

Battlebots IQ

Competitive Science and Technology

Summer 2002

BBIQ Teacher Work Shop Outline

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Battlebots IQ is a national high school academic program in which students acquire and manipulate the mathematical, scientific knowledge and technological skills necessary to gain an advantage over opposing robots.

This program affords students the competitive excitement of athletics as well as the empowerment and satisfaction that comes from knowing, doing and thinking.

The following outline suggests that Battlebots IQ would serve as an attractive and engaging program for students as well as a foundation activity that supports the math, science and technology benchmarks specified for State and Federal educational programming.

Battlebots IQ Goals

- Create an engaging and exciting venue for passionate learning and doing.
- Empower Students and teachers to contribute to the effort.
- “Share the experience” by growing the program.
- Specify, identify and source engineering components.
- Develop safe and effective work habits and “Best practices”
- Full Immersion in the engineering process.
- Use and apply technology to produce inventions.
- Use learned science math and technical skills to obtain a competitive advantage by working and thinking smart.
- Develop an appreciation for science and engineering by doing science and engineering.
- Visualize solutions using sophisticated graphic design tools.
- Develop communication and presentation skills.
- Apply science and engineering methodologies to create a robot warrior
- Design and build a competitive BattleBot
- Compete in the BattleBots IQ High School Tournament

BattleBots IQ: The Mission Statement

Build Robots
Have Fun
Learn As Much As possible
Change the World

BattleBots IQ: Fighting to Know More

Battlebots IQ is supported by constructivist educational theories described by Seymour Papert and in the epistemology of learning outlined by Jean Piaget.

Like the robot competitions made famous at MIT and other leading Institutes of Technology, the overarching purpose of Battlebots IQ is learning, knowing and doing.

Hard Skills

Engineering Drawing
3D Solid Modeling
Computer Animation
Algebraic Manipulations
Data Analysis
Fluid Power/Pneumatics

Creative Technical Writing/Presentation
Organizational skills
Electronic Fundamentals
Kinematics
Precision Measurement
Energy and Power

Soft Skills

Creative Thinking
Exercising Leadership
Integrity / Honesty
Work with Diversity
Self-management
Allocates Resources
Negotiates
Apply Technology to a Task
Research and Testing

Self-management
Decision Making
Interpret Information
Maintain Technology
Teaching Others
Responsibility
Serving Clients
Monitoring and Correcting Performance
Developing a sense of Humor
Putting the Good Times and the Bad Times
in Proper Perspective.

The Workshop Theme

Provide BBIQ participants with a comprehensive integrated unit of instruction whereby they will learn to use the BattleBots IQ Curriculum Website to acquire technical skills, science and math knowledge and the positive attitudes to establish a BBIQ program in their school. Participants will be fully immersed in the engineering design and construction of an electro-pneumatic radio controlled ancient weapon of siege. The participants will use their creations in a contest of skill and strategy called the “**Traveling Trebuchet Tournament**”.

Activity Areas

Design

IQ Workshop Participants will use accepted design methodologies described in the BBIQ Curriculum to “Brainstorm” their designs for “Traveling Trebuchet Tournament” game. The Five Budgets and the Great 8 BBIQ design concepts will be explained

Scheduling and Organization

- Develop time lines and benchmarks
- Milestone reports: Completion of the two major subassemblies.
- Organize/inventory/maintain materials and supplies
- Develop a schedule for the (4 day) project

Researching

- Identifying, specifying and sourcing engineering components
- Interacting with manufacturers and suppliers of engineering components.
- Using the Web and manufacturers online catalogs and design software such as SMC’s E-Tech, identify parts and resources used in the kit, as well as where they can be obtained.

Communication

- Engineering drawing
- 3D parametric design
- Digital prototyping
- Graphic analysis and Spread sheets
- Video/Multimedia/Web development
- Writing/Speaking effectively
- Reading for content and enjoyment
- Researching
- “Farming and mining” Ideas
- Maintaining a Journal

Safety

- Safety begins with establishing a safe culture.
- Example: If you get hurt, or are associated in any way with an accident, you loose your robot kit 😊

Physics

Power Force Energy
Electrical/Magnetic
Motion/Kinematics

Math

Algebra/Geometry/Trigonometry/Spreadsheets

Fabrication

Strength of Materials
Material Processing
Machine Tool Processes
Structures/Subassemblies
Threaded Fasteners/Mechanical Drive Systems
Wiring/Electrical Circuits
Pneumatics operations and controls

Computer Science and Applications

Using the IFI Robot Controller
Micro-controller applications

Creativity

Developing Ideas
Analyzing and experimenting with ideas, components, materials and processes.

Marketing and Public Relations

Organizing a booster organization
Maintaining communication with the school and community
Travel and competition logistics.

Associated benefits of the Battlebots IQ program

Engages students imagination and passion for knowing and doing.
Attractive to local and regional corporate sponsors
Provides a compelling basis for a fully integrated academic approach
Provides multiple justifications for Technology investments
 Digital graphics
 3D design
 Solid model animations
 Logic control
Provides dramatic opportunities to profile school/student achievement locally, regionally and nationally.

Equipment and Environment

20-30 kids/teachers

Computer lab 20 workstations w/Internet access
Fabrication room 1000 sq/ft
Software
 Solid model Design/2D and 3D design

Imaging software
Video software
Animation
Web Authoring tools

Teaching aids and books

Physics texts/math texts/software manuals

Applied Science teaching aids

SMC Pneumatics Books and Software

Electro/mechanical bread boarding kits

The “Battlebots kit” of suggested sources and parts. Chain and gear sizing, battery options, Tools, wheels, Motors and pneumatic components.

Robot Controllers

Appropriate hand and power tools

Microprocessor learning kits

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Teacher Work Shop Outline

Summer Session 2002

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Overview

Create a Teacher workshop that will enable all the participants to successfully develop a BattleBots IQ program at their respective schools.

Using the BBIQ Table Top Prototyping Kits, BBIQ teachers are guided through the complete robot development cycle. Particular attention is paid to respecting the 5 budgets: Time, Money, Knowledge, Power and Weight. This is accomplished by using the BBIQ Educational Engineering System kits to develop a competitive robot.

The contest is the final exam.

Day One

8:00 AM Open the classroom, ready the lessons and equipment

8:30 AM Meet the Participants, introductions and outline the weeks activities. Assign a folder and data sheets to every student. The engineering journal is discussed, and the use of the digital cameras is explained.

9:00 AM **Session I begins**

BattleBotsIQ: Introduction to the BBIQ Education Engineering System

Participants review a slide show about the BBIQ Educational Engineering System to become familiar with the quipment we will be using and activities we will be doing throughout the week. These activities are mapped to the activities required to build a competitive BattleBot.

How the design journal will be used as the assessment tool and expectations for the design journal are explained.

The Robot Game of the Week is explained. Traveling Trebuchet Tournament

Session I A

The Process of Invention

Design Methodologies are discussed and the BBIQ Chapter on Design is reviewed. The online Design Slide Shows are Reviewed.

Idea Creation/Idea Sharing and Evolution/The 5 Budgets/The Great 8

Graphic Elements of Design Methods

Sketching

2D CAD

3D and solid models

Parametric Solid Models

Computer Animation

Activities

The Process of Game Creation and this years Game is explained.
The Process of Design is reviewed.
Examine the Kit of Parts/The importance of touching the stuff.
The Science and Art of Sourcing materials/supplies and managing costs by developing cost comparisons with a catalog and online materials.
Game playing or game winning strategies are developed/Game playing Ideas are discussed.
Develop Concepts and write a concept statement and share it using Rorbach 365
The educational uses and benefits of the design journals are explained.
Teachers will be given time to make sketches of subassemblies of the robot.
Sketching improves understanding.
Teachers will create a list of parts used in the **Traveling Trebuchet Tournament** and will be asked to make decisions about the cost of the parts and component options. Example. Cost out a sprocket/chain drive subassembly with a torque ratio of 6:1 using 3/16" and/or 1/4" shafting.

Session I B	Introduction to the BattleBot Prototyping design kits. Drive systems are demonstrated and discussed. The Advantages and Disadvantages of Chains/Belts and Gear Drives. The operation of the IFI Control system is demonstrated. Reference the BBIQ website.
10:20 AM	Sessions I A and I B end and the groups reunite for a 20 minute review period and a refreshment break.
10:40 AM	Sessions I A and I B are reversed for each group.
12:00 AM	Session I A and I B end and the group breaks for lunch
12: 50 PM	Session II A Begins Accurate measuring using Dial Calipers. Teachers produce a cad drawing with evenly spaced holes such as those found in the BattleBot Prototyping Kit pieces. Teachers Produce 3D Geometry in CAD. The Extrude/Revolve/Render commands. Exporting 3DS files. Parts are modeled as solids. Basic animation is demonstrated and the concept of modeling is introduced. Selected pieces from the erector set are modeled by the teachers. The Default Robot animation is reviewed and commented on. Session II B Begins. Start construction of the robot chassis and drive system. Explain the Control System.
2:10 PM	Sessions II A and II B end. The group gathers to review the lessons and have a refreshment.
2:30 PM	Sessions II A and II B are reversed for each group.
4:00 PM	Teachers are given time to make design journal entries. The design journal will be important. When the workshop ends, it will contain all the information they need to begin a successful BBIQ program.

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Day Two

- 8:00 AM Open the classroom, ready the lessons and equipment
- 8:30 AM Meet the teachers and organize them into groups. Outline the days activities.
- 8:40 AM **Session V begins**
- Session VI A **Traveling Trebuchet Tournament** construction continues
Teachers continue to modify and test their “actual” machines.
Teachers develop mathematical analysis of the vehicles performance and compute the vehicle speed and power.
- Session VI B The Miniature Pneumatic “Catapult” Systems will be constructed and used to demonstrate and explain pneumatic basics, BBIQ pneumatic safety regulations and “Best Practices” with respect to using and designing pneumatic circuits.

Note: Throughout the activities teacher participation is recorded on video and in digital picture format by the staff, to be used in a scrapbook the teachers will produce.

- 10:00 AM Sessions V A and V B end and the groups reunite for a 20 minute review period and a refreshment break.
- 10:20 AM **Sessions V A and V B are reversed for each group.**
- 11:40 AM Session V A and V B end and the group breaks for lunch and demonstrations of what BBIQ students have accomplished. General questions and concerns are entertained.
- 12: 30 PM **Session VI A Begins**
- Organizing and maintaining journals, assessment and course content are discussed. The Importance of the SCANS in developing a quality program is discussed. Engineering and engineering attitudes are explained.
- Session VI B Begins.**
- BBIQ Table Top Robot construction continues.
- 1:45 PM Sessions VI A and VI B end. The group gathers to review the lessons and have a refreshment.
- 2:00 PM Sessions VI A and VI B are reversed for each group.
- 3:30 PM Teachers are given time to make design journal entries. The design journal will be important. When the workshop ends, it will contain all the information they need to begin a successful BBIQ program

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Day Three

- 8:00 AM Open the classroom, ready the lessons and equipment
- 8:30 AM Meet the teachers and organize them into groups. Outline the days activities.
- 8:40 AM **Session III begins**
- Session III A **Traveling Trebuchet Tournament** construction continues. Chassis. Drive trains and weapon systems are brainstormed and fabricated using BattleBot Prototyping kit parts. Students use the information from the web (Simple Machines) and the previous day's lessons to enhance their designs.
- Session III B Auto Cad 3D parts are designed. Machines are "Mocked up" using previously prepared 3D Cad virtual parts. "Virtual" construction begins. Teachers will use parts they draw in Cad along with parts from the "virtual" erector set, to visualize the design of their BBIQ machine.
- 10:00 AM Sessions III A and III B end and the groups reunite for a 20 minute review period and a refreshment break.
- 10:20 AM **Sessions III A and III B are reversed for each group.**
- 11:40 AM Session III A and III B end and the group breaks for lunch and a demo of how to use the BBIQ curriculum
- 12: 30 PM **Session IV A Begins**
- Students continue to develop their **Traveling Trebuchet Tournament** chassis and drive components, adding Sub assemblies, and control systems. At this point students are testing traction strategies and solving unexpected design problems. Some students will complete their design and go on to enrichment activities such as driving skills, programming and component selection.
- The importance and application of CAD design in Engineering education.
- Session IV B Begins.**
- The SMC pneumatics Education products and equipment are introduced. Mr. Dave Johnson National Education Director for SMC will provide insight into the benefits of partnering with SMC for your pneumatic requirements.
- 1:50 PM Sessions IV A and IV B end. The group gathers to review the lessons and have a refreshment.
- 2:10 PM Sessions IV A and IV B are reversed for each group.
- 3:30 PM The End of the Day

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Day Four

- 8:00 AM Open the classroom, ready the lessons and equipment
- 8:30 AM Meet the teachers and organize them into groups. Outline the days activities.
- 8:40 AM **Session VII begins for all the students**
- Session VII A
Teachers are introduced methods of analyzing motor performance. Motor power and torque are measured. Personal HP is measured Motors are demonstrated and discussed. Assessing torque and motor analysis. Reference the BBIQ website.
- Session VII B
Teachers participate in “timed” drag races using their BBIQ Robots. Lessons on speed and acceleration are introduced. Robots are weighed and the concept of the 5 budgets is introduced. Weight, Power, Money, Time and Knowledge are discussed in length.
- 10:00 AM The students break for a refreshment, and we review the lessons.
- 10:20 AM **Session VIIA and VIIB are reversed.**
- 11:40 AM Session VIII A and VIII B end and the group breaks for lunch. Team organizational strategies are discussed. Potential problem areas are identified and remedies are suggested.
- 12: 30 PM **Session IX A IX Begins**
- Session IX A. Teachers learn to use stop watches, and measuring devices like the voltmeter and ammeter. Battery tests are performed and the concept of “Amp/hrs” is explained. Teachers are given instruction in the fabrication and use of battery test equipment. Teachers are given the opportunity to perform and record battery analysis. They are asked to report and compare the results of their testing. Current draw and voltage concepts are discussed. The BattleBots IQ Battery Chapter is introduced.
- 1:45 PM Sessions IX A and IX B end. The group gathers to review the lessons and have a refreshment.
- 2:00 PM Sessions IX A and IX B are reversed for each group.
- 3:30 PM Teachers are given time to make design journal entries. The design journal will be important. When the workshop ends, it will contain all the information they need to begin a successful BBIQ program.

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Day Five

- 8:00 AM Open the classroom, ready the lessons and equipment
- 8:30 AM Meet the teachers and organize them into groups. Outline the days activities.
- 8:40 AM **Session X begins**
- The **Traveling Trebuchet Tournament** begins. The games are played, the winners celebrated and the loser consoled. The workshop participants are debriefed and educational materials are disassembled and repacked.
- 10:00 AM
- 12:20 PM Lunchtime
- 1:00 PM Robots are disassembled and the BBIQ Engineering System pieces, and IFI control system kits are organized and put away neatly. Teachers will be given instruction and time to download and organize their journals. Digital images taken throughout the day and videos clips will be used to create a collage of images and text illustrating the new knowledge and skills gained at the BBIQ Summer Workshop.
- 3:30 PM The End of the Day/Week

Note: *Throughout the week there will be enrichment exercises to enhance the teachers ability to organize and maintain a successful BBIQ program. These enrichment activities will be provided for those teachers who finish the prescribed activities within the allotted time frames and or during breaks and lunch time. All lunches will be working lunches.*