they’re negative OR positive)

Important Note: Pick a Specific Topic

Breaking the problem down into smaller parts and then start brainstorming those specific problems, this way it will be extremely beneficial, and less overwhelming!

Evaluation

- After a brainstorm session, review the ideas before you forget the small details of the idea.
- As a team, pick which ideas you think will work and want to focus on. Don't erase any of the ideas, for they may be beneficial later on in the process!
- Try to organize your ideas into categories and themes.

Have fun!

Picking a Solution to Test

After brainstorming, you should have many ideas, and it's important to have a way to sort through all of them. One way to do this is by creating a decision matrix. This is a way to rank your five to ten best ideas on criteria that are important to you. Decision matrices, just as brainstorming should be on a very specific question, not one that is broad or vague.

Shorten your long brainstorming list to the several ideas that you want to decide between. Make sure to keep several ideas that maybe were not the most standard solutions. Sometimes these creative ones will work the best! For an example, let's pretend that we were trying to decide where to have a birthday party. There was a long list of ideas, but out of that list, we decided on the list:

- Home
- Pool
- Pizza place
- The Tech Museum
- Amusement park
- Garbage dump

Agree on what criteria you will use to decide. For our party example, some important criteria might be:

- How much fun people will have?
- How expensive is it?
- How many people can fit?
- Is it easy to provide food there?

Give each criterion a weight (from one to five). For instance, cost may be very important since our parents won't pay for it if it's too expensive, so we'll rank that a 5. Even though everything may seem important, do not just rank all the criteria as a 5. Discuss which are really more or less important. The more you work on this step, the better information you will get from your decision matrix.

Create a matrix with the criteria down the left side, and in the next column write in all the ratings of the criteria. Along the top, write your solutions from step 1.

Finally, total up all of the information. For each solution, multiply the ranking for the criteria times the ranking of that solution for the criteria, and add up all the numbers you get.

Note: It often helps to create a "Design Sheet" for each idea so that you can keep track of your ideas and make sure to add them to your journal.

See the next page for an example of a sample design sheet.

Design Sheet # _____

Design Name: _____

Designer: _____

Pros

Cons

How this design would work

Questions & challenges related to this design

Sketch

Material Selection

What materials should you use for your device? There are several properties of materials that you should consider when making your choice. For The Tech Challenge, you will most likely need to consider a material's mechanical, physical, and even sometimes electrical properties. (There are many other properties as well.)

Mechanical Forces

These forces will affect different materials in different ways:

- Tension: pulling the material apart
- Compression: squeezing the material together
- Shear: two pieces of the material sliding past each other
- Torsion: twisting the material

Mechanical Properties

Some of the ways materials withstand mechanical forces include:

- Strength: how much tension, compression, shear or torsion can a material take before it breaks apart, ruptures, twists, etc.
- Elasticity: how much can you stretch a material and still have it return to its original form (rubber bands are highly elastic)
- Stiffness: how much weight can a material hold without flexing, the opposite of elasticity (glass is quite stiff)
- Plasticity: how easily a material can be pushed (malleability) or pulled (ductility) into a new shape (clay is malleable, chewing gum is ductile)
- Brittleness: how easily a material will break before it is deformed, the opposite of plasticity (glass is quite brittle)
- Hardness: how well a material resists denting, scratches, etc. (diamonds are quite hard)
- Toughness: how well a material absorbs energy without breaking (a hammerhead is quite tough)
- Fatigue: how well a material maintains its material properties under repeated stress (a spring must resist fatigue to work well)

Physical Properties

These describe the qualities of the material such as shape, size, weight, and surface texture. In particular, consider:

- Density: weight/volume. Liquids and gases can hold up materials that are less dense than they are. That's why helium balloons float, and the oil goes to the bottom of your Italian salad dressing.
- Porosity: how much of a material is made up of air space. Highly porous materials are lightweight because of all the air space. However, that air space can suck up water or glue. How might that affect how you build your device?

Electrical Properties

Some ways to measure a material's electrical properties include:

- Conductivity: how well does a material conduct electricity. If they do it well, they are conductors, if not, they are insulators.
- Resistivity: how easily an electric current will flow through a material

In addition to these scientific properties of materials, think practically about your materials.

- Does it cut easily?
- Can you use any kind of glue or tape on it?
- How much does it cost?

- How easy is it to purchase, borrow, or find?
- What do you need it to do in your device?

The following chart gives you a few samples of things you might use to build your device. Use this as a starting point but make sure to explore other options as well.

Materials Use for....

- Wood: Heavy structures, weighted base
- PVC: Medium weight structures; light but flexible; cheap
- SCH40: Strong structures; less flexible
- Aluminum: Strong, thin structures
- Foam: Light weight solid panels
- Foamcore: Light weight panels
- Cardboard: Light weight panels

Fasteners: What materials can I use it with?

- Wood screws: Wood
- Bolts/nuts: Wood
- Self tapping: PVC, ABS
- Wire connectors: Electrical wires
- Terminal Lugs: Electrical wires

Adhesives

- Solder: Can connect metals like gold, copper, tin, zinc or lead. Can't be used on iron or steel.
- Epoxy: Aluminum, coat hanger
- White glue: Wood
- Hot glue: Foamcore, wood (but it's temporary), PVC ("light" adhesion)
- PVC glue: PVC
- Duct tape: The universal fix-it tool

Now Start Building & Good Luck!