# Lesson Plan

**Course Title:** Robotics and Automation

**Session Title:** How to Construct a Robot Part 1: Team Structure and Leadership

**Performance Objective:**
After completing this lesson, students will identify how to become part of a team, work within a team structure, and follow team leadership when constructing a robot by a Plan Sheet that matches the criteria in the How to Construct a Robot Part by Part Rubric.

**Specific Objectives:**
- Explain why team structure and leadership are main considerations when constructing a robot part by part.
- Describe what the Team Manager, Design Manager, and Construction Manager are responsible for.
- Identify the activities of the Design Team (group brainstorming, decision making, creating virtual and physical prototypes, game strategies).
- Identify the activities of the Manufacturing Team (using software drawing tools, power and manual tools, appropriate safety gear, and Plan Sheets).
- Identify the activities of the Technology Team (using software drawing design tools to guide construction process, website software, and t-shirt design software).
- Describe what is meant by team operations and the activities involved (developing a sense of unity outside club meetings, including all members, clarifying virtual and physical prototypes and theoretical concepts through discussion).
- Discuss community outreach and The Mandelbrot Construct (presenting robot, publicizing the program, spreading the word with a brochure).

## Preparation

**TEKS Correlations:**
This lesson, as published, correlates to the following TEKS. Any changes/alterations to the activities may result in the elimination of any or all of the TEKS listed.

**Robotics and Automation:**

- 130.370(c)(1)(D)
  
  . . . demonstrate the principles of teamwork related to engineering and technology;

- 130.370(c)(2)(B)(C)
  
  . . . use teamwork to solve problems; and
  
  . . . serve as a team leader and a team member and demonstrate appropriate attitudes while serving in those roles.
• **130.370(c)(3)(A)(B)(D)**
  
  ... use time-management techniques to develop and maintain work schedules and meet deadlines;
  ... complete work according to established criteria;
  ... develop a plan for production of an individual product.

• **130.370(c)(5)(A)(C)**
  
  ... demonstrate the use of computers to manipulate a robotic or automated system and associated subsystems;
  ... demonstrate knowledge of process control factors;

• **130.370(c)(8)(A)(B)(C)(D)(F)**
  
  ... understand and discuss principles of ideation;
  ... think critically, identify the system constraints, and make fact-based decisions;
  ... use rational thinking to develop or improve a product;
  ... apply decision-making strategies when developing solutions;
  ... describe perceptions of the quality of products and how they affect engineering decisions;

• **130.370(c)(9)(C)**
  
  ... use multiple software applications to simulate robot behavior and present concepts.

• **130.370(c)(10)(A)(B)(C)(F)**
  
  ... interpret industry standard system schematics;
  ... identify areas where quality, reliability, and safety can be designed into a product;
  ... improve a product design to meet a specified need;
  ... evaluate design solutions using conceptual, physical, and mathematical models at various times during the design process to check for proper functionality and to note areas where improvements are needed;

• **130.370(c)(11)(D)(E)(F)**
  
  ... construct a robot or automated system to perform specified operations using the design process;
  ... test and evaluate the design in relation to pre-established requirements such as criteria and constraints and refine as needed;
  ... refine the design of a robot or automated system to ensure quality, efficiency, and manufacturability of the final product.

**Interdisciplinary Correlations:**

**English Language Arts and Reading, English I:**

• **110.31(b)(1)(A)(E)**
  
  ... determine the meaning of grade-level technical academic English words in multiple content areas (e.g., science, mathematics, social studies, the arts) derived from Latin, Greek, or other linguistic roots and affixes;
• Use a dictionary, a glossary, or a thesaurus (printed or electronic) to determine or confirm the meanings of words and phrases, including their connotations and denotations, and their etymology.

• 110.31(b)(11)(A)(B)
  • Analyze the clarity of the objective(s) of procedural text (e.g., consider reading instructions for software, warranties, consumer publications);
  • Analyze factual, quantitative, or technical data presented in multiple graphical sources.

• 110.31(b)(12)(A)
  • Compare and contrast how events are presented and information is communicated by visual images (e.g., graphic art, illustrations, news photographs) versus non-visual texts;

• 110.31(b)(15)(B)
  • Write procedural or work-related documents (e.g., instructions, e-mails, correspondence, memos, project plans) that include:
    (i) Organized and accurately conveyed information;
    (ii) Reader-friendly formatting techniques;

• 110.31(b)(19)(A)(B) - Oral and Written Conventions/Spelling

• 110.31(b)(21)(A)(B)
  • Follow the research plan to compile data from authoritative sources in a manner that identifies the major issues and debates within the field of inquiry;
  • Organize information gathered from multiple sources to create a variety of graphics and forms (e.g., notes, learning logs);

• 110.31(b)(22)(B)
  • Evaluate the relevance of information to the topic and determine the reliability, validity, and accuracy of sources (including Internet sources) by examining their authority and objectivity;

• 110.31(b)(23)(C)(D)
  • Uses graphics and illustrations to help explain concepts where appropriate;
  • Uses a variety of evaluative tools (e.g., self-made rubrics, peer reviews, teacher and expert evaluations) to examine the quality of the research;

• 110.31(b)(26) - Listening and Speaking/Teamwork
**Occupational Correlation:** (reference: O*Net – [www.onetonline.org](http://www.onetonline.org))

Aerospace Engineers 17-2011.00

Similar Job Titles: Aerospace Engineer, Flight Test Engineer, Design Engineer, Systems Engineer, Structures Engineer, Test Engineer, Aeronautical Engineer, Aerospace Stress Engineer, Avionics Engineer, Flight Systems Test Engineer

Tasks:
- Direct or coordinate activities of engineering or technical personnel involved in designing, fabricating, modifying, or testing of aircraft or aerospace products.
- Formulate conceptual design of aeronautical or aerospace products or systems to meet customer requirements.
- Plan or coordinate activities concerned with investigating and resolving customers' reports of technical problems with aircraft or aerospace vehicles.
- Plan or conduct experimental, environmental, operational, or stress tests on models or prototypes of aircraft or aerospace systems or equipment.
- Analyze project requests, proposals, or engineering data to determine feasibility, cost, or production time of aerospace or aeronautical products.
- Maintain records of performance reports for future reference.
- Write technical reports or other documentation, such as handbooks or bulletins, for use by engineering staff, management, or customers.
- Review performance reports and documentation from customers and field engineers, and inspect malfunctioning or damaged products to determine problem.

Soft Skills:
Critical Thinking; Reading Comprehension; Active Listening; Complex Problem Solving; Operations Analysis; Speaking; Mathematics; Science; Writing; Monitoring

**Teacher Preparation:**
1. Review How to Construct a Robot Part 1: Team Structure and Leadership slide presentation
2. Prepare How to Construct a Robot Part by Part Rubric for each student
3. Prepare Plan Sheet handouts for each student
4. Research books and internet for applications on how to construct a robot
5. Be prepared to talk about the problem solving process, team structure, leadership, and team operations.

**References:**
3. Magazines for mechanics
4. NASA Robotics
5. Internet search for gears, problem solving applications

### Instructional Aids:
1. How to Construct a Robot Part 1: Team Structure and Leadership slide presentation
2. How to Construct a Robot Part by Part Rubric
3. Plan Sheet handout
4. Computer aided design/drafting software
5. Internet access

### Materials Needed:
1. How to Construct a Robot Part by Part Rubric for each student
2. Plan Sheet handout for each student
3. Computer aided design/drafting software

### Equipment Needed:
1. Computer with internet access
2. Projector and Screen

### Learner Preparation:
None required

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### Introduction (LSI Quadrant I):

**SAY:** Today we are going to learn about the team structure and leadership needed to effectively construct a robot part by part.

**ASK:** Does anyone know what you should keep in mind when designing the team structure and leadership? (Allow time for answers.)

**SAY:** You will need a Team Manager, Design Manager, and a Construction Manager; and an understanding of leadership, design, manufacturing, technology, and team operations relative to constructing a robot.

**SAY:** We are now going to go through How to Construct a Robot Part 1: Team Structure and Leadership slide presentation. We will stop during the presentation so that you will be able to talk about team structure, leadership and team operations as it relates to constructing a robot part by part.

**SHOW:** How to Construct a Robot Part 1: Team Structure and Leadership slide presentation and point out main points from the presentation.

**SAY:** Next we will look at how to construct a robot by a Plan Sheet and things to keep in mind.

**SHOW:** A Plan Sheet and then stop and let the students discuss how they would develop their own Plan Sheet for a part.

**ASK:** What do you think is the best practice - to have a team structure or to follow the leadership of the student creating each part? (Allow time for the students to EXPLAIN their answers.)
Outline (LSI Quadrant II):
Instructors can use the slide presentation, slides, handouts, and note pages in conjunction with the following outline.

<table>
<thead>
<tr>
<th>MI</th>
<th>Outline</th>
<th>Notes to Instructor</th>
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<tbody>
<tr>
<td></td>
<td>I. Team structure and leadership defined</td>
<td>Teacher will begin How to Construct a Robot Part 1: Team Structure and Leadership slide presentation and define team structure and leadership. Slides 1-7. Teacher will distribute the How to Construct a Robot Part by Part Rubric and the Plan Sheet handout.</td>
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<tr>
<td></td>
<td>A. Team manager supervises process of creation of robot</td>
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<td></td>
<td>B. Design manager supervises discussion of various concepts</td>
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<td>C. Construction manager supervises construction parts</td>
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<td></td>
<td>D. Construction manager supervises assembly process</td>
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<td></td>
<td>II. Team operations</td>
<td>Teacher discusses team activities, operations, and community outreach with the students. Slides 7-8.</td>
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<tr>
<td></td>
<td>A. Design team activities</td>
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<tr>
<td></td>
<td>1. brainstorms and discusses</td>
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<td></td>
<td>2. decides what would be best for robot</td>
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<td></td>
<td>3. creates virtual and physical prototypes</td>
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<td></td>
<td>4. considers two game strategies</td>
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<td></td>
<td>5. considers uniqueness of design</td>
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<td>6. results include successful robot</td>
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<td></td>
<td>B. Manufacturing team activities</td>
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<td>1. uses drawings created with software during design process as templates and guidelines</td>
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<td></td>
<td>2. uses a variety of tools (power and manual)</td>
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<td>3. uses appropriate safety gear</td>
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<td>4. manufactures robot efficiently and safely</td>
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<td>5. creates parts and assembles robot</td>
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<td></td>
<td>C. Technology team activities</td>
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<tr>
<td></td>
<td>1. uses drawing and design software</td>
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<tr>
<td></td>
<td>2. uses drawings to guide construction process and explain theoretical concepts</td>
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<td></td>
<td>3. uses website software for publicity</td>
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<td></td>
<td>4. uses design software for t-shirts</td>
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<tr>
<td>D. Team operations</td>
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<tr>
<td>1. develops sense of unity outside of club meetings</td>
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<td>2. includes youngest members in design and manufacturing process</td>
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<tr>
<td>3. uses discussion for design process (virtual and physical prototypes and theoretical concepts clarified)</td>
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<tr>
<th>E. Community outreach</th>
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<tr>
<td>1. presents robot to technology students at a middle school</td>
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<td>2. publicizes program in school newspaper</td>
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<td>3. spreads word about the team with a brochure</td>
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<tr>
<th>III. Problem solving process for team structure and leadership</th>
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<tbody>
<tr>
<td>A. Understanding the problem</td>
<td>Teacher will discuss the steps to the problem solving process as it relates to creating team structure and leadership.</td>
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<td>B. Devising a plan</td>
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<td>C. Carrying out the plan</td>
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<td>D. Questioning students</td>
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<td>E. Looking back</td>
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<td>1. evaluate designs</td>
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<td>2. vote on best design</td>
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<tr>
<th>IV. Construct a robot</th>
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<tbody>
<tr>
<td>A. First by a plan sheet</td>
<td>Slides 9-14. The teacher will discuss how students will construct a robot part by part in How to Construct a Robot Parts 2-7 lessons.</td>
</tr>
<tr>
<td>B. Things to keep in mind</td>
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<tr>
<td>C. Review plan sheet</td>
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<td>D. Review tools, steps or procedure, safety</td>
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<td>E. Revise or select drawing</td>
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<tr>
<th>V. Evaluation of robot challenges</th>
<th></th>
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<tbody>
<tr>
<td>A. Which device worked and why?</td>
<td>Students will not be building a part during How to Construct a Robot Part 1: Team Structure and Leadership. The teacher should talk about how students will evaluate how the team structure, leadership, team</td>
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</tbody>
</table>
VI. Students to design and team structure and leadership and discuss
   A. Different challenges may require different leadership styles
   B. Students may compete for leadership
   C. Who should be team manager
   D. Who should be the design manager
   E. Who should be construction manager

The teacher will stop at the end of slide 13 to allow students to begin talking about their own designs of team structure, leadership, and team operation when they begin to construct a robot part by part. The teacher should question students about why they chose the team structure and leadership they chose.

VII. How to Construct a Robot Part by Part Rubric

The teacher should review the criteria and expectations on the rubric so students know what will be expected when they are constructing the robot part by part in the next six lessons.

<table>
<thead>
<tr>
<th>Verbal Linguistic</th>
<th>Logical Mathematical</th>
<th>Visual Spatial</th>
<th>Musical Rhythmic</th>
<th>Bodily Kinesthetic</th>
<th>Intra-Personal</th>
<th>Inter-Personal</th>
<th>Naturalist</th>
<th>Existentialist</th>
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**Guided Practice (LSI Quadrant III):**
The teacher guides the students through the How to Construct a Robot Part 1: Team Structure and Leadership slide presentation. The teacher discusses team structure, leadership, and team operations with the students.

**Independent Practice (LSI Quadrant III):**
Students will be required to be creative, think critically, and develop their own team structure, leadership, and team operations.

**Summary**

**Review (LSI Quadrants I and IV):**

**Question:** Which structure is best for your school?
**Answer:** (It depends on the structure created.) The best answer will most likely be a kind of structure that gets the job done to create a robot part by part.

**Question:** Which structure could best move the robot along in creating a robot part by part?
**Answer:** (It depends on the leadership created.) The best answer will be most likely be a kind of structure that will build the robot quickly with time to test (ask the students just that).

**Question:** Which structure worked best for combination and multiple tasks?
**Answer:** The structure that had the best combination of getting the job done. Speed is the result of good craftsmanship.

**Evaluation**

**Informal Assessment (LSI Quadrant III):**
The teacher will observe the students as they work on creating their team structure, leadership, and team operations.

**Formal Assessment (LSI Quadrant III, IV):**
There is no formal assessment for this lesson. The teacher will review the How to Construct a Robot Part by Part Rubric with the students in preparation for using it in Parts 2-7.

**Extension**

**Extension/Enrichment (LSI Quadrant IV):**
For more enrichment, students can develop various team structures and leadership styles to be used with different challenges and evaluate how they worked. Students can compete for leadership of different challenges.
PLAN SHEET

Name______________________________________Grade_______________Class____________________

Name of Project ___________________Date Started ________________Date Completed______________

Working Drawing - Refine part in drawing software or three-view drawing.

<table>
<thead>
<tr>
<th>SIZE NO</th>
<th>T</th>
<th>W</th>
<th>L</th>
<th>NAME OF PART</th>
<th>MATERIAL</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
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Tools and Machines:
1. ______________________________________
2. ______________________________________
3. ______________________________________
4. ______________________________________
5. ______________________________________
6. ______________________________________
7. ______________________________________
8. ______________________________________
9. ______________________________________
10. _____________________________________

Steps or Procedure:
1. ______________________________________
2. ______________________________________
3. ______________________________________
4. ______________________________________
5. ______________________________________
6. ______________________________________
7. ______________________________________
8. ______________________________________
9. ______________________________________
10. _____________________________________

STUDENT MUST PASS TEST BEFORE USING MACHINE
# How to Construct a Robot Part by Part Rubric

**Task Statement:** Students will demonstrate they can construct a robot part by part.

**Task Assignment:** Students will lay out and dimension each part; consider the weight, speed and tolerance; determine what tools to use and how to use them; incorporate safety tips as a priority; and use appropriate materials for cost effectiveness.

<table>
<thead>
<tr>
<th>Criteria - Concepts/Skills to be Assessed</th>
<th>Novice 1</th>
<th>Developing 2</th>
<th>Exemplary 3</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lay out and dimension the robot part by part</td>
<td>Pencil sketch main idea</td>
<td>Complete sketch to working drawing and dimensions</td>
<td>Complete working drawing, and dimension with exact measurements (*add five extra credit points to simulate and animate the parts)</td>
<td>(11-15 points)</td>
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<tr>
<td>(Possible 15 points)</td>
<td>(1-5 points)</td>
<td>(6-10 points)</td>
<td>(11-15 points)</td>
<td></td>
</tr>
<tr>
<td>Consider weight, speed, and tolerance of each part</td>
<td>Correct height, width, and depth of each part</td>
<td>Correct height, width, depth, weight, speed, and tolerance of each part</td>
<td>Correct height, width, depth, weight, speed, and tolerance of each part to balance load for winning applications</td>
<td>(11-15 points)</td>
</tr>
<tr>
<td>(Possible 15 points)</td>
<td>(1-5 points)</td>
<td>(6-10 points)</td>
<td>(11-15 points)</td>
<td></td>
</tr>
<tr>
<td>What tools will you use and how do you use the tools?</td>
<td>Correct tools for the correct job</td>
<td>Correct tools for the correct job; precision and accuracy required</td>
<td>Correct tools for the correct job; precision and accuracy required to save you time and effort</td>
<td>(11-15 points)</td>
</tr>
<tr>
<td>(Possible 15 points)</td>
<td>(1-5 points)</td>
<td>(6-10 points)</td>
<td>(11-15 points)</td>
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<tr>
<td>What safety tips are required?</td>
<td>Always wear safety glasses; have a clean and safe work space</td>
<td>Always wear safety glasses; have a clean and safe work space; lay out stock before cutting; make</td>
<td>Always wear safety glasses; have a clean and safe work space; lay out stock before cutting; make</td>
<td></td>
</tr>
<tr>
<td>(Possible 15 points)</td>
<td>(1-5 points)</td>
<td>(6-10 points)</td>
<td>(11-15 points)</td>
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<tr>
<td><strong>Use only materials provided in class</strong></td>
<td>Select correct materials for each part</td>
<td>Select the correct materials, size, speed, weight, and application for all functions</td>
<td>Select the correct materials, size, speed, weight and applications for all functions and measurements to take you through the applications with ease</td>
<td></td>
</tr>
<tr>
<td><strong>Why are you using the materials selected?</strong></td>
<td>Ability to apply needed constraints</td>
<td>Choose materials to apply the best constraints and accuracy for results and efficiencies</td>
<td>Choose materials to apply the best constraints and accuracy for results and efficiencies that will accurately affect performance</td>
<td></td>
</tr>
<tr>
<td><strong>Find cost of materials</strong></td>
<td>To avoid waste</td>
<td>To avoid waste; and is for best business practices</td>
<td>To avoid waste; and is for best business practices; and results in the efficiency of management</td>
<td></td>
</tr>
</tbody>
</table>

A = 73-105 points; B = 40-72 points; C = 8-39 points; D = 0-7 points

*Add five extra credit points to simulate and animate the parts: ________

**Total Points:** ________