This is a Notebook!
(some assembly required)
Objectives Of This Session

1. How The Project Engineering Notebook Fits Into The Competition

2. How You Are Evaluated: Requirements, Evaluation Criteria, And Score Sheet

3. How To Design A Notebook

4. How To Get Help
2015 Changes

1. The notebook may be delivered in electronic format (PDF only) or in physical format. Electronic format preferred.

2. New Software Design & Simulation Section and new mandatory Award based on score

3. Changed delivery for Team Demographics form
   - No longer a included in the Notebook and no points awarded
   - Form is now required to be submitted by team as part of the Robot Compliance check at Practice Day and required before a team is allowed to compete.
OVERVIEW

How does a Project Engineering Notebook fit into the competition?

Notebook Purpose
Engineering Design Process
Judging
2015 Schedule
Purpose of the Notebook

- **The Goal:** To document the process the team uses to design, build, and test the team’s robot.
  - The Notebook is your team’s opportunity to tell the story of your robot; it’s part “diary” and part “log” that the team keeps as they progress through the process.

- **Why:** Documentation is a critical aspect of the **Engineering Design Process**
  - Provides a crucial record of the process
  - Provides critical information between different groups
  - Provides essential information for new people
Importance of the Engineering Design Process

- Provides a methodical approach to help solve problems to achieve objectives within constraints
- May be used for any design/build project
  - Whole robot, robot components, project engineering notebook, and marketing presentation
- Helps students maintain some objectivity with respect to design ideas
- Helps identify problems early
Engineering Design Process:
Set of steps for creation & invention

The Goal
Elements of the Engineering Design Process

One way to define Engineering Design Process (EDP):

1. Define the Problem
   - Read the Rules
   - Determine Requirements
   - Research Similar Designs
   - Inventory Resources Available

2. Brainstorm Strategy and Design Possibilities

3. Evaluate the Strategies & Design Approaches

4. Analyze Several Alternative Solutions

5. Select Strategy & Preliminary Design Configuration

6. Accomplish Detail Design
   - Build Prototypes if Necessary

7. Build & Test

8. Modify & Retest

9. Deliver Product

Document Process & Decisions (CRUCIAL!)
Judging Procedure

- The Judges are a distinguished team of professionals using the score sheets and provide comments on how to improve
  - Teams advancing to Frontier Trails BEST Regional competition will be briefed on their score sheet on Denver Game Day
  - Teams not advancing will have their score sheets mailed to them after Game Day
  - Make it easy for the judges to find the scoresheet topics in your notebook – highlight in table of contents and in document
Notebook Score Use

1. Chance at Wild Card Match Phase
   - The Wild Card Match Phase to fill the 8th slot in Semi-finals phase
   - Single match between 4 teams with highest BEST notebook score - not already ranked in top seven seeding phase teams

2. Criteria for Several Awards
   - BEST Award,
   - Founders Award
   - BEST Rookie Team Award
   - Engineering Notebook (non-BEST Award Team)

3. Determines Software Design and Simulation Award
   - Highest Score on the Software Design and Simulation score sheet section receives this award
   - ALSO, RM BEST winner is entered into BEST drawing for one of three $1000 cash awards (announced after all local hub competitions)
Our 2015 Schedule

**Kickoff**
Today 12 September
Denver South HS

**BEST Award RSVP Deadline**
NLT 25 September
BEST Award & Marketing Presentation Scheduling
lscott@rockymountainbest.org
or 720-250-6896

**Practice Day**
Saturday 17 October
Thomas Jefferson HS
Project Engineering Notebooks Can be Submitted in Hardcopy or electronic format (PDF) Only on USB memory stick
By 2:00pm
NO EXCEPTIONS

**Game Day**
Saturday 24 October
Auraria Campus Events Center @ Metro
Project Engineering Notebooks are returned at registration
Score Sheets are available at the end of Game Day
THE NOTEBOOK EVALUATION

What the judges are looking for?

- Notebook Specification
- Notebook Evaluation
- Notebook Score Sheet
Notebook Specifications

ALL teams are required to submit a Project Engineering Notebook.

The notebook may be delivered in electronic format (PDF only) or in physical format.

The notebook must meet the following specifications:

1. All physical notebooks must be submitted in a *standard* 3-ring binder with a maximum 2” ring size
2. A cover sheet/title page must identify the school, team name, teacher contact, and team number
3. 30 typed single-sided pages or less (note that title page and Table of Contents page(s) will not be counted as part of the 30 pages)
4. Research paper: Within the 30 pages, include a description of how the current year’s game theme is related to current technological practices or scientific research (minimum of 2 pages, maximum of 5 pages out of the 30 allotted)
5. Provide description of the process the team used to design and complete its robot
6. Standard, 8 ½” x 11” paper, double-spaced, 1” margins, and Times New Roman (preferred) or similar business-style font no smaller than 12 pt. Single-spacing is acceptable in tables and outlines.
7. Teams may include a supplemental appendix of no more than 20 pages double sided sheets of information. The appendix may include support documentation such as drawings, photos, organization charts, minutes of team meetings, test results, etc. *This material should directly support the process described in the primary document and NOT reflect activities related to community or promotional efforts, spirit development, or team-building.*
1. Implementation of the Engineering Design Process
   Evidence that the engineering process was effectively used.

2. Research Paper
   Correlation between game and how the technology is being used at a company/industry/research lab in the team’s state or region; Any related information of game theme, such as history, famous inventor(s), or major milestones; Creativity in linking game theme to appropriately related science/technology content; Proper use of grammar and composition throughout paper; citations of sources used to gather information for paper; staying within 2-5 page limit

3. Brainstorming Approaches
   How well organized and productive was the brainstorming approach used and documented?
4. **Analytical Evaluation of Design Alternatives**

Use of analytical and mathematical skills in deciding upon and implementing design alternatives.

5. **Offensive and Defensive Evaluation**

Analysis of gaming strategies and design elements used to achieve goals.

6. **Software Design and Simulation**

Evidence of custom software design versus using the default robot program; Evidence that a software design process was followed; Demonstration of design of functionality applicable to the defined task; Evidence of use of software simulation (e.g., Simulink, virtual worlds, etc.) to verify the correct operation of the robot program; Evidence that good software design practices, testing/debugging techniques and efficiency and portability were all considered.
7. Safety

Evidence that safety training occurred and safe practices were followed to prevent students’ misuse of tools and other devices/equipment that may result in personal injury or damage to property.

8. Support Documentation

CAD /other drawings, photos, organization, team minutes, test results, etc. that support the main document.

9. Overall Quality and Completeness of Notebook

Organization, appearance, adherence to specifications, quality of content.
2015 Score Sheet

Score Sheet has 3 Sections

1. Research Paper 4 Points
2. Design Process 17 Points
   *(Includes new Software Design and Simulation section)*
3. Overall Quality & Completeness 9 Points
   *of Notebook* *(Team Demographics Form Removed)*

Total 30 Points

Tip: Make it easy for the judges to find evidence of each criteria! **Follow the format of the Score Sheet.**
2015 Project Engineering Notebook Score Sheet (1 of 3)

<table>
<thead>
<tr>
<th>Purpose: To document the process used to design, build, and test the robot (30 Points)</th>
<th>Possible Points</th>
<th>Score</th>
</tr>
</thead>
</table>

**RESEARCH PAPER (4 Points)**

- Correlation between game and how the science/technology is being used at a company/industry/research lab in the team’s state or region
  
  **Comments:**
  
  - Any related information of game theme, such as history, famous inventor(s), or major milestones.
  
  **Comments:**
  
  - Creativity in linking game theme to appropriately related science content
  
  **Comments:**
  
  - Proper use of grammar and composition throughout paper, citations of sources used to gather information for paper, stayed within 2-5 page limit
  
  **Comments:**

**DESIGN PROCESS (17 POINTS)**

- Implementation of the Engineering Design Process
  
  Evidence that the engineering process was effectively used.
  
  **Comments:**
  
  - Brainstorming Approaches
  
  How well organized and productive was the brainstorming approach used and documented
  
  **Comments:**
  
  - Analytical Evaluation of Design Alternatives
  
  Use of analytical and mathematical skills in deciding upon and implementing design alternatives
  
  **Comments:**
### DESIGN PROCESS continued (17 Points)

<table>
<thead>
<tr>
<th>Item</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Offensive and Defensive Evaluation</strong></td>
<td>25</td>
</tr>
<tr>
<td>Analysis of gaming strategies and design elements to achieve goals</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td><strong>Software Design and Simulation</strong></td>
<td>25</td>
</tr>
<tr>
<td>(from additional scoresheet on next 2 pages)</td>
<td></td>
</tr>
<tr>
<td>Evidence of custom software design vs default program; Demonstration</td>
<td></td>
</tr>
<tr>
<td>of software design process; Evidence of use of simulation (e.g.,</td>
<td></td>
</tr>
<tr>
<td>Simulink) to verify correct operation of robot program; Consideration</td>
<td></td>
</tr>
<tr>
<td>of good software design practices such as comments, naming conventions,</td>
<td></td>
</tr>
<tr>
<td>design simplicity, modularity, portability, etc.</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>20</td>
</tr>
<tr>
<td>Evidence that safety training occurred and safe practices were followed</td>
<td></td>
</tr>
<tr>
<td>to prevent students’ misuse of tools and other devices/equipment that</td>
<td></td>
</tr>
<tr>
<td>may result in personal injury or damage to property</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td><strong>Support Documentation</strong></td>
<td>25</td>
</tr>
<tr>
<td>CAD/other drawings, photos, team organization, meeting minutes, test</td>
<td></td>
</tr>
<tr>
<td>results, etc. that support the main document</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
</tbody>
</table>
OVERALL QUALITY AND COMPLETENESS OF NOTEBOOK (9 Points)

<table>
<thead>
<tr>
<th><strong>Organization and appearance:</strong></th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of contents, summary, page numbers, discussion of evaluation points, linkage to appendices.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Adherence to specifications:</strong></th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard binder, business font no smaller than 12 pt., double-spaced (single spaced ok in tables and outlines), 30 one-sided page limit for main section, 20 double-sided page limit for appendices, 1” margins, required cover information.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Quality of content:</strong></th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well written descriptions, clear photo labels, lack of extraneous material, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Total</strong></th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>÷10</strong></td>
<td>÷ 10</td>
</tr>
<tr>
<td><strong>Final score:</strong></td>
<td>30</td>
</tr>
</tbody>
</table>
Purpose: To document the software design process and practices used for creating and testing the robot program. (25 Points)

<table>
<thead>
<tr>
<th>SOFTWARE DESIGN PROCESS (180 points)</th>
<th>Possible Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of custom software design versus using the default robot program</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence that a software design process was followed</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>• Identifying the required operations (e.g., locomotion/drive, chassis rotate, arm lift/bend/rotate/extend, claw rotate/open, ...)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>• Designing each required operation (e.g., flow charting the steps involved)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>• Designing a user-interface (e.g., how the robot will be controlled)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Test planning (how correct operation of the robot program will be tested)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence of advanced testing and debugging techniques utilized to verify the correct operation of the robot program without depending solely on the physical robot (e.g., software simulation via Simulink, virtual world, software-in-the-loop, etc.)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence that the defined program functionality is applicable to the defined task(s). The program functionality maps clearly to the desired game strategies.</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOFTWARE DESIGN PRACTICES (55 POINTS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>• Consideration of good software design practices (e.g., commenting, naming conventions, code simplicity, modularity)</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Consideration of error conditions and response actions. (e.g., motor/servo stop limits, out of bounds values, etc.)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Consideration of code portability and maintainability (e.g., use of variables vs. hardcoding values; use of functions, tasks and subsystems, etc.)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLARITY OF DESIGN AND DESCRIPTION (15 POINTS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clarity of design and description</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

\[ \frac{250}{10} = 25 \]

Final score: 25
LET’S DESIGN A NOTEBOOK

We’ll use the Engineering Design Process:

- Design steps for Project Engineering Notebook
- Table of Contents Examples
- 45 Minute Quick Start Notebook Design
### Engineering Design Process for your Notebook (1 of 2)

<table>
<thead>
<tr>
<th>Elements of the Engineering Design Process</th>
<th>Designing the Project Engineering Notebook</th>
</tr>
</thead>
</table>
| **1. Define the Problem - Read the Rules, Determine Requirements, Research Similar Designs, Inventory Resources Available** | • Read Specification and Evaluation Criteria  
• Review past Notebook outlines  
• Inventory currently available tools - drawing, word processing, camera, CAD (Computer Aided Design), printers  
• Determine type of skills that would be helpful |
| **2. Brainstorm Strategy and Design Possibilities** | • Define rough draft of Table of Contents  
• Determine if additional tools might be available  
• Define possible team member skills to help  
• Create top level schedule of tasks |
| **3. Evaluate the Strategies & Design Approaches** | • Recruit team members  
• Evaluate tools – including decide if paper or pdf file delivery |
| **4. Analyze Several Alternative Solutions** | • Evaluate rough draft of Table of Contents options against Specification and Evaluation Criteria  
• Assess team members against tasks  
• Confirm all tools work together |
| **4. Select Strategy & Preliminary Design Configuration** | • Select 1st draft of Table of Contents  
• Finalize tools to use, team, team responsibilities and schedule |
<table>
<thead>
<tr>
<th>Elements of the Engineering Design Process</th>
<th>Designing the Project Engineering Notebook</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6. Accomplish Detail Design</strong></td>
<td>• Generate Detailed Outline</td>
</tr>
<tr>
<td></td>
<td>o Select document styles</td>
</tr>
<tr>
<td></td>
<td>o Paragraph numbering scheme</td>
</tr>
<tr>
<td></td>
<td>o Table/Figure numbering scheme ...</td>
</tr>
<tr>
<td></td>
<td>• Finalize plan to accomplish schedule with team, tools, and team responsibilities</td>
</tr>
<tr>
<td><strong>7. Build Prototypes if Necessary</strong></td>
<td>• <strong>Gather Robot and Project Engineering Notebook Product information</strong> and continually “build” your draft document</td>
</tr>
<tr>
<td><strong>8. Build &amp; Test</strong></td>
<td>• Complete Notebook Draft Version</td>
</tr>
<tr>
<td></td>
<td>• Assess Notebook Draft Version against Specification and Evaluation Criteria</td>
</tr>
<tr>
<td></td>
<td>• Form scoring team to score your notebook using score sheet</td>
</tr>
<tr>
<td><strong>9. Modify &amp; Retest</strong></td>
<td>• Complete Notebook - Update based on findings from step 8.</td>
</tr>
<tr>
<td><strong>10. Deliver Product</strong></td>
<td>• <strong>Deliver Notebook at Practice Day 17 October</strong></td>
</tr>
<tr>
<td></td>
<td>• Describe your documentation process in your notebook</td>
</tr>
</tbody>
</table>
### Example 1 – SAIL Homeschoolers 2011
1. Implementation of the Engineering Design Process
   - Analyzing Task and Brainstorming Game Strategy
   - Requirements Definition
   - Brainstorming & Analyzing Design Ideas
   - Math Used To Determine Requirements & Analyze Design Alternatives
   - Building, Testing, and Revising the Robot
2. Offensive and Defensive Evaluation
3. Safety
4. Research Paper
5. Summary
6. Appendix – Drawings, Meeting Notes, Team Organization, and Software

### Example 2 – STEM Academy 2012
1. Executive Summary
2. Design Process
   - 2.1 Problem Statement
   - 2.2 Overview of Engineering Design Process
   - 2.3 Brainstorming
   - 2.4 Strategy Evaluation
   - 2.5 Robot Design
   - 2.6 Mathematical Analysis
   - 2.7 Programming
   - 2.8 Robot Integration & Testing
3. Team Organization & Meeting Minutes
4. Safety
5. Research Paper
6. Appendix

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Sample notebook on RM BEST Web Site under: Our Competitions > 2012 Competition > Special Awards: 2012 STEM Notebook
Design a Table of Contents

A 45 minute quick start to Table of Contents 1st Draft

1. Read Specification and Evaluation Criteria & Review example Notebook outlines (15 minutes)

2. Write down a rough draft of Table of Contents - include quick estimate of number of pages and team responsibilities (15 minutes)

3. Evaluate rough draft of Table of Contents against Specification and Evaluation Criteria and revise Table of Contents to create 1st draft (15 minutes)

Don’t let the first week go by without a Table of Contents 1st Draft
ADDITIONAL RESOURCES

Where to go for Help:
Rocky Mountain BEST Judge
BEST Website Resources
Questions?

This is a Notebook!
(some assembly required)
Contact Information

Project Engineering Notebook Lead Judge

- Linda Scott
- lscott@rockymountainbest.org
- Cell 720-250-6896
BEST Website Resources

http://rockymountainbest.org

www.bestinc.org

- Project Engineering Notebook Specific
  - Engineering Notebook Requirements at Participants => File Manager => Main => 2015 Game Files => Awards & Judging => For Teams => 2015 Awards and Judging Policies.pdf*
  - Project Engineering Notebook Example at Participants => File Manager => Main => Public Resources and Training => Team Resources => Examples

- Contest General Information
  - Participants => File Manager => Main => Public Resources and Training ... all sections

- 2015 Contest Information:
  - Participants => Contest Information => Main => 2015 Game Files ...all sections*

*Password required until 18 September
Any Questions?