



The Tech
Challenge

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Guide for Advisors, Educators, and Parents



The purpose of this guide is to help new advisors, team organizers, teachers, and parents lead student teams participating in The Tech Challenge. The Guide complements the resources available on The Tech Challenge website (<http://techchallenge.thetech.org/>).

Overview of The Tech Challenge

The Tech Challenge is a signature program of The Tech Museum. For over twenty-two years, this program has given kids from grades five through 12 practical experience with the engineering process, literally challenging them to design, build, document and present a solution to a real-world problem. The hands-on, project-based nature of The Tech Challenge provides young people with skills that are relevant for the rest of their lives, no matter what kind of higher education or career path they choose.

The Tech Challenge is a great program for educators to tap into, as it ties into California curriculum standards. Teachers can participate with their classes and know that Tech Challenge will hit on many of the topics essential to their science and math teaching objectives.

The program also provides parents and other adults with the opportunity to engage with young people in a very positive and productive way. As advisors/mentors to participating teams, parents and other adults have reported that their Tech Challenge experience enabled them to spend high quality time with their children focused on something they know will help their children lifelong: *science and math made real.*

At the heart of The Tech Challenge program is the challenge itself. Unlike other high profile science competitions such as the US FIRST Robotics competition, which focuses exclusively on robotics, Tech Challenge has consistently offered participating kids the opportunity to work on many different real-world engineering challenges and scenarios. They have included:

- 2009 – Explore the Volcano
- 2008 - Water Works
- 2007 - Mars Crater Mission
- 2006 - Fight the Flood
- 2005 - Battle the Blaze
- 2004 - Pick a Pike
- 2003 - Canopy Climb
- 2002 - Pass the Tech Torch
- 2001 - Martian Crater Escape
- 2000 - High Adventure in Space: Mission to Power Up a Satellite
- 1999 - Rescue at Sea
- 1998 - Climb an Elevated Bridge Cable and Prevent a Major Disaster
- 1997 - Land a Robotic Rover on Mars and Escape from an Ancient Crater
- 1996 - Climb a Treacherous Passageway Inside an Ancient Egyptian Pyramid
- 1995 - Take the Climb
- 1994 - Under-ice Salvage Mission in Antarctica A Nuclear Fishin' Impossible
- 1993 - High Adventure in Space: Mission to Power Up a Satellite
- 1992 - Martian Motion
- 1991 - Escape from Valles Marineris on Mars
- 1990 - Analysis of Martian Soil and Steep Incline Martian Terrain
- 1989 - Mars Traction Problem
- 1988 - Mars Crater Hole Problem

ROLE OF THE ADVISOR

We use the word “advisor” to mean any adult who works with teams on The Tech Challenge. The Tech Challenge teams come from a variety of circumstances. Some participate as part of a required class, some are from programs or clubs that meet before or after school, many are “just friends” who may or may not attend the same school. The adults who work with these youth can be teachers, community youth organization leaders, parents, or community volunteers. Whatever your relationship to the team, welcome to The Tech Challenge! Your support and encouragement is very important to their experience.

There is no single definition of “advisor.” Your role as a team advisor can range from chauffeur and chef, to referee, to manager, or even technical support. Technical skills are not required; in fact, many teams seek an advisor who will specifically not be offering technical assistance! The most important role you play is to encourage the team. Help them through the difficult phases of the project, encourage them to prototype and test their ideas early and often, so they can “fail their way to success.”

For those of you who might be prone to share too much of your technical expertise -- remember that this is the students', not yours! Please take the lead where safety is concerned (especially when using tools), but be sure to follow the students' exact direction without imposing your “corrections”. One common question that advisors ask is “how involved can I be?”

The following should help you evaluate your interaction with the team:

The team	The advisor
Is having fun	Mentors and guides the team on its process
Can explain their process, why certain decisions were made and what they've learned	Facilitates conversations and discussions to help the team think about the from different perspectives
Is involved and engaged in every phase of the process	Helps the team with problem solving by asking questions but not giving answers
Feels ownership	Is encouraging, supportive, and patient
Experiences failure and learns from it	Keeps his/her hands off (except in the case of safety concerns) the device

Here are a few questions that can help guide your interaction with the team:

- Are the students doing the actual work?
- Are the design ideas generated by the team?
- Center your steering questions on the constraints.
- Are you advising and mentoring or problem solving?

The most important role of an advisor to a team for The Tech Challenge is that of facilitator. An effective advisor uses open-ended questions and reflective statements to involve students directly in their teams' problem solving process.

GETTING HELP

You don't have to go it alone! There are many ways to get help from schools or youth organizations, teachers, and other parents. Here are a few suggestions on how to engage those supporters.

School and Community Organizations

- You can seek help from teachers (science, shop or woodworking, drafting, art, and more!), or volunteers throughout a school or community organization. Be sure to expand your search outside the school, organization, or teachers you know. Maybe your middle school team can connect with a nearby high school to gain access to expertise and tools found there!
- Invite students from school or the community organization to attend The Tech Challenge event! This is a great way to build a cheering section of friends and relatives.
- Organizations can recognize the student's participation and achievement in publications (print or web) and/or student award ceremonies.

Team Members' Parents

Parents of team members can play a key supporting role. The Tech Challenge is fun and rewarding, but it requires a time commitment from both students and their parents. Communication is key! We recommend a parent meeting at the beginning of the project so that everyone understands the scope of the Challenge, puts key dates on their calendars, and has a common understanding of everyone's role.

Here are key support roles parents of team members can play:

- Driving team members to and from the Challenge Trials
- Organizing and hosting team meetings
- Preparing lunch/snacks for team meetings
- Donating items to be used in prototyping or constructing the device itself
- Driving the team to the hardware store or craft store to purchase supplies
- Providing tools and expertise in their use for construction
- Assisting with team costumes
- Attending The Tech Challenge Event and cheering loudly!

PROJECT SCHEDULE

Often, students have never taken on a project like this one, and they can use your help in seeing the big picture as they create a timeline and milestones. To help teams establish a project schedule, break down the work into four general stages:

Stage 1

- **Get organized.** Announce a few regularly-scheduled team meetings.
- **Start thinking.** Help the team research the challenge background and constraints. Encourage them to analyze the Challenge – break it into smaller parts. Encourage them to keep an eye out in the world around them for ways this problem can be approached.
- **Prepare for the Information Clinic.** Encourage the team to create a list of questions to ask. Help them plan to take notes and pictures at the clinic.
- **Attend Information Clinic:** Learn more about this year's challenge.

Stage 2

- **Planning.** Help the team create a timeline with milestones.
- **Brainstorming and research**
- **Design journals.** Make sure the team is recording their every move in a design journal (or notebook). They should pick three or four favorites from the brainstorm list and develop those ideas more fully with sketches, words, and quick models.
- Complete **team registration** if you haven't already.
- **Attend Team and Advisor Workshops**

Stage 3

- **Decide** on one design to pursue for the actual day of The Tech Challenge after you've prototyped and tested all of your challenge solution ideas.
- **Analysis.** Remind the team to take good notes at every meeting or trial and to spend time analyzing what works well and what needs improvement.
- **Review judging criteria.** The team can understand what judges are looking for by reading the judging criteria and constraints on the website.
- **Attend Challenge Trials**

Stage 4

- **Test and redesign.** This month will be filled with testing and troubleshooting
- **Organize the documentation.** Encourage the team to organize their notes, and review their process throughout the project. Remind them of the judging criteria and help them find relevant examples in their experiences.
- **Creative Flair.** Encourage the team to express their creativity on event day.
- **Final Days** Help the team keep their focus as they make finishing touches to the device, the design journal and the team presentation. Encourage them to practice their device operation and presentation in front of adults.
- **Final Challenge Trial.** This one is especially busy – arrive early!
- **Tech Challenge Day.** Bring friends & family to cheer the team on.

After the event - Throw a party! Celebrate the team's accomplishments.

TEAM MEETINGS

This is where all the action happens – team meetings! Here are a few tips for making sure each meeting is successful.

Set ground rules

As the team begins regular meetings, it's a good idea for them to agree to some ground rules (or "norms"). Here are a few suggested team rules – have your team work together to create their own list!

- We will attend all team meetings (if anyone misses more than a few meetings then they should consider dropping The Tech Challenge this year).
- We will make a commitment to help each other as much as possible.
- We will discuss the project at school (or after school) as much as possible.
- We will all work on the project during team meetings (ok, a little play is all right).
- We will take advantage of the skills of every team member (there are a lot of hidden talents in every team).
- Most of all, we'll have fun together!

Meeting logistics

- **Meeting time:** We know of teams who meet at most any time imaginable – some meet before school or after school; others meet on weekends. There are some who even meet during school – when this is a class or club project! Find a regularly scheduled time that works for everyone and stick to it.
- **Meeting length:** Keep in mind that most students this age can work on a of this type for about 2 hours before their productivity drops.
- **Snacks:** Snacks are helpful for many team meetings. They can break up longer meetings.
- **Goals for each meeting:** Each meeting should have goals or outcomes – what the team wants to accomplish in the given time. Also, be sure there is someone watching the time, making sure the team has time to clean up at the end of each meeting.
- **Journal, Journal, Journal:** Encouraging teams to write things in their journal can be a difficult task. Here is one simple tip to make journaling seem less daunting, as well as helping to organize each meeting. Have the teams answer this question at the beginning of each meeting:

What are we going to do today? What are our goals?

At the end of the meeting, teams should answer:

What did we learn today? What do we need to do at the next meeting?

These answers can be in words, photographs, or sketches. This is the beginning of a great journal!

BUDGET AND MATERIALS

You should help the team establish a budget. The Tech Challenge offers no specific guidelines or constraints on the budgets that teams use. Key budget elements are:

- Material costs for building device (can range from \$10 or more).
- Documentation costs (notebook, paper, film, etc.).
- Spirit costs (costume and marketing presentation) – can vary significantly depending on team's preference. Be sure to check with craft stores such as Michael's for home-printed T-shirt options and other fun, inexpensive ways to show team spirit. Other spirit-themed items such as a team logo, creative team name, team colors are all very inexpensive and add lots of creativity and fun to the. Have the "cheering section" also get into the act!
- Cost to build the quick rig. You can usually recreate the key elements of the test rig at home or at your school. Note: If the school or youth group is entering multiple teams, everyone can share one test rig.
- You might consider a budgeted cost of \$20-40 per student, which could include T-shirts if the team was creative in finding most of the components in their garages or around the house. *Note: Team costumes are not required, but can be fun! Plus there is an award given for Best Costume!*

Finding materials

- **What:** Your team can use a variety of materials – many different items are useful for prototyping and building the actual device. Don't forget items for the team to take apart – electronic toys and other discarded items can help the team learn many valuable things about mechanics, motors and more!
- **Where - scrounging:** In addition to the "stuff" that you can get from your own garage, you can also head to local garage sales, the San Jose Flea Market and Goodwill or Salvation Army stores for gadgets, tools, junk, used toys and appliances to take apart.
- **Where - shopping:** There are many surplus stores, hardware stores, or hobby/craft stores that may also be helpful. Keep in mind other sources of materials, including small stores that specialize in one particular material (i.e., plastics, foam, etc.). There are many on-line offerings available, including stores such as American Science & Surplus and Oriental Trading Company that will help with parts for the device or the team spirit aspect of the project.
- **Where – RAFT:** The Resource Area for Teachers (RAFT) sells supplies and materials to local teachers and educators. As an advisor for the Tech Challenge, you are qualified to become a member of RAFT. Membership is \$10 a day or \$35 for the year. To learn more about this great resource visit <http://www.raft.net>.

THE SPRIT OF THE CHALLENGE

In addition to being familiar with the judging criteria, judging process, and constraints, the team also needs to understand **The Spirit of Tech Challenge**. There are five key elements to the Spirit of The Tech Challenge: Participation, Process, Performance, Imagination, and Fun. Each one is equally important for a successful experience at The Tech Challenge.

Participation

This includes teamwork, taking risks and learning new skills in the course of this project. What challenges did the team face and how did they overcome them? Perseverance and learning from failure are also important.

Process

What are the steps that lead from brainstorming to the final product? Did the team layout goals for the design early on? How were those goals modified as prototypes were built and tested? The journal is a key piece of keeping track of all the steps to the project. Judges will want to hear the team's reflection on their process.

Performance

What makes the team's innovation work well? Is it efficient? Does it have both "form" and "function"? In addition to basic functionality, other design features of the solution can be highlighted here.

Imagination

In the world of The Tech Challenge, imagination is about ingenuity, inspiration, and inventiveness. Whimsy paired with functionality is fabulous! This is about bringing those crazy ideas into practice – creating something that is truly inventive and really works!

Fun

We want teams to have fun in the process as well as in showing off their product on the event day. Teams are encouraged to showcase their team spirit and what makes them unique. Some teams write poems or songs, others come in costume. Some teams have fun team names, others decorate their devices.

WORKING TOGETHER

As an advisor, there are certain team issues that may arise as your students learn to work together. Here is a list of some challenges that teams may face:

- **Gender roles:** If you are advising a mixed gender team, keep an eye on which roles boys and girls take on. Ultimately, each team member should have experience in all facets of the project (i.e. each student should have hands-on experience in using tools and journaling). Make sure that all students have an equal chance to learn new skills.
- **Procrastination:** Mid-way through the project students may begin to show signs of procrastination or a lack of motivation to finish theirs. Often this behavior occurs because the team feels “stuck.” As an advisor, try to help them see paths around, through, over, or under their problem. Help the team look elsewhere for inspiration, both from their original brainstorm (hopefully recorded in their journals) and from external resources (books, toys, other teams, games, TV shows, etc.).
- **Communication:** Students sometimes need a little nudging to get out of the “all about me” phase, especially when working in collaborative groups. When the communication breaks down, give the students some hints about how to talk to each other:

Common phrasing	More productive phrasing
We should...	What about if you tried...
My idea is...	Remember when you came up with the idea that...
I think...	What do you think you should try next?
We need to...	Have you looked at ALL of your options?...Have you tried the Internet?

- **Equity in Engagement:** Some students will take over the project, leaving others’ voices unheard; some will disengage on their own, while others are pushed out...Don’t let this happen – say things like, “Have you taken a vote on this?”

“Starter” Design Challenges

If your students need to ramp up their teamwork, brainstorming, or design skills before they tackle a more complex challenge, here are some straightforward activities to try:

- The Tech Museum has several activities and design challenges posted on our website.
- Registered team can RSVP for space in one of our Tech Challenge Workshops.
- The website to accompany the PBS series “Building Big” has many great activities related to design and structures:

http://www.pbs.org/wgbh/buildingbig/educator/act_index.html

BRAINSTORMING TECHNIQUES

“The best way to get a good idea is to get lots of ideas.” – Linus Pauling

There is no single right way to brainstorm. There are, however, tried-and-true suggestions that will help enable a successful brainstorming session. The renowned design firm IDEO in Palo Alto, CA, describes brainstorming as “part art, part science.” Below are their brainstorming rules:

- Be visual
- Defer judgment
- Encourage wild ideas
- Build on the ideas of others
- Go for quantity
- One conversation at a time
- Stay focused on the topic

Broad brainstorming around The Tech Challenge problem is useful at the beginning, but brainstorming shouldn't be limited to just the beginning of the project! Brainstorming is useful to help solve a specific, smaller problem within the larger project.

Set-up

- Have lots of paper: sticky notes, index cards, large pieces of blank paper
- Pens, markers, crayons, of all different colors
- Bring relevant materials: items related to the challenge, pictures of the test rig
- Scissors, glues, foam core, tape – build relevant stuff on the spot
- Anything else to help communicate ideas visually

Pick a Facilitator

- Pick someone on your team to be a facilitator, someone who will only document the ideas.
- Try not to brainstorm for longer than 1 hour; take breaks to get fresh ideas
- The facilitator helps to remind everyone of the rules
- List ideas, number, or sketch quickly. Be aware to list everybody's ideas.

Pick a Specific Topic

- Breaking the problem down into smaller parts and then brainstorming those specific problems can be extremely beneficial, and less overwhelming.

Evaluation

- After a brainstorm session, review the ideas before you forget the small details and write down notes.
- Try to organize your ideas into categories and themes.
- 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! Sometimes a combination of two or three wild ideas can result in an innovative approach that will work.

TESTING IDEAS

“Be supportive. Have patience. Make it fun...AND Test everything!”

Advice to future advisors from a Tech Challenge participant

Build the key elements of the Test Rig

Teams can speed the design and testing process by building mockups of the test rig, or its key elements. This will give them preliminary experience with teamwork, design, construction tools and techniques, in addition to providing them a great opportunity to really examine the challenge.

Going from idea to prototype to functional solution

Veteran advisors tell us that their teams have always done the best when they quickly design an idea (rapid prototype), get the major design flaws documented, and then design the device itself.

Below are some key tips for prototyping:

- Multiple prototypes are best – encourage the team to mock up their top two or three ideas in three dimensions using cardboard, foam core, or similar materials.
- After getting design ideas from those mock ups, encourage the team to build a functional prototype – not made of the final materials.
- Finally, the team is ready to move to a full sized and fully functional device – they’ll know a great deal about what it takes to create a functional device if they have gone through several steps with three-dimensional prototypes first.
- It’s this prototyping phase that informs the selection of materials and many of the design features for the final device. Don’t worry that the prototype isn’t functional; the team will still learn a lot about their design ideas!

Test and redesign

Encourage your team to attend The Challenge Trials. Not only will they gain valuable experience under event day conditions, but they will also learn a lot from other teams. Bring the device to try any single part of it on the rig. Teams “in the know” attend every single trial to see what others are doing and to test some aspect of their device. Simply put, the team should “test, don’t guess” as to how something will function.

Encourage the team to attend as many trials as possible. Don’t forget that there can be important differences between your test rig and the official test rig at The Tech Museum, so it is essential to test your team’s device to test at least once on the real thing at one of the test trials.

- Make the test trial a team meeting.

Have the team bring their journal, a camera to document the test, plenty of paper and pens to describe in words and pictures what happened during the test. Also, bring extra materials and tools for quick repairs or modifications!

It’s important to make sure the team doesn’t get defeated by failures of their design in this phase. Remind them how much they’re learning about what doesn’t work, and encourage them to persevere.

PREPARING FOR EVENT DAY

The final event day is usually very hectic. It is very important to have assignments clearly established and practiced before the competition day. Experienced advisors recommend:

- Make a checklist of EVERYTHING you need to bring to The Tech Challenge event and check that list TWICE! Bring a kit of spare parts and tools to the event (similar to what you've been bringing to the Challenge Trials!). Make sure everyone knows what is available.
- All team members should know how the device could accidentally break (and how to make repairs). Over the years, we have seen many last minute device repairs.
- Make sure every team member knows exactly what his or her role is at The Tech Challenge event: who carries what, who sets up what portion of the solution, who controls the device, etc. There are a LOT of people and commotion the day of the Challenge event and it helps to be organized.
- The team should repeatedly practice the entire device demonstration procedure – including “set up”, device operation and clean up.
- The team should practice their group presentation in front of “stand-in judges” (parents or other supportive adults).
- Make sure all the parents know in advance the date and time of the event.
- Check the schedule for The Tech Challenge event on The Tech Challenge website. Allow plenty of time for travel, parking and lunch!
- Teams need the support and encouragement of you and their parents & families. Try to keep the focus on the fun of participating in The Tech Challenge, not the stress of competing to win an award. Celebrate the team's accomplishments, regardless of the day's outcome.
- Have FUN!

JUDGING

The Tech Challenge judges will evaluate your project as a whole, based on your device performance, your engineering process, and your presentation. The device and operational constraints are the only restrictions to your design. They help ensure safety and uniform judging of a wide variety of devices. The website has a complete description of all parts of the rules.

On the event day, you will be paired up with two judges that will stay with you during the complete judging process. The judges will evaluate your Tech Challenge entry in three stages; Pre-Interview, Device Performance, and a Post-Interview. The whole process will take approximately 40 minutes.

Pre-Interviews

During the Pre-Interview the judges will review your team's design documentation, examine the device, and talk to each of you in order to understand your design process from brainstorming through to testing and final preparations for The Tech Challenge event. In addition, judges will want to get to know you, how you worked together, worked through challenges, and learned from failure. Let your own personalities and team style shine through.

During the interview with the judges, team members should be prepared to:

- Discuss their roles, process, and experiences in working on the challenge—especially how they dealt with failure;
- Point out elements of their documentation that highlight their process and experience;
- Explain their innovations in design and/or use of materials and how these relate to the challenge;
- Reflect on what you have learned and how your device completed the task during the device performance; and
- Show off your creativity, inventiveness, and style. In previous years, teams have done this through costumes, songs, marketing materials, cheers and even videos!

Remember, this is an interview. Judges are mostly interested in talking with you. While prepared presentations are welcome, they are not required. Prepared presentations should take no longer than 2 minutes to ensure judges have plenty of time to talk with you.

Device Performance

The team group that you are in will take turns demonstrating their device at the test rig. The judges will evaluate the device. After all the teams in your group have gone, each team will go with two judges for the interview portion and the head judge will join the next group of teams to be operating their devices.

Post Interviews

During the Post Interview the judges will review the successes and failures of your team's device, and talk to each of you in order to understand how much you've learned about the design process. They will want to see if you would have done anything differently and why. They will want to find out what you've learned from failure (*if applicable*). This is the very last time that you'll be able to WOW the judges, so let your personalities and team style shine through.

Note: If any portion of your entry requires electronic equipment (computer, boom box, etc.) you must bring your own battery-powered device(s). Power outlets will not be available.

FOR MORE HELP

As you start The Tech Challenge with your team, there are a number of ways that you can seek help from others and from The Tech Museum. Check out the ongoing support available to advisors:

New Advisor Training - Completely new to Tech Challenge? Attend one of our Tech Challenge new advisor trainings to learn how to get started with your team and meet other new advisors .

Email Q&A – You can email questions to challenge@thetech.org and expect to receive an answer within 2-5 business days. We post frequently asked questions (FAQ) and answers on The Tech Challenge website.

Challenge trials – Volunteer engineers, Tech staff, and judges are available to answer your technical and/or team related questions. Check website for dates.

CONTACT US

- Web: <http://techchallenge.thetech.org>
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Have fun with your team!