

**BEST**

**Boosting Engineering, Science, and Technology**



# *Introduction to the BEST Robotics Program*

*David Trussell – UIL Director of STEM Activities*

*Slides Courtesy of Greg Young  
Director of Operations,  
BEST Robotics Inc*



**BEST**™

# Our Mission

We're *not* about robotics.

Robotics is simply the vehicle we use to

*Inspire, Motivate, and Educate*  
Students



# Our Guiding Principles



- **Students** are the primary participants, decision-makers, designers, and builders
- **BEST is open to all schools**, regardless of type, size, location, or socio-economic status
- **BEST keeps costs low** for schools to participate
  - UIL team registration fee \$525
- Robotics equipment and construction materials **are provided at no additional cost to participating schools**
- BEST teams are **school-based teams, 1 team per school**

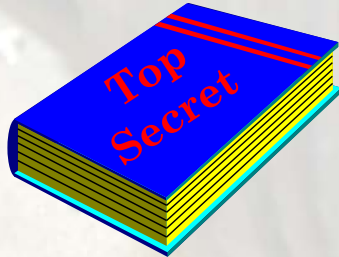


**BEST**™

# How BEST Works

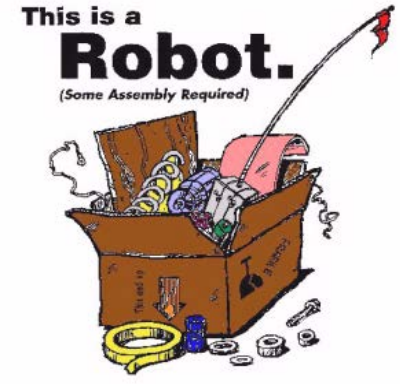
## The Rules

Size, Weight Specifications  
Task (Game) Description



## The Kit

Constrained Parts Selection



## Team of Students

- Unlimited Size
- Various Backgrounds

## Mentors





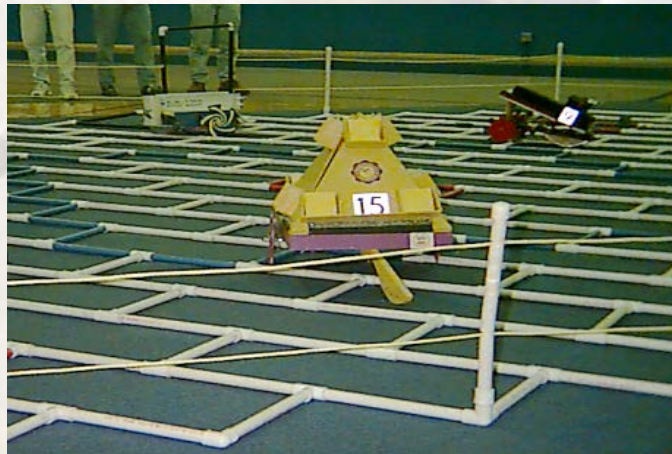
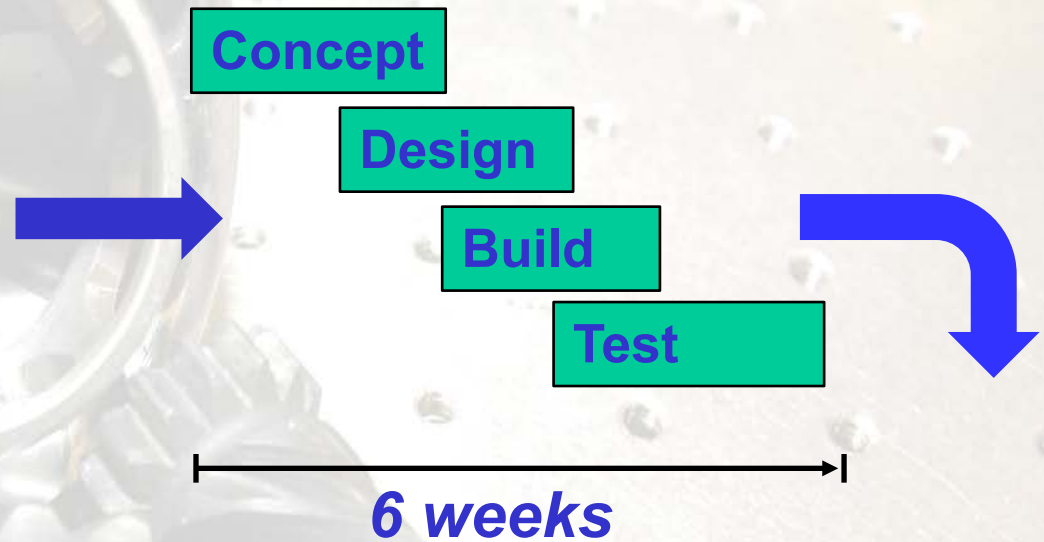
# How BEST Works



## Team of Students



## Product Development Process



## Remote-Controlled Robot



Head-to-Head Competition **Performance**

# BEST - UIL Partnership



- **New UIL State Championship Event**
  - Complimentary to existing Texas BEST Regional Championship
  - Top 40 teams
  - December 8-10, 2016, Frisco, Texas
- **High School teams opting for UIL participation**
  - Qualify at a local Hub Competition
  - Judged against other UIL teams
  - Advancement based on BEST Award scores
  - Can advance to both BEST Regional and UIL State Championships

# UIL Team Registration

- It is important to start putting your team together in the Spring
- The program begins in early Fall, just as school starts (early/mid September)
- The competition season is already underway for 2016
- Find a local hub to participate with and register for subsequent competitions:  
[http://www.bestinc.org/b\\_hubs.php#TX](http://www.bestinc.org/b_hubs.php#TX)



# UIL Team Registration – TX Hubs



Capitol BEST  
Austin TX

North Houston BEST  
The Woodlands TX

Collin County (CoCo) BEST  
McKinney TX

San Antonio BEST  
San Antonio TX

Cowtown BEST  
Fort Worth TX

Southeast Texas BEST  
Huntsville TX

Dallas BEST  
Dallas TX

U-STEM BEST  
Houston TX

Heart of Texas BEST  
Waco TX

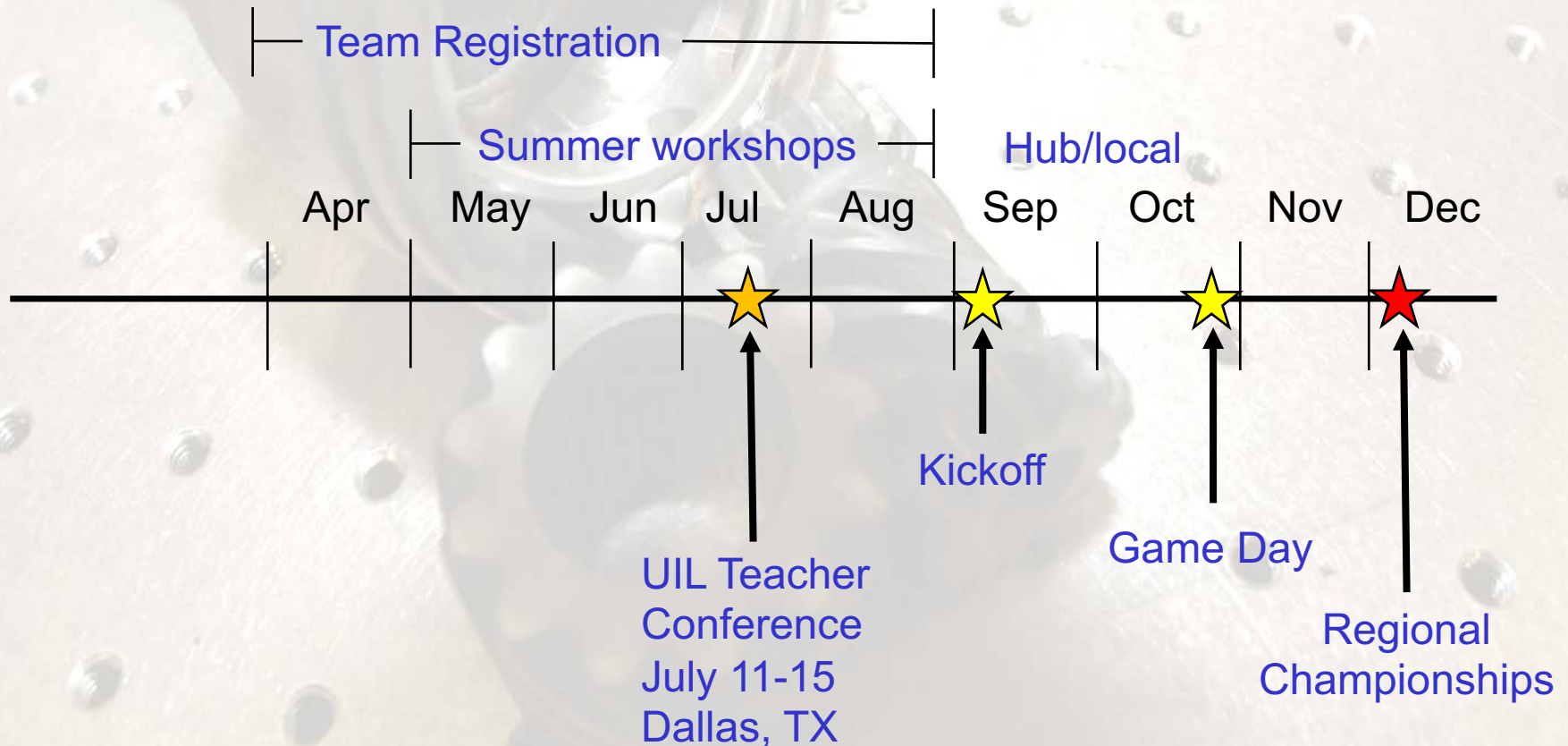
West Texas BEST  
Lubbock TX



**BESI**™

# Timeline Reminder

- Team registration starts in Spring
- Fall 6-week Program
- Championships in early December



# BEST Events



<i>Kickoff Day</i>	<i>Early/Mid September</i>
<i>Test Drive (Practice)</i>	<i>End of 3<sup>rd</sup> Week</i>
<i>Practice Day</i>	<i>End of 5<sup>th</sup> Week</i>
<i>Machine Compliance Check</i>	<i>End of 6<sup>th</sup> week (night before)</i>
<i>Local Competition</i>	<i>End of 6<sup>th</sup> week</i>
<i>Regional Championship</i>	<i>Nov/Dec</i>

Top teams at local competition will advance to the Texas BEST Regional Championship.

Top UIL teams will advance to the UIL State Championship.

The number of teams advancing will depend on the total number of teams participating.

# BEST Philosophy



- The students will get the most out of the process if they do the work
- Mentors and Teachers should help the students realize the students' ideas
- The six-week development process is more important than the game-day competition
- BEST does not stand for “Beat Every Single Team



## The School Provides...

- At least one school sponsor as a teacher-coach
- Classroom/shop facilities
- Transportation to the competition sites
- A single student team representing the school ★
- Outreach to potential team mentors (e.g., parents)

★ *No Limit on Team size (determined by school)  
Sub-Teams will be necessary.*

## **BEST Hub Provides...**

- A single “Kit” for each school
  - Control System (returnable at conclusion)
  - Raw Materials (consumable items in specific quantity)
- Volunteer mentors from industry, as best we can
- Volunteers to coordinate and run all events
- The game field for all events
- Awards for student and team recognition



**Student, Teacher, Mentor  
Roles**

*If you build it...they will fail!*

# Role of Teacher/Coach (1)

- Primarily team logistics
- Recruit students for the team
  - get posters hung, flyers made
- Determine student eligibility for the program
- Have primary responsibility for the students
- Enforce school rules and code of conduct
- Recruit team mentors
- Schedule tool safety training





# Role of Teacher/Coach (2)

- Coordinate with other disciplines
  - art, language, shop teachers, etc.
- Manage access to school facilities and equipment
- Manage transportation to and from events
  - bus or other transportation, drivers
- Manage parent permission for student participation
  - travel, handling power equipment, photo release, etc.
- Build student leadership
- Support student organization
- Recruit more teachers, don't do this alone!



# Building The BEST Team

- Most successful teams are composed of **mixed grade-levels** and minimum 2 technical mentors
- Teams operate best from a **single campus** population
- Design and build **facilities are necessary**
- **Safety** Training is MANDATORY
- Students learn best **when they are responsible** for ALL activities
- Mentors and Teachers are primarily for basic **guidance and consultation**



# The Mentor Experience (1)

## Role of Mentors

- Provide an understanding of engineering process
- Explain the importance of schedules and budgets
- Provide technical guidance
- Ensure students consider all phases & deliverables
- Guide student brainstorming sessions
- Discuss methods for evaluating design concepts
- Describe prototyping methods
- Pose questions to force team to think through ideas
- Encourage student participation



## The Mentor Experience (2)

### Best Practices

- Encourage proper organization early
- Promote teamwork/ teaming concepts
- Ensure the team
  - Identifies requirements/ set goals up front
  - Sets realistic schedules
  - Has on-time deliverables
- Teach the Engineering Design Process
- Teach design margin (weight, size)
- Promote new design/invention...steer away reuse
- Follow the rules, be an example

## The Mentor Experience (3)

### How Much Time Will This Take?

- Meeting times vary by team/school
- Most meet after school (at least)
- Commit to regular participation
- Put in the time that you can...anything helps
- You are providing guidance

# Role of the Students

- Students Learn the Most By Doing It
- Guide the Students, Don't Direct the Team
- Make Them Work, Don't Give Them Answers
- Students are Responsible for
  - What They Do
  - What They Don't Do
- Students Determine Meeting Times
- Students organize/run meetings (with encouragement/guidance)



# Tools You Need

## Bare Minimum

- ◆ Basic hand tools  
(screw drivers, wrenches, pliers, etc.)
- ◆ Drill bits
- ◆ Drill/driver
- ◆ Hacksaw
- ◆ Saber saw
- ◆ Soldering iron
- ◆ Wire stripper
- ◆ C clamps
- ◆ Square
- ◆ Tape measure
- ◆ Work table

**(must have)**

## Basic

- Drill press
- Router
- Heat gun
- Dremel tool
- Hole saws
- Vise
- Scale with 25 lb capacity
- Tap and die set  
specifically,  
#10-32 tap  
¼ - 20 die

**(nice to have)**

## Deluxe

- Chop saw
- Scroll saw
- Band saw
- Table saw
- Z-bender
- Oven/heating element
- Metal brake
- Sander  
disk/drum/belt

**(best possible)**

# Engineering Tools Provided Annually

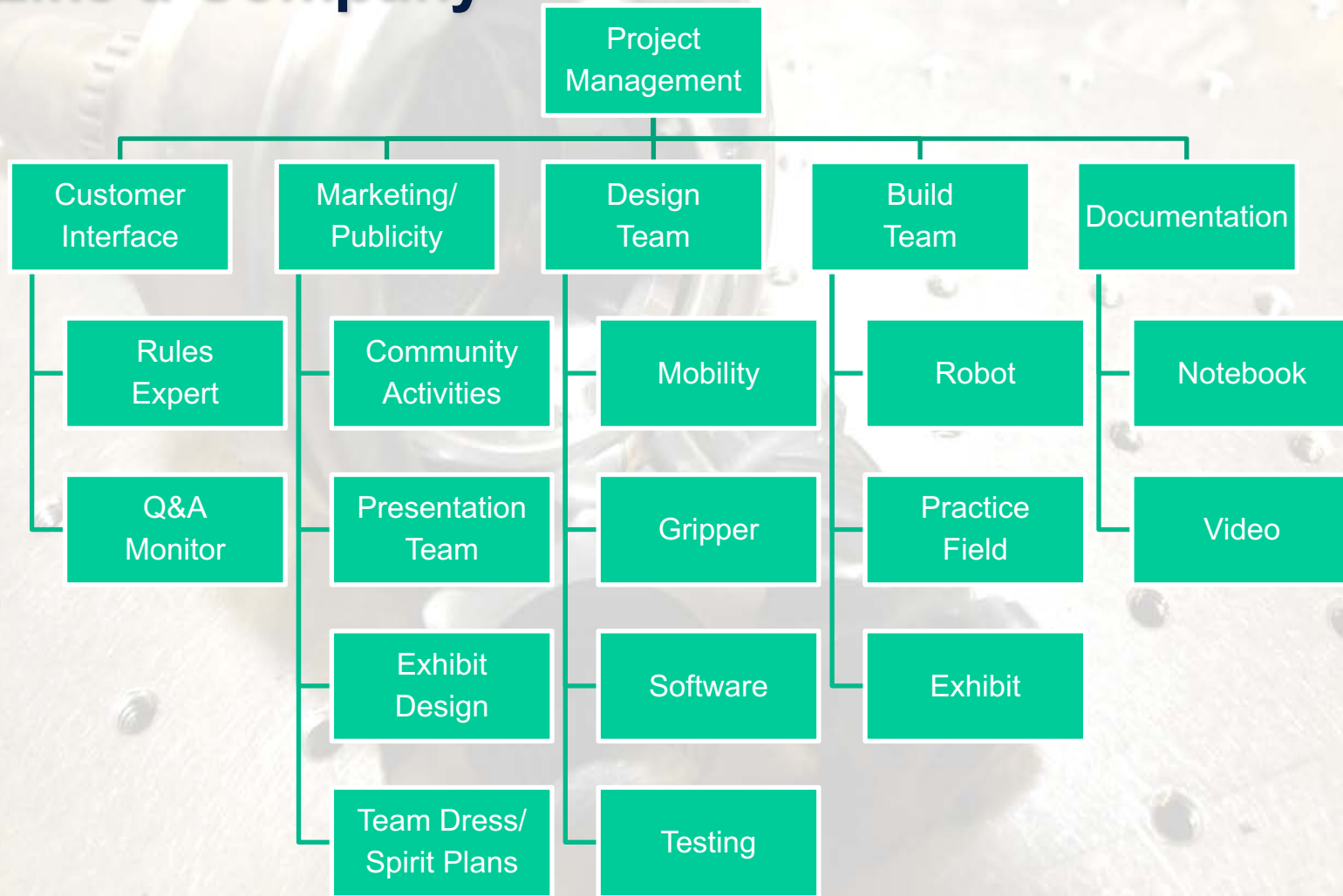
- ◆ CAD/CAM Software
  - SolidWorks 3D CAD Software (150 days)
  - Solidwize – SolidWorks video training courses (5 months)
  - HSMWorks/HSMXpress tooling software (5 months)
  - AutoCad
- ◆ Graphical programming & simulation
  - MathWorks SIMULINK (13 months)
  - MathWorks 3D Virtual game world
- ◆ C Programming Environments (3 seats, 4 months)
  - Intelitek easyC
  - Robomatter RobotC
- ◆ Computation systems
  - MathWorks MATLAB (with SIMULINK above)
  - Wolfram Research Mathematica for Students (12 months)
  - Wolfram Alpha Pro





# **Organizing the Team**

# Teams Typically Organize Like a Company



# Organizing the Team

- Discuss the functional areas to be addressed
- Organize based on desired outcomes
  - Assign clear responsibilities & tasks to teams/individuals
  - Discuss deliverables (team internal & BEST)
  - Create a team schedule (milestones)
- Let students lead
- Teach don't Tell
- Don't spend a week organizing the team
- Plan regular meeting times/location
- Identify who will take meeting notes

# Pre-Kickoff Planning

- Working with Mentors
  - Recruit from local industry, Rotary, PTO, parents, etc.
  - Background checks are responsibility of the school
  - Mentors do not have to be engineers!
  - Meet at least a week prior to Kickoff for strategizing how to work with the team
  - Define duties and expectations – yours vs. theirs
- Working with Other Teachers
  - Do not do this by yourself! Divide and Conquer
  - Enlist other teachers to help in relevant areas
    - Notebooks – English/writing teachers
    - Exhibit, Team Dress – Art & Drama teachers
    - Robotics – Career Tech/Shop/VoTech/Math/Physics teachers
    - Marketing – Speech & English Teachers

# Pre-Kickoff Planning

- Working with Students
  - Recruit students! Let them follow their interests
  - More students is better; expect fall-out, schedule conflicts
  - Introduce mentors early and explain their role to the team
  - You are not responsible for doing the work, the students are!

# Pre-Kickoff Planning

- Training & Resources
  - Plenty can be accomplished before Kickoff
    - Research the game theme
    - bESTology – teaching resource/activities (16 weeks)
    - Tool/shop safety training
    - Programming workshops
    - Take a look at past game rules, kit lists, etc.
  - Some software is available early (Summer) - MathWorks
  - Visit [www.bestinc.org](http://www.bestinc.org) for many resource/training materials
    - *Various training presentations*
    - *Past game documents*

# Consumable Kit

- ◆ Raw Materials
- ◆ Plywood, Plastics, Metal, PVC
- ◆ Hardware
- ◆ Specific quantities of materials
- ◆ Use no more than quantity available in kit to build the robot
- ◆ See past Kit Lists



## The RETURN Kit

- ◆ Aka the Control System
- ◆ Packaged Separately
- ◆ Must be returned at conclusion of game day
- ◆ Don't modify parts...







***Kickoff***

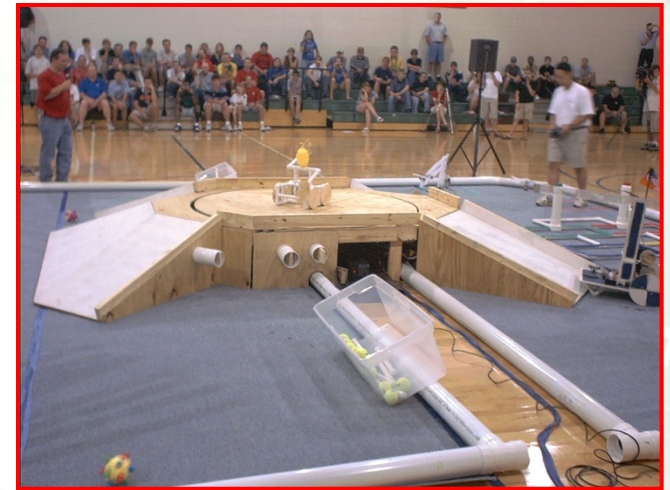
# What Happens At Kickoff?

- Sign-in & Team Packet Pickup
- General Assembly
  - Welcome, School Roll Call
  - Important Information (schedules, handouts, etc.)
  - Fun Stuff (teaming games, drawings, contests, tours)
- Training Sessions (varies by hub)
  - Run in parallel
  - Typically 1 hour+, hub dependent
  - Meant for students, bring enough
    - Consumable Kit Training
    - Control System Training
    - Programming
    - CAD Software Training
    - Practice Day Signup
    - BEST Award Review
    - Others?



# What Happens At Kickoff?

- Game Intro and Demonstration
  - Unveiling of the game field
  - Walk through of the game rules
  - Possible demonstration robot(s)
    - DO NOT COPY THE DEMO BOT!!!
- Kit Distribution & Inventory
  - Return Kit (aka \$Control System\$) – be prepared to sign for it
    - Controller, joystick, motors, servos, batteries, chargers, etc.
  - Consumable Kit – lots of pieces
    - Plywood, PVC, metal, plastic, hardware, misc. items
  - Inventory EVERYTHING AT KICKOFF! (checklists provided)



# Who/What To Bring?

- Plenty of students to cover the Breakout Sessions
- One large vehicle to receive the kit, and several able bodies to carry it (the parts...NOT the vehicle)
  - 2x4 foot plywood
  - 5 foot PVC
- Enthusiasm & excitement (we give awards for it!)
  - Spirit and Sportsmanship starts on Day 1



# **The Rules**

*Read...before you ask...*

# Documents and more documents

- There are LOTS of documents to be reviewed
- This is JOB #1...starting at Kickoff
- Assign one or more students to be Rules Expert
- BEST is about product development process
  - The team is judged on their process
  - Team organization is KEY to succes
  - Document everything as you go
  - Emphasize planning before execution

# So What's in the Rules?

- Robot Head-to-Head Competition
  - Game Specific Rules + Field Drawings
  - Generic Rules
  - Returnables Kit List
  - Consumables Kit List
  - Online Q&A
- Awards and Judging Policies
  - Policy Documents
  - Scoresheets/Rubriks

# Game Specific Rules + Field Drawings

- Game Theme
  - Useful in Engineering Notebook research paper
- Game Objective
- Rules for playing the game
- Point values and scoring
- Drawings of the game field



# Generic Rules

- Safety rules
- Robot materials & construction constraints
- Robot size/weight constraints
- Robot compliance checking
- Interaction with field & other robots
- Tournament Format
  - seeding, **wildcard**, semifinal, final)
- Match setup/ robot removal (30 sec)
- Drivers & spotters requirements
  - **Min 50% of team or 5 drivers (rotate per match)**
- General penalties

# On-Line Question & Answer

- Use Q&A to pose questions regarding clarification of rules, field, kits, judging, etc.
- Designate a student to have Q&A responsibility
  - Monitor daily
  - Hundreds of questions will be asked (...some useful)
  - Please do not pose questions until you have **THOROUGHLY READ THE RULES!**
- **Q&A will be password protected until after last Kickoff**
- Abuse may result in your team being blocked from using Q&A system

# BEST Award Score Sheets



## 2009 Project Engineering Notebook Score Sheet

Purpose: To document the process used to design, build, and test the robot (30 Points)	Possible Points	Score
<b>DESIGN PROCESS (18 Points)</b>		
<ul style="list-style-type: none"> <li><b>Implementation of the Engineering Design Process</b> Evidence that the engineering process was effectively used.</li> </ul>	30	
<i>Comments:</i>		
<ul style="list-style-type: none"> <li><b>Brainstorming Approaches</b> How well organized and productive was the brainstorming approach used and documented.</li> </ul>	30	
<i>Comments:</i>		
<ul style="list-style-type: none"> <li><b>Analytical Evaluation of Design Alternatives</b> Use of analytical and mathematical skills in deciding upon and implementing design alternatives.</li> </ul>	30	
<i>Comments:</i>		
<ul style="list-style-type: none"> <li><b>Offensive and Defensive Evaluation</b> Analysis of gaming strategies and design elements to achieve goals</li> </ul>	30	
<i>Comments:</i>		
<ul style="list-style-type: none"> <li><b>Design Creativity</b> Overall use of creativity to solve the problem presented in the game.</li> </ul>	30	
<i>Comments:</i>		
<ul style="list-style-type: none"> <li><b>Support Documentation</b> CAD/other drawings, photos, team organization, meeting minutes, test results, etc. that support the main document.</li> </ul>	30	
<i>Comments:</i>		

# Project Engineering Notebook

- Documents your engineering design process
- This is NOT a photo album...
- Use photos and diagrams efficiently
- Check your gramr and speling
- Don't write it the night before it's due
- Requires participation from the design team

# Team Exhibit & Interviews

- Team Exhibit does not document the robot design!
- Promotion of BEST in the community
- Foster BEST spirit, camaraderie, & participation
- Evidence of sportsmanship
- You can't display what you haven't done...
- Team Exhibits are often themed
- Judges perform informal interviews with students at the team exhibits and in the pits



TM





# Marketing Presentation

- 12 minute Powerpoint presentation (30 min total)
- Minimum 4 students participate, no adults
- Present to a panel of judges
- Should cover:
  - Company demographics
  - Marketing strategies employed
  - Design and construction processes
  - Technological resources & invention
- Presentation timeslot is selected by the team
- Don't be late, don't go over your time
- Practice, practice, practice



# Spirit & Sportsmanship

- Pretty self-explanatory
- Signs, posters, trinkets, hand-outs
- Bands, cheerleaders, mascots
- Dress the part
- Sorry...no throwing objects into the stands
- Capitol BEST Spirit Break! 2 minutes of fun...
- Visible positive attitudes regardless of performance
- Support for others
- Graceful winning and losing

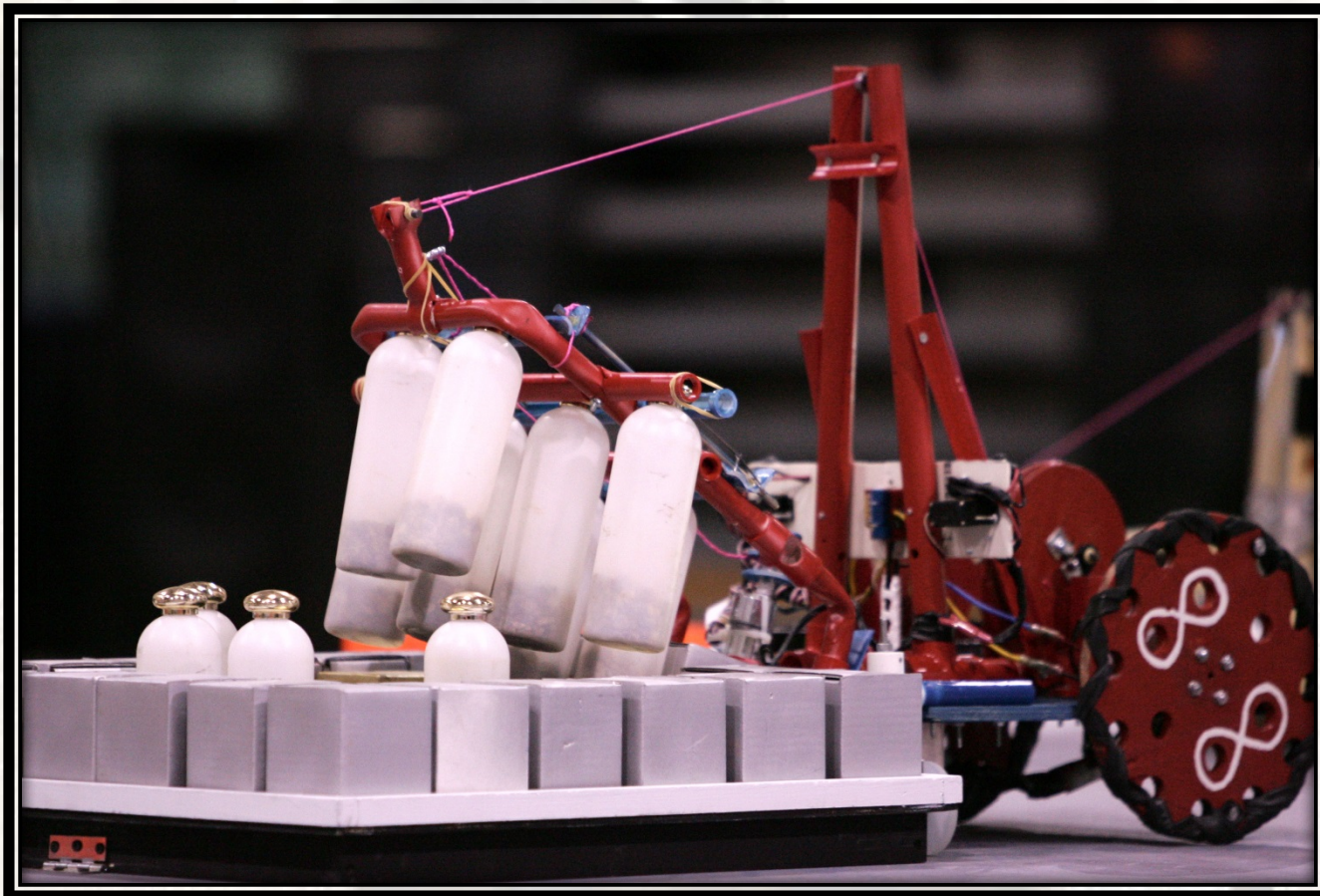
# Getting Help – First Year

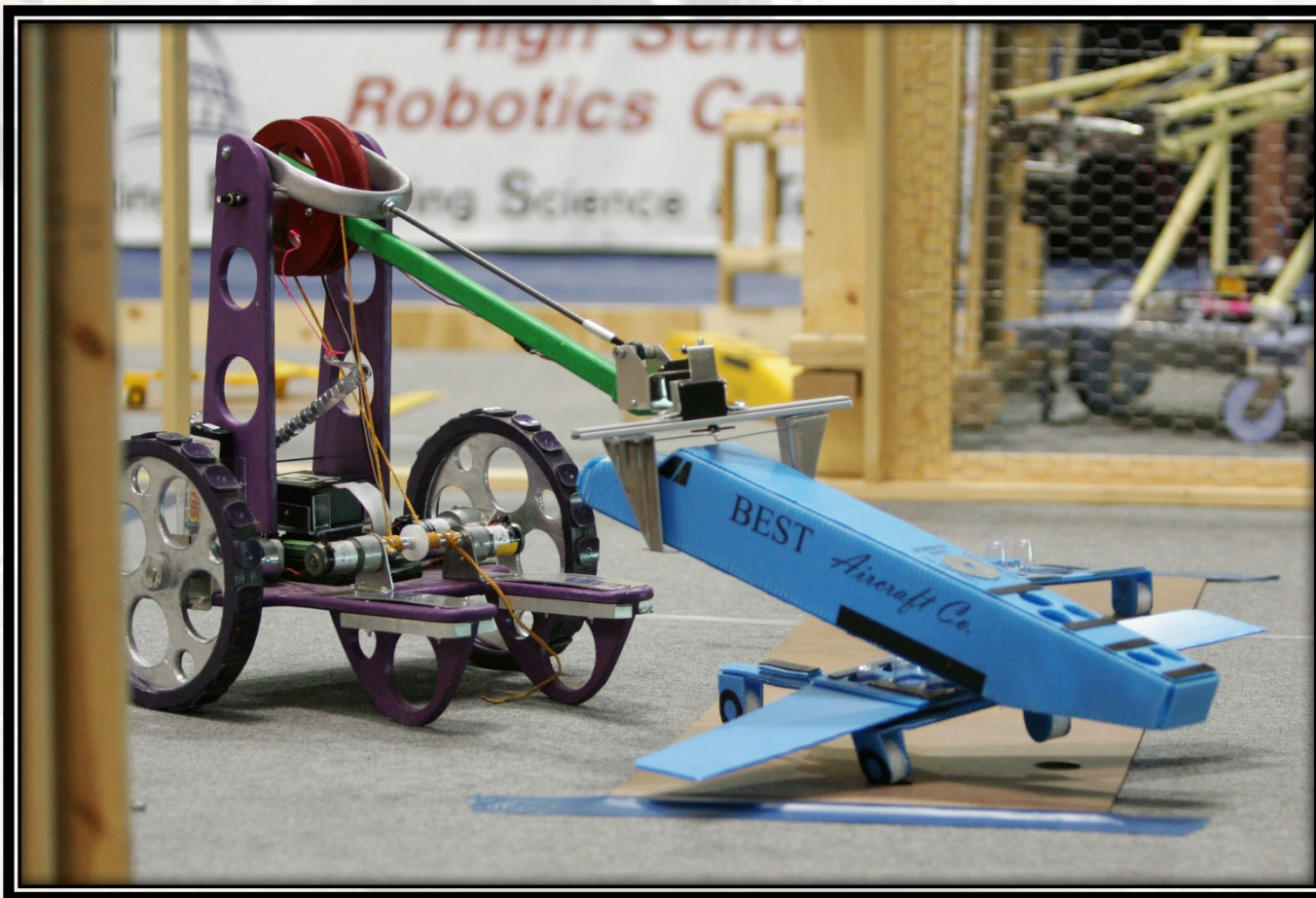
- ◆ *BEST Resources & File Manager*
  - *Various training presentations*
  - *Past game documents*
- ◆ *Contact your mentor team (veteran team)*
- ◆ *Use the BEST forum for general questions*
- ◆ *Use the Q&A for game related questions*
- ◆ *Have students read, read, read and report on their findings*

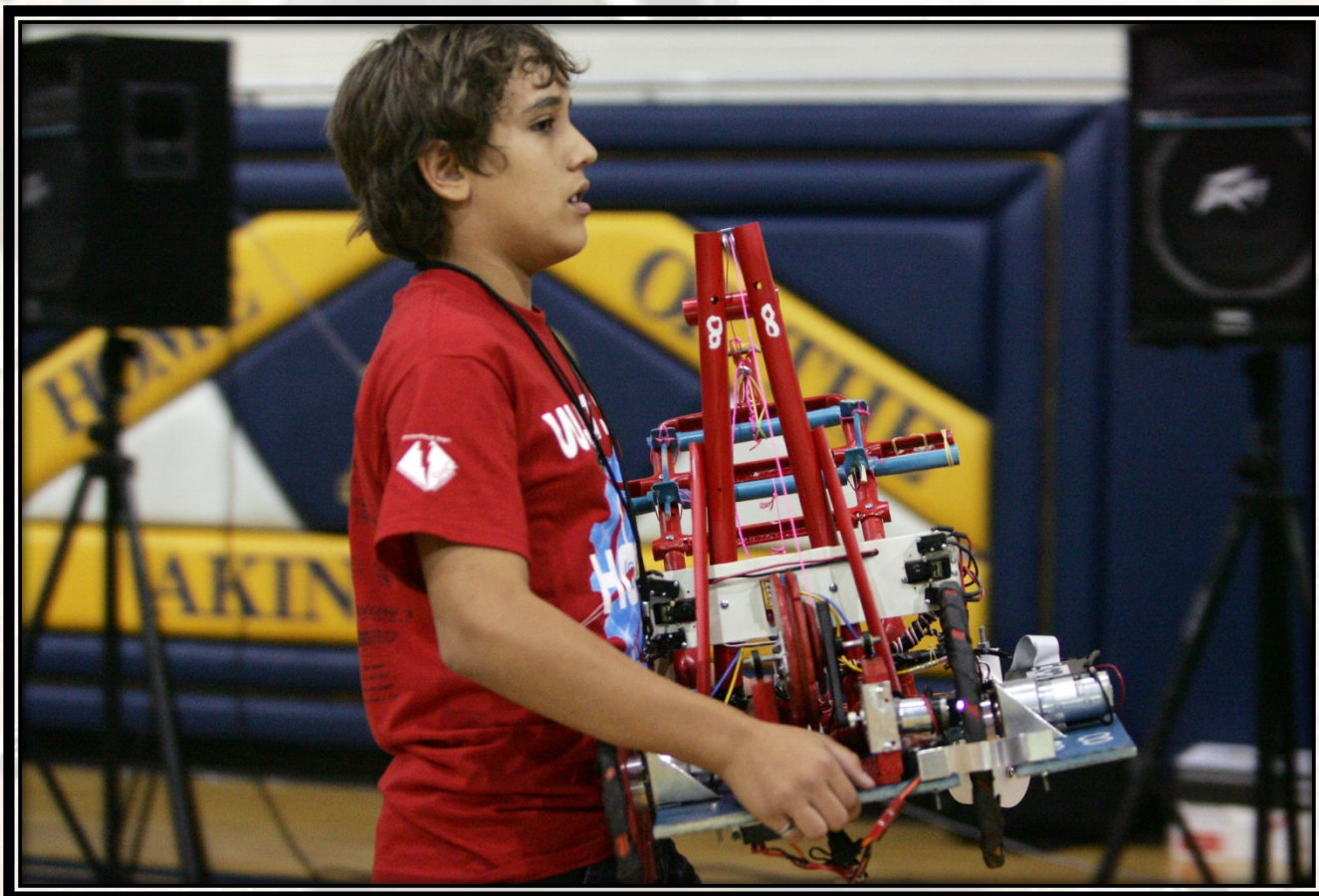
# REMEMBER...

- Failure is OK; it's how we learn
- The process is more important than the product
- Few are discouraged, Many are inspired

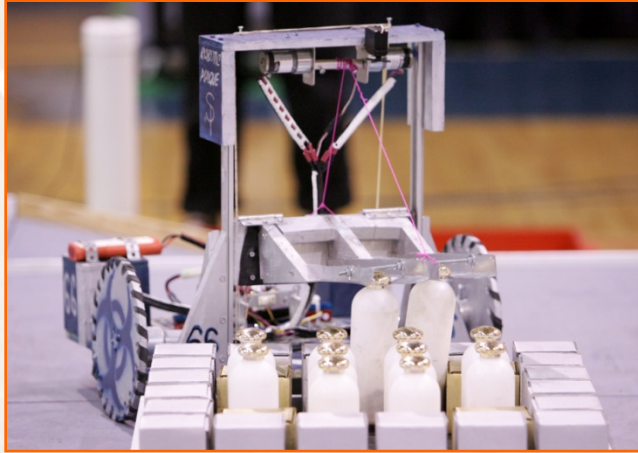
***Let the Fun Begin!***







# Game Day Photos





# Game Day Photos



# **Contacts**



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**<http://www.bestinc.org>**



***Questions?***