CTE/ROP Gateway to Technology 1

San Diego County Office of Education - Sweetwater Union High School District
Pacing Guide/Course Description

Course Length: 1 Semester	**Classroom Instruction:** 90 hours
SUHSD Course Number: 87291	**Grade Level:** 7, 8
SDCOE Course Number:	**SDCOE Total Hours:** 110 hours
CBEDS Number/Title: 4650/Business Career Exploration (grades 6-9)	**Year of Implementation:** 2011
Course Pre-requisites: None	**Articulation (school/credits):** None
CTE Industry Sector: Engineering and Design	**CTE Pathway(s):** Engineering Design, Engineering Technology
Job Titles: Mechanical Drafter, Industrial Drafter, Mechanical Engineer, Industrial Engineer, Field Engineer, Civil Engineer, Manufacturer	
Credential Information: Preliminary or Clear Full-Time Designated Subjects CTE Teaching Credential in Engineering Design	
Required Textbooks: None	
Course Description: This course addresses the interest and energy of middle school students while incorporating national standards in mathematics, science, and technology. This activity-oriented, cutting-edge program shows students how technology is used in engineering to solve everyday problems. Students will gain the skills they need to develop, produce, and use products and services. This course provides project-based learning – a hands-on approach – that is exciting and challenging for the full range of students in today's grade 6 – 8 classrooms. The curriculum relates technology to students' daily lives. It promotes communication and collaboration by emphasizing a teaming approach in the instructional units. This approach utilizes the strengths of each team member to accomplish the goals of the project while offering students learning challenges at all ability levels.	

CTE/ROP Gateway to Technology 1

Semester 1

Unit 1: Design and Modeling

- Lesson 1.1 What is Engineering?
- Lesson 1.2 Design Process
- Lesson 1.3 Measurement
- Lesson 1.4 Sketching and Dimensioning Techniques
- Lesson 1.5 Designing for Production

Unit 2: Automation and Robotics

- Lesson 2.1 What is Automation and Robotics?
- Lesson 2.2 Mechanical Systems
- Lesson 2.3 Automated Systems

Semester 1 - **Unit 1 – Design and Modeling (45 hours)**

Competencies	Standards	Suggested Pacing	Essential Vocabulary	Resources/Materials
1A - Understands Engineering and its History. **1B** - Is able to identity fields in Engineering **1C** - Demonstrates knowledge of Engineering Technologies	**Career Technical Education:** ***ED/EDP/** **C1.1** Know historical and current events that have relevance to engineering design ***ED/CPM/** **3.1** Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in a career. **3.2** Understand the scope of career opportunities and know the requirements for education, training, and licensure. **Core Academic:** ***ED/C/2.2W/WS/G8** **(1.4)** Plan and conduct multiple-step information searches by using computer networks and modems. **(1.5)** Achieve an effective balance between researched information and original ideas.	**Lesson 1.1 –** **7 hours:** What is Engineering?	Agriculture Artifact Biotechnology Communication Construction Energy Engineering Environment Ergonomics Industrial Innovation Invention Manufacturing Math Nanotechnology Process Science System Technology Transportation	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

Suggestions/Assessments:

Lesson 1.1

Section 1 (1 hour)

- The teacher will give an overview of the curriculum's six sections (or the sections offered at your school): Design and Modeling, Science of Technology, Automation and Robotics, Magic of Electrons, Energy and the Environment, and Flight and Space.
- The teacher will cover class rules, homework policy, test and/or quiz policy, and GTT notebook requirements.
- The teacher will do an Internet search to find a "Did You Know" video to show students why they need to learn about Technology and Engineering. The 2009 version is located at: **http://www.youtube.com/watch?v=6ILQrUrEWe8**
- The teacher will present **Concepts, Key Terms,** and **Essential Questions** in order to provide a lesson overview.
- The teacher will complete and distribute the **Activity 1.1.1 Gateway To Technology Notebook Dividers** to each student or have students create their own. The dividers need to be completed with appropriate course and classroom information before printing this activity.
- Student will organize their GTT notebook as directed by teacher.
- Note: The teacher should read **Lesson 1.1 Teacher Notes** for suggestions on notebook organization.
- The teacher will use the **Sample Engineer's Notebook Entries** located in the teacher notes or in the purchased Engineering

Notebooks to discuss what constitutes acceptable and unacceptable entries.

- The teacher will distribute **Activity 1.1.1a Engineering Notebook Templates** for students to use or the purchased Engineering Notebook.
- Teachers will evaluate GTT Notebooks and Engineering Notebooks at the end of each lesson. Teachers may use the **GTT Notebook Grading Rubric**.
- Students will use appropriate engineering notebook template for daily entries.

Section 2 (1 hour)

- The teacher will open **Activity 1.1.2 Introduction to Engineering** by asking students to define the following terms in their own words: STEM, science, technology, engineering, and math on the activity.
- The teacher will lead a discussion in how students defined each term.
- The students will complete Activity 1.1.2 Introduction to Engineering while the teacher presents **Introduction to Engineering.ppt.**
- The teacher will show the DVD *Engineers Can Do Anything! (*20 minutes)
- The teacher will lead a discussion of the essential elements of the presentation and DVD.
- Students will complete the conclusion questions for Activity 1.1.2 Introduction to Engineering and put in notebook for future use.
- Students will use appropriate engineering notebook template for daily entries.

Sections 3 – 5 (3 hours)

- The teacher will purchase enough 30-40 piece puzzles from a dollar store for each group of three students in the class. The teacher will take three pieces from each puzzle and exchange with three pieces from another puzzle before students enter class.
- As students enter class the teacher will direct them to a table where they will work with other students assigned to that table to put together a puzzle.
- The teacher will tell students they will be timed as they compete to finish their puzzle first.
- The teacher will lead a discussion about the importance of teamwork in all of the engineering challenges they will complete in this class, just like on a sports team or performing in a musical ensemble.
- The teacher may use the **Teamwork.ppt** adapted from IED to help lead the discussion. Discuss that as a team they may need to work with other teams in the classroom in order to be successful – just like they did with the puzzle challenge today.
- The teacher will introduce students to **Project 1.1.3 Technology Investigation.**
- Teacher will partner students for this project.
- Teachers and students will brainstorm a list of technological products so that the student will realize the list is seemingly endless. Students should choose an invention/innovation of interest to them. The teacher will list chosen artifacts so that students know they must select a different invention or innovation.
- Students will research a technological artifact of the past and present using **Project 1.1.3a Questions to Guide You.**
- Students will differentiate between invention and innovation and discuss how science, technology, math, and engineering were used in the creation of the product. Notes will be kept in their notebooks.
- Students will create one of the following as their final product: presentation, poster, 2-page flyer, or movie. Visual presentation type can be teacher choice or student choice. Students will present their product to their peers as an oral presentation and be prepared to answer questions on Day 8.
- Students will be given **Project 1.1.3 Technology Investigation Grading Rubric.**
- The teacher will demonstrate what a good presentation looks and sounds like and what a bad presentation looks and sounds like so students understand the expectations for their Day 8 presentations.
- Students will use appropriate engineering notebook template for daily entries.

Sections 6 – 7 (2 hours)

- The teacher and students will define and discuss the importance of technology in their daily lives. The major areas of technology will be discussed.
- The teacher will use **What is Technology?.ppt** to aid in the discussion while the students use **Activity 1.1.4 What is Technology?** to record their responses and ideas.
- The teacher will check responses for completion in Activity 1.1.4 What is Technology?
- The teacher will remind students that their Project 1.1.3 Technology Investigation presentation will be due next class.
- Students will use appropriate engineering notebook template for daily entries.

Section 8 (1 hour)

- Students will present their project to their classmates.
- Teacher will assess using Project 1.1.3 Technology Investigation Grading Rubric.
- Students will use appropriate engineering notebook template for daily entries.
- Teacher will lead a discussion about engineering using the Teachers' Domain videos: *What if Engineering Disappeared for a Day?* and *Ten Fun Facts About Engineering.*

Sections 9 – 10 (2 hours)

- There are six different career activities for your students to complete. It is suggested that you choose one activity for each of the units taught in Gateway to Technology®. The teacher will choose one of the six options explained in the teacher notes for the Engineering Career Project.
- The teacher may want to introduce Engineering Careers using this YouTube video: **http://www.youtube.com/watch?v=Y0DxmthvkKU** or the cartoon found on this site: **http://www.cartoonstudio.co.uk/Pages/EngineeringAndTechnologyMap.html**
- Students will follow the directions to complete an activity that introduces them to different engineering careers, using **Activity 1.1.5(A-F) Engineering Careers.**
- The teacher will collect the Engineering Careers activity, evaluate it and encourage students to keep it in their portfolio or with their career plan.
- **Optional:** The teacher may wish to assign **Key Terms 1.1 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter their best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 1 – Design and Modeling**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
2A - Understands many design processes that guide professionals in developing solutions to problems. **2B** - Identifies design processes including brainstorming, defining a problem, researching, identifying requirements, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing, refining, making, and communicating results. **2C** - Is able to design in teams using brainstorming techniques to generate large numbers of ideas in short time periods. **2D** - Understands the use of an engineer's notebook to chronologically document all aspects of a design project. **2E** - Understands the results of the design process are commonly displayed as a physical model. **2F** - Works in design teams to generate large numbers of ideas in short time periods. **2G** - Uses decision matrices to help make design decisions that are based on analysis and logic.	**Career Technical Education:** ***ED/PSCT/*** **5.1** Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks. ***ED/EDP/*** **C1.2** Understand the development of graphic language in relation to engineering design. **C2.2** Apply conventional engineering design processes and procedures accurately, appropriately, and safely. ***ED/ETP/*** **D5.1** Understand the steps in the design process. ***ED/LT/*** **9.1** Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace settings. **9.3** Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. **9.4** Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace. **Core Academic:** ***ED/A/1.1M/NS/G7/*** **(1.2)** Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers. ***ED/A/1.1M/MR/G7/*** **(2.1)** Use estimation to verify the	**Lesson 1.2 –** **5 hours:** Design Process	Aesthetics Annotate Brainstorming Constraints Consumer Criteria Decision Matrix Design Design Brief Design Elements Design Process Designer Dimension Engineer Ergonomics Evaluate Experimentation Exponentially Investigate Model Modify Optimize Problem Solving Process Prototype Requirements Research Specification Testing Texture Trade-off Visualization	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

	reasonableness of calculated results.			

Suggestions/Assessments:

Lesson 1.2

Sections 1 - 2 (2 hours)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions**, in order to provide a lesson overview.
- The teacher will lead a whole class discussion so the students can gain an understanding of the design process.
- The teacher will present **Design Process.ppt**
- Students will complete **Activity 1.2.1 Design Process** notes page while Design Process presentation is shown.
- Students will complete Design Squad questions in Activity 1.2.1 Design Process while watching one of the videos from Season 2 at **http://pbskids.org/designsquad/** (available on 10/2/08).
- Students will complete conclusion questions and turn in Activity 1.2.1 for grading.
- The teacher will lead students in a discussion about the elements of design and why they are important using **Design Elements.ppt.**
- Students will complete a concept map using **Activity 1.2.2 Design Elements** during the discussion.
- The teacher will show the video of the invention of the yike bike (or another invention). **http://www.yikebike.com/design/video-gallery/yikebike-discovery-channel**
- The teacher will lead a discussion about the design elements considered while developing the yike bike.
- Students will use appropriate engineering notebook template for daily entries.

Sections 3 - 5 (3 hours)

- The teacher will introduce **Project 1.2.3 Furniture Design** or **Project 1.2.3a Hobby Organizer Design**. The teacher may want to review **Design Briefs IED.ppt** prior to teaching this part of the lesson. The presentation explains what a design brief entails. If you want to use a presentation with students, use **the Design Briefs GTT.ppt** version.
- The teacher will assign students a partner to work with on the furniture design project or hobby organizer design project.
- The teacher will discuss rules for brainstorming. The IED **Brainstorming.ppt** is in the teacher guidelines for your review.
- The teacher will lead students in a brainstorming activity about the purpose of working in teams and how teams can be successful. (Remind students of puzzle activity done in Lesson 1.)
- With direction from the teacher and their partners, students will complete the Design Brief and meet their group goals.
- The teacher may wish to provide graph paper for sketching. Graph paper templates are located in the Teacher Guidelines section at the end of this lesson. Both orthographic and isometric templates are available; however, students may also use plain white paper.
- The teacher will serve as a facilitator and keep students on task by offering cues and reiterating the problem statement. Make sure that students do not design furniture or organizers that are too complex for them to model with 3D modeling software.
- Students will complete their furniture design or hobby organizer design through step 5 (Choose the Best Idea) of the design process. The **Decision Making Matrix.ppt** from the IED curriculum is included for your review or to demonstrate to students how to use the matrix.
- Students will complete the Furniture or Hobby Organizer Design Solution page of Project 1.2.3 Furniture Design or Project 1.2.3a Hobby Organizer Design as they proceed through each step in the design process.
- The teacher will evaluate student work using **Project 1.2.3 Furniture Design Grading Rubric** or **Project 1.2.3a Hobby Organizer Design Grading Rubric.**
- **Optional:** The teacher may wish to assign **Key Terms 1.2 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.

- Students will review activities completed in this lesson and enter their best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

<table>
<tr><th colspan="5">Semester 1 - Unit 1 – Design and Modeling</th></tr>
<tr><th>Competencies</th><th>Standards</th><th>Suggested Pacing</th><th>Essential Vocabulary</th><th>Resources/Materials</th></tr>
<tr>
<td>3A - Is able to apply dimensions to drawings to communicate size information.
3B - Understands manufactured parts are often created in different countries, where dimensional values are often converted from one standard unit to another.
3C - Understands that the amount of variation that can be measured depends on the precision of the measuring tool.</td>
<td><u>Career Technical Education:</u>
*ED/EDP/
C3.1 Know how the various measurement systems are used in engineering drawings.
C3.2 Understand the degree of accuracy necessary for engineering design.
<u>Core Academic:</u>
*ED/A/1.1M/GM/G8-12/
(15.0) Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles.
(19.0) Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.</td>
<td>Lesson 1.3 –
5 hours:
Measurements</td>
<td>Accuracy
Customary System
Denominator
Caliper
Diameter
Measurement
Metric System
Micrometer
Numerator
Precision
Unit</td>
<td><u>Teacher Resources:</u>
Refer to Suggestions/ Assessments section

<u>Student Resources:</u>
Refer to Suggestions/ Assessments section</td>
</tr>
<tr>
<td colspan="5">Suggestions/Assessments:
Lesson 1.3
Section 1 (1 hour)
• Before making copies of Activity 1.3.1 the teacher will edit question 9 to list items available in the classroom for students to measure.
• The teacher will present Concepts, Key Terms, and Essential Questions in order to provide a lesson overview.
• The teacher will introduce the concept of measurement using the Introduction to Standard and Metric Measurement.ppt.
• After watching the PowerPoint, students will complete Activity 1.3.1 Standard and Metric Measurement.
• The teacher will lead a discussion on standardized measurements and review the correct answers to Activity 1.3.1 Standard and Metric Measurement.
• For additional practice with English measurement, students may play the ruler game: http://www.rickyspears.com/rulergame/
• Students will use appropriate engineering notebook template for daily entries.
Section 2 (1 hour)
• The teacher will introduce the Early Measurement History.ppt and the related Activity 1.3.2 History of Measurement sheet.</td>
</tr>
</table>

- Students will observe how inaccurate measurement methods in the past compare to the current standards that we use.
- Students will complete Activity 1.3.2 Early Measurement Chart and conclusion questions.
- Teachers will collect and evaluate Activity 1.3.2 Early Measurement Chart.
- Students will use appropriate engineering notebook template for daily entries.

Section 3 (1 hour)

- The teacher will introduce students to measurement with precision instruments using the **Precision Measurement.ppt.**
- Students will complete **Activity 1.3.3 Precision Measuring** and **Activity 1.3.3a Precision Measuring Worksheet** during the presentation.
- The teacher will provide several items for students to measure with the dial calipers. Make sure that students have practice measuring inside diameter, outside diameter, thickness, step distance, and depth.
- Students will complete the chart in Activity 1.3.3 Precision Measuring and check their answers with a peer for accuracy in reading the caliper.
- Students will file the activity in their GTT notebook.
- Students will use appropriate engineering notebook template for daily entries.

Sections 4 - 5 (2 hours)

- The teacher will introduce students to **Activity 1.3.4 Measurement Lab – Skimmer.**
- Students will complete Activity 1.3.4 Measurement Lab – Skimmer.
- Teachers will check skimmer for completion, accuracy, and quality workmanship and the Conclusion questions for completion.
- **Optional:** The teacher may wish to assign **Key Terms 1.3 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter their best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 1 – Design and Modeling**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
4A - Creates sketches to quickly record, communicate, and investigate ideas. **4B** - Uses pictorials and tonal shading techniques in combination to give sketched objects a realistic look. **4C** - Is able to develop models to communicate and evaluate possible solutions. **4D** - Uses isometric, oblique, perspective, and multiview sketching to maintain an object's visual proportions. **4E** - Uses CAD modeling systems to quickly generate and annotate working drawings.	**Career Technical Education:** ***ED/EDP/** **C3.2** Understand the degree of accuracy necessary for engineering design. **C4.2** Understand the orthographic projection process for developing multiview drawings. **C4.3** Understand the various techniques for viewing objects. **C6.1** Know a variety of drafting applications and understand the proper dimensioning styles for each. **C6.2** Apply dimensioning to various objects and features **Core Academic:** ***ED/C/2.2W/WS/G8** **(1.5)** Achieve an effective balance between researched information and original ideas ***ED/C/2.4LS/LSSA/G8/** **(1.4)** Prepare a speech outline based upon a chosen pattern of organization, which generally includes an introduction; transitions, previews, and summaries; a logically developed body; and an effective conclusion	**Lesson 1.4 –** **6 hours:** Sketching and Dimensioning Techniques	Annotation Centerline Construction Line Depth Diameter Dimension Dimension Line Extension Line Height Hidden Line Isometric Leader Line Line Conventions Line Weight Location Dimension Object Line One-Point Perspective Orthographic Projection Perspective Drawing Plane Radius Scale Size Dimension Sketch Three Dimensional (3D) Thumbnail Sketch Two Dimensional (2D) Two-Point Perspective Views Vanishing Point Visualize Width	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

Suggestions/Assessments:

Lesson 1.4

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** in order to provide a lesson overview.
- The teacher will present **Sketching Techniques.ppt.**
- Students will follow along with the presentation using **Activity 1.4.1 Sketching Techniques.**
- Students will complete conclusion questions and show to teacher.
- The teacher will check for completion and accuracy.
- Students will file in GTT notebook.
- Students will use appropriate engineering notebook template for daily entries.

Section 2 - 3 (2 hours)

- The teacher will review and check for student understanding and possible misconceptions about sketching types and techniques.
- The teacher will present **Sketching Practice.ppt.**
- Students will complete **Activity 1.4.2 Sketching Practice** while they watch the presentation.
- The teacher will provide blocks and other simple objects for students to sketch as a thumbnail, isometric, and orthographic drawing.
- Students will complete conclusion questions and turn in Activity 1.4.2 to the teacher.
- The teacher will check for completion and student understanding.
- (Optional Homework) Students will review the sketching types using **Activity 1.4.3 Language of Sketching.**
- Teachers will review correct answers to Activity 1.4.3 Language of Sketching, students will file in GTT notebook.
- Students will use appropriate engineering notebook template for daily entries.

Section 4 (1 hour)

- The teacher will introduce **Activity 1.4.4 Orthographic Projection**. Activity 1 will use linking cubes or sugar cubes, Activity 2 will use wooden blocks created by the teacher, and Activity 3 can use either set of blocks. Directions for making the wooden block sets are located in **Lesson 1.4 Teacher Notes**.
- The teacher will assign students to work in partners for this activity.
- Students will complete Activity 1.4.4 Orthographic Projection.
- The teacher will assess each model that students build in Activity 2 using **Activity 1.4.4 Orthographic Projection Answer Key.**
- Students will complete conclusion questions and turn in Activity 1.4.4 Orthographic Projection to the teacher.
- The teacher will check for completion and student understanding.
- Students will use appropriate engineering notebook template for daily entries.

Sections 5 - 6 (2 hour)

- The teacher will use the **Dimensioning.ppt** to introduce **Activity 1.4.5 Dimensioning.**
- Students will complete Questions 1-7 on the activity.
- The teacher will show **Dimensioning Guidelines.ppt** to introduce eight rules that students will follow when creating orthographic projections.
- Students will complete **Activity 1.4.5 Dimensioning** and turn in to instructor for grading.
- The teacher will check student work for completion and understanding.
- Optional: The teacher may wish to assign **Key Terms 1.4 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.

- Students will review activities completed in this lesson and enter their best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 1 – Designing for Production**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
5A - Understands packaging not only protects a product, but contributes to that product's commercial success. **5B** - Uses CAD systems to increase productivity and reduce design costs. **5C** - Understands geometric and numeric constraints are used to define the shape and size of objects in Computer Aided Design (CAD) modeling systems. **5D** - Presents working drawings that contain only the dimensions that are necessary to build and inspect an object. **5E** - Uses CAD models, assemblies, and animations to check for design problems, verify the functional qualities of a design, and communicate information to other professionals and clients. **5F** - Understands design solutions can be created as an individual or in teams. **5G** - Understands engineers use design briefs to explain the problem, identify solution expectations, and establish project constraints. **5H** - Understands that teamwork requires constant	**Career Technical Education:** ***ED/EDP/** **C4.1** Understand the commands and concepts necessary for producing drawings through traditional or computer-aided means. **C4.2** Understand the orthographic projection process for developing multiview drawings. **C4.3** Understand the various techniques for viewing objects. **C7.2** Use a sectional view and appropriate cutting planes to clarify hidden features of an object. **C8.1** Understand what constitutes mating parts in engineering design **C9.2** Develop drawings using notes and specifications. **C9.3** Understand the methods of title block creation. **C10.1** Understand the process of producing proportional two- and three-dimensional sketches and designs. **C10.3** Use freehand graphic communication skills to represent conceptual ideas, analysis, and design concepts. ***ED/ETP/** D1.2 Understand, organize, and complete an assembly drawing by using information collected from detailed drawings ***ED/LT/** **9.3** Understand how to organize and structure work individually and in teams for effective performance and	**Lesson 1.5 –** **22 hours:** Designing for Production	Annotate Browser CAD (Computer-Aided Design) Chamfer Coincident Collinear Concentric Constraint Counterbore Countersink Design Dimension Constraint Documentation Edit Extend Feature Fillet Fabricate Fix Functional Geometric Constraints Horizontal Isometric Mockup Model Offset Parallel Perpendicular Polygon Profile Prototype Revolve Right Triangle Rotation Sketch Plane Specification	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

communication to achieve the goal at hand. **5I** - Researches to develop knowledge base, stimulate creative ideas, and make informed decisions. **5J** - Uses a design process to create solutions to existing problems. **5K** - Uses CAD modeling systems to quickly generate and annotate working drawings. **5L** - Works in design teams to generate large numbers of ideas in short time periods. **5M** - Produces multiview projections as a method of communicating the shape and size of an object that is intended for manufacture. **5N** - Uses decision matrices to help make design decisions that are based on analysis and logic. **5O** - Understands each team member's strengths are a support mechanism for the other team members' weaknesses. **5P** - Understands conflict between team members is a normal occurrence, and can be addressed using formal conflict resolution strategies.	the attainment of goals. **9.4** Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace. **9.5** Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others. **9.6** Understand how to organize, conduct, lead, and participate in student-centered activities and events through student-based organizations. **Core Academic:** ***ED/C/2.4LS/LSSA/G8/** **(1.2)** Paraphrase a speaker's purpose and point of view and ask relevant questions concerning the speaker's content, delivery, and purpose. ***ED/C/2.4LS/LSSA/G9-10/** **(1.7)** Use props, visual aids, graphs, and electronic media to enhance the appeal and accuracy of presentations.		Tangent Trim Vertical	

Suggestions/Assessments:

Lesson 1.5

Section 1 - 2 (2 hours)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** in order to provide a lesson overview.
- The teacher will demonstrate the use of a 3D modeling program by showing a video(s) of projects created using the software. See the Teacher Notes for suggestions.
- The teacher will guide students through **Activity 1.5.1 Descriptive Geometry and the Coordinate System.**
- The teacher will provide each student with a block to sketch in Activity 1.5.1 Descriptive Geometry and the Coordinate System.
- Students will complete Activity 1.5.1 Descriptive Geometry and the Coordinate System.
- Students will show completed activity to teacher.
- The teacher will check for completion and understanding.
- Students will use appropriate engineering notebook template for daily entries.

Sections 3 - 4 (1 hours)

- The teacher will introduce geometric constraint terms by asking students to use their bodies to demonstrate the following terms:
- Horizontal
- Vertical
- Parallel to each other
- Tangent to the wall
- Fixed in one spot
- Hands coincident (this is where they may not know what to do)
- The teacher will present **Computer Modeling Fundamentals.ppt**. At several points during the presentation, the teacher will allow students time to practice the skill demonstrated using the 3D modeling program.
- Students will complete **Activity 1.5.2 Computer Modeling Fundamentals** while the teacher is presenting.
- The teacher will instruct students on how to open the solid modeling software.
- The teacher will instruct students on how to set up project files in the software for organization of GTT classroom projects.
- The teacher will initial on activity to indicate that students have demonstrated the skill in the software.
- Students will use appropriate engineering notebook template for daily entries.

Section 5 (1 hour)

- The teacher will follow the steps in **Creating A Custom Titleblock** to create a customized titleblock for students to use.
- The teacher will present **Parametric Modeling.ppt** to demonstrate steps involved in creating 3D objects.
- Students will take notes in their GTT notebook on the presentation.
- After Part 1 of the presentation, students will practice the steps in the software as they were presented by sketching and extruding several shapes. Save this file as Practice.
- Each student will use **Project 1.5.3 Parametric Modeling** to sketch and dimension the outline of a simple block. Engineering notebook designs from Project 1.5.3 will be exchanged with another student, preferably in another class, for that student to complete the sketch.
- Students will create a 3D model from information provided in a sketch and save file as Partner. Return Project 1.5.3 to original owner.
- Note - Do not share block with partner who is 3D modeling, only the annotated and dimensioned sketch from the student notebook.

Section 6 (1 hour)

- The teacher will review steps in parametric modeling and present Part 2 of Parametric Modeling.ppt, adding a feature.

- Students will take notes in GTT notebook.
- Students will open their Practice file in the software and add at least two features, including a hole and additional extrusion. Save the file.
- Students will sketch and dimension additional features from the original block on their original sketch in Project 1.5.3 Parametric Modeling.
- Students will exchange Project 1.5.3 again with the same student.
- Students will add features to the original model using the software. Return Project 1.5.3 to original student.
- Students may complete **Optional Activity 1.5.4 Sketch Plane Cube** for additional practice.
- Teachers will continually check for students':
- Use of the Engineering Notebook Design pages
- Accurate and neat sketching and annotating
- Accurate use of the 3D modeling program

Sections 7 - 8 (2 hours)

- The teacher will use 3D modeling program to demonstrate browser editing.
- Students will practice browser editing in their Practice file.
- Students will make notes on their original Project 1.5.3 Parametric Modeling sketch about two dimension changes that must be made to the model.
- Exchange Project 1.5.3 with same student that previously modeled it using the 3D software.
- Students will open their Partner file and edit it using their browser to complete changes made by the original author.
- Teachers will continually check for students':
- Use of the Engineering Notebook Design pages
- Accurate and neat sketching and annotating
- Accurate use of the 3D modeling program

Sections 9 - 11 (3 hours)

- The teacher will introduce students to assembly of parts using **the Basic Assembly Constraints.ppt.**
- The teacher will introduce students to **Activity 1.5.5 Pegboard Toy**.
- Students will complete the activity.
- The teacher will review parametric modeling concepts for the Pegboard Toy using **Pegboard Formulas**.
- The teacher will demonstrate working drawings in the 3D modeling program.
- Students will complete **Activity 1.5.5a Pegboard Toy Working Drawings**.
- **Optional:** Students will complete **Activity 1.5.5b Pegboard Toy Presentation Drawings.**
- Students will use appropriate engineering notebook template for daily entries.
- **Optional:** The teacher may have students work on the following additional activities and projects:
  - **Activity 1.5.6 Bracket**
  - **Project 1.5.7 Switch Plate Design**
  - **Project 1.5.8 Hair Brush Design**
  - **Project 1.5.8a Watch Design**

Sections 12 - 14 (3 hours)

- The teacher will review the design process.
- Students will locate Project 1.2.3 Furniture Design or Project 1.2.3 Hobby Organizer Design in their GTT notebook.
- Working with the same partner, students will continue with the design process in Project 1.2.3 Furniture Design or Project 1.2.3a Hobby Organizer Design.
- The teacher will guide students through completing the following steps:
- Make a 3D computer model of your best idea by creating each part file and assembling it (model or prototype stage of the design process).
- Evaluate the model by having classmates, family, or friends look at the design and see if they would buy it (test and evaluate stage of the design process).
- Ask reviewers for suggestions for improving the design.
- Improve the 3D computer model (improve design stage of the design process). Use browser editing if possible.
- Complete Design Process Steps summary from Project 1.2.3 Furniture Design or Project 1.2.3a Hobby Organizer Design(Communicate Results stage of the design process).
- The teacher will collect and evaluate for completion and accuracy Project 1.2.3, working drawings of furniture or organizer, and GTT notebook entries.
- Students will use appropriate engineering notebook template for daily entries.

Section 15 (1 hour)

- The teacher will invite another adult, community member, principal, another teacher, etc. to introduce **Problem 1.5.9 Playground Design Problem.**
- The teacher will use **Problem 1.5.9a Playground Design Problem Teacher Support** to review assembly constraints and see sample .idw files.
- The teacher will guide students through completing the Playground Design Brief.
- The teacher will require students to consider safety as a criteria in the Playground Design. This website contains information on playground safety: **http://www.cpsc.gov/cpscpub/pubs/325.pdf**
- Students will identify their strengths and what part of the design process for this design problem most matches their expertise.
- Students will use appropriate engineering notebook template for daily entries.

Sections 16 - 21 (6 hours)

- Students will complete Problem 1.5.9 Playground Design Problem.
- The teacher will continually monitor student progress through the problem by giving suggested deadlines, assisting with design process steps, and dividing students into smaller groups.
- The teacher may act as project manager or assign a student to act as project manager.
- Students will use appropriate engineering notebook template for daily entries.
- **Optional:** The teacher may wish to assign **Key Terms 1.5 Crossword Puzzle** after all key terms have been introduced.

Section 22 (1 hour)

- Students will explain to the playground committee representative how they solved their design problem and what they did at each step in the design process.
- Each student needs to be involved in the presentation.

- The teacher will evaluate using the 1.5.9 Playground Design Problem Grading Rubric. (to be developed)
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter their best works in their GTT portfolio. Portfolios should be maintained as students progress throughout the other GTT units.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 2 – Automation and Robotics (45 hours)**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
6A - Understands automation is the use of technology to ease human labor or to extend the mental or physical capabilities of humans **6B** - Understands robotics is the specialized field of engineering that deals with the design construction and applications of robots **6C** - Understands robotics and automation have had an influence on society in the past and present and will influence society in the future **6D** - Is aware that engineers, designers and engineering technologist are needed in high demand for the development of future technology to meet societal needs and wants. **6E** - Describes the purpose of automation and robotics and its effect on society. **6F** - Investigates a career related to automation and robotics and determine the requirements for entering the field.	**Career Technical Education:** ***ED/TC** **4.1** Understand past, present, and future technological advances as they relate to a chosen pathway. **4.2** Understand the use of technological resources to gain access to, manipulate, and produce information, products, and services. **4.3** Understand the influence of current and emerging technology on selected segments of the economy. ***ED/PSCT/** **5.1** Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks. **5.2** Understand the systematic problem-solving models that incorporate input, process, outcome, and feedback components. ***ED/EDP/** **C1.1** Know historical and current events that have relevance to engineering design **Core Academic:** ***ED/A/1.1M/MR/G7/** **(2.1)** Use estimation to verify the reasonableness of calculated results. **(2.2)** Apply strategies and results from simpler problems to more complex problems. **(2.3)** Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques	**Lesson 2.1 –** **7 hours:** What is Automation and Robotics	Algorithm Automation Controller Computer program Debug Economics Electric End effector Ethical Factory Hydraulic Impact Limitation Maintenance Manipulators Power supply Pneumatic Programmer Reprogram Robot Robotics Society Trade-off Troubleshoot Workforce Work envelope	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

Suggestions/Assessments:

Lesson 2.1

- **Section 1 (1 hour)**
- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** in order to provide a lesson overview.
- The teacher will divide the class into two groups. One group will complete **Activity 2.1.1a Sandwich Algorithm**, and the other group will complete **Activity 2.1.1b fischertechnik® Build**. After approximately ten minutes, students from each group will become partners.
- The teacher will determine the ingredients for the sandwich activity based on food allergies or vegetarians in the class.
- Students who wrote the sandwich algorithm will read their directions to their partner. The partner will follow exact directions as given by partner. After one algorithm is followed, students will exchange and follow the verbal directions given to build a fischertechnik® object that matches the one the partner built.
- During the fischertechnik® build activity partners should sit with their back to each other; one student will explain what the model looks like while the other partner builds a model to match.
- The teacher will lead a discussion about writing and following directions and how technology does exactly what the programmer tells it to do.
- Students will use appropriate engineering notebook template for daily entries.

Section 2 (1 hour)

- The teacher will lead a discussion on types of robots, what inputs the robot may have, sensors that a robot may use, and the output or ultimate goal of the robot.
- (Optional) The teacher will show the video: Understanding Robots. Students will complete **Optional Activity 2.1.2a Understanding Robots** while watching the video.
- (Optional) The teacher will show the online video from the Honda Documentary Series – The Power of Dreams – Dream the Impossible. Found at this website: **http://dreams.honda.com/#/video_wi** (Warning – approximately 4 ½ minutes in, this video shows male nudity while showing how to teach a robot to walk)
- Students will make a list of new uses for robotic technology in their GTT notebooks. Answer the question, "How can a robot be used in… a store, a movie theater, an amusement park, school, etc."
- The teacher will show the presentation **Automation and Robotics.ppt**.
- Students will take notes in their GTT notebooks while the presentation is given.
- Students will use appropriate engineering notebook template for daily entries.

Sections 3 - 4 (2 hours)

- The teacher will introduce **Activity 2.1.2 What Do We Use Robots For?** Divide the class into 5 or more groups as suggested in the teacher notes.
- Each group of students will further investigate information about one type of robot using the questions listed in Activity 2.1.2 What Do We Use Robots For?
- The teacher will encourage all students to participate in order to complete the task on time.
- Students will use appropriate engineering notebook template for daily entries.

Section 5 (1 hour)

- Each group will present their robot information to the class.
- Students will write in their GTT notebooks a summary of the information they learned after each of the other groups presents.
- The teacher will show *Robotics Engineering* video from Teachers Domain website.

- Students will use appropriate engineering notebook template for daily entries.

Sections 6 - 7 (2 hours)

- The teacher will choose one of the six options explained in the teacher notes for the Engineering Career Project in Lesson 1.1 of the Design and Modeling™ Unit. Select a career project that students have not completed in other Gateway To Technology™ units. The teacher may want to alter the activity to make it specific to the Automation and Robotics™ unit.
- The teacher may want to introduce Engineering Careers using this YouTube video: **http://www.youtube.com/watch?v=Y0DxmthvkKU** or the cartoon found on this site: **http://www.tomorrowsengineers.org.uk/_db/_images/What_is_Engineering_poster.jpg**
- Students will follow the directions to complete an activity that introduces them to different engineering careers. Use **Activity 1.1.5(A-F) Engineering Careers.**
- The teacher will collect the Engineering Careers activity, evaluate it, and encourage students to keep the completed activity in their portfolio or with their career plan.
- **Optional:** The teacher may wish to assign **Key Terms 2.1 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 2 – Automation and Robotics**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
7A - Understands that energy is the capacity to do work. **7B** - Understands that engineers and technologists design mechanisms to change energy by transferring direction, speed, type of movement, and force or torque. **7C** - Investigates and understand various mechanisms to determine their purpose and applications. **7D** - Is able to apply its knowledge of mechanisms to solve a unique problem. **7E** - Understands that mechanisms can be used individually, in pairs, or in systems. **7F** - Understands there is always a degree of variation between the actual manufactured object and its dimensioned drawing.	**Career Technical Education:** ***ED/CHENEP/** **B4.1** Understand how to design and assemble systems that use computer programs to interact with hardware. ***ED/ETP/** **D1.2** Understand, organize, and complete an assembly drawing by using information collected from detailed drawings **D5.1** Understand the steps in the design process. **D5.2** Determine what information and principles are relevant to a problem and its analysis. **D6.4** Estimate and measure the size of objects in both Standard International and United States units. **D6.5** Calibrate and measure objects by using precision measurement tools and instruments. **D8.1** Understand how to design systems that use computer programs to interact with hardware **Core Academic:** ***ED/A/1.1M/MR/G7/** **(2.1)** Use estimation to verify the reasonableness of calculated results.	**Lesson 2.2 –** **12 hours:** Mechanical Systems	Belt & pulley Bevel gear Cam & follower Crank & slider Crown & pinion Drive gear Driven gear Energy Force Gear Gear ratio Idler gear Input Inverse Lead screw Linear motion Mechanism Oscillate Output Pitch Rack & pinion Ratio Reciprocating Rotary motion Simple gear train Torque Universal joint Work Worm & wheel	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

Suggestions/Assessments:

Lesson 2.2

Section 1 (1 hour)

- The teacher will present Concepts, Key Terms, and Essential Questions in order to provide a lesson overview.
- The teacher will demonstrate what a mechanism is and how they are used to change force or torque, speed, direction of movement, and type of movement by showing examples in the classroom.
- The teacher will present Mechanism Toybox.ppt if physical examples are not available.
- Students will complete Activity 2.2.1 Observing Mechanisms while the teacher explains the relationship between speed, force and torque, gear ratios, and the four types of motion.
- Students will use appropriate engineering notebook template for daily entries.

Sections 2 - 4 (3 hours)

- The teacher will introduce the individual fischertechnik® pieces, their uses, how to assemble, and the proper way to store parts. The teacher will use the **Building with fischertechniks®** handout to demonstrate proper assembly.
- The teacher will divide students into groups to complete **Activity 2.2.2 Mechanical Gears.**
- Each group of students will build the first five mechanisms: universal joint, bevel gear, simple gear with idler, worm and wheel, and crown and pinion. After each mechanism is built, students will answer questions in their GTT notebooks using the IQIA (include question in answer) format.
- The teacher may copy in color and provide the **Build Sheets** if students struggle with building the mechanical gears.
- (Optional) Students will take a picture of the model they've built and find a real-life example of the mechanism. Students can take a picture of the mechanism or print a picture from the Internet to include in their GTT notebook.
- The teacher will review the answers to Activity 2.2.2 Mechanical Gears by using the **Mechanisms.ppt** presentation – slides 1-11.
- Students will complete worksheets taken from the Focus Book on transmitting rotary movement and the Mechanisms Homework One to reinforce the concepts learned while completing the four mechanisms.
- (Optional) Students will complete **Project 2.2.3 Windmill Construction**. The teacher will evaluate sketch, completed model and conclusion questions.
- Students will use appropriate engineering notebook template for daily entries.

Sections 5 - 6 (2 hours)

- The teacher will divide the class into at least five different groups.
- Each group of students will build one of the five remaining mechanisms.
- Students will rotate around the classroom observing how each of the five mechanisms works and answering the questions in their GTT notebooks using IQIA (include question in answer) format.
- (Optional) Students will take a picture of each model and find a real-life example of the mechanism. Students can take a picture of the mechanism or print a picture from the Internet to include in their GTT notebook.
- Students will complete worksheets taken from the Focus Book on Changing Rotary Movement to Linear Movement, Mechanisms Homework Two, Reciprocating Movement and Transmitting Rotary Movement: 3 to reinforce the concepts learned while observing the six mechanisms.
- Students will use the **Mechanisms Review Game.ppt** with a partner or alone to assess their knowledge of mechanisms.
- Optional: The teacher may wish to assign **Key Terms 2.2 Crossword Puzzle** after all key terms have been introduced.
- Students will use appropriate engineering notebook template for daily entries.

Section 7 (1 hour)

- The teacher will review the answers to Activity 2.2.2 Mechanical Gears by using the fischertechnik® Mechanisms presentation.
- Students will correct their answers in their GTT notebook while the teacher presents and discusses the ten mechanisms.
- Students will complete **Activity 2.2.2a Mechanical Gears Review** and submit it to the teacher for grading.
- The teacher will use **Activity 2.2.2a Mechanical Gears Review Answer Key** to assess student work.
- The teacher will divide the students into groups and introduce Project **2.2.4 Pull Toy Construction** or **Project 2.2.5 Survival Challenge.**
- The teacher will review the design process.
- Students will use appropriate engineering notebook template for daily entries.

Sections 8 - 11 (4 hours)

- The students will complete Project 2.2.4 Pull Toy Construction or Project 2.2.5 Survival Challenge. Each group will follow the design process and complete one copy of the following templates for each task:
- **Design Brief Template**
- **Decision Matrix Template**
- **Our Design Process Solution**
- Each member of the group should sketch and annotate at least one example for how to solve each task.
- Students will build a fischertechnik® model that includes mechanisms to solve their tasks.
- The teacher will evaluate student work using **Project 2.2.4 Pull Toy Construction Grading Rubric** or **Project 2.2.5 Survival Challenge Grading Rubric.**
- Students will use appropriate engineering notebook template for daily entries.

Section 12 (1 hour)

- Each group will present and explain to the class their solution to the Pull Toy or Survival Task that they chose to solve.
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric.**

Comments:

Semester 1 - **Unit 2 – Automation and Robotics**				
Competencies	**Standards**	**Suggested Pacing**	**Essential Vocabulary**	**Resources/Materials**
8A - Understands automated systems require minimal human intervention **8B** - Understands an Open-Loop system has no feedback path and requires human intervention, while a Close-Loop system uses feedback. **8C** - Design, build, wire, and program both open and closed loos systems. **8D** - Understands troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. **8E** - Understands invention is a process of turning ideas and imagination into devices and systems. **8F** - Understands some technological problems are best solved through experimentation. **8G** - Is aware automated systems can be powered by alternative energy sources like solar and fuel cells. **8H** - Designs, build, wire and program a system operated by alternative energy. **8I** -Understands solid modeling programs allow the designer to create quality designs for production in far less time than traditional	**Career Technical Education:** ***ED/PSCT/** **5.1** Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks. **5.2** Understand the systematic problem-solving models that incorporate input, process, outcome, and feedback components ***ED/CHENEP/** **B4.1** Understand how to design and assemble systems that use computer programs to interact with hardware. **B4.6** Understand the process of assembling, testing, and troubleshooting computer equipment and systems. **B5.1** Understand the steps in the design process. **B5.2** Determine what information and principles are relevant to a problem and its analysis. **B8.1** Use appropriate tools and technology to install equipment, assemble hardware, perform tests, collect data, analyze relationships, and display data in a simulated or modeled automated system. **B8.2** Understand the use of sensors for data collection and process correction in an automated system. **B8.3** Understand how to program a computing device to control an automated system or process. ***ED/EDP/** **C2.1** Use the appropriate methods and techniques for employing all	**Lesson 2.3 –** **26 hours:** Automated Systems	Analog Signal Automation Computer Aided Manufacturing (CAM) Computer-Integrated Manufacturing (CIM) Closed-Loop System Digital Signal Efficiency Electromagnet Experimentation Feedback Flexible Manufacturing System (FMS) Flowchart Fluid Power Fuel Cell Hydraulics Icon Innovation Input Interface Invention Malfunction Normally Closed Normally Open NTC Resistor Open-Loop System Output Photocell Pneumatics Program Reed Switch Sensor Software Solar Cell Switch	**Teacher Resources:** Refer to Suggestions/ Assessments section **Student Resources:** Refer to Suggestions/ Assessments section

design methods. **8J** - Understands fluid power systems are categorized as either pneumatic, which uses gas, or hydraulic, which uses liquids. **8K** - Experiences fluid power by creating and troubleshooting a pneumatic device. **8L** - Troubleshoot a malfunctioning system using a methodical approach.	engineering design equipment. **C2.2** Apply conventional engineering design processes and procedures accurately, appropriately, and safely. **C2.3** Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway. **C10.1** Understand the process of producing proportional two- and three-dimensional sketches and designs ***ED/ETP/** **D1.2** Understand, organize, and complete an assembly drawing by using information collected from detailed drawings. **D3.7** Understand how electrical control and protection devices are used in electrical systems. **D4.3** Know the six simple machines and their applications **D5.1** Understand the steps in the design process. **D5.2** Determine what information and principles are relevant to a problem and its analysis. **D8.1** Understand how to design systems that use computer programs to interact with hardware **<u>Core Academic:</u>** ***ED/C/2.4LS/LSSA/G8/** **(1.1)** Analyze oral interpretations of literature, including language choice and delivery, and the effect of the interpretations on the listener. **(1.2)** Paraphrase a speaker's purpose and point of view and ask relevant questions concerning the speaker's content, delivery, and purpose.		System Threshold Troubleshoot	

Suggestions/Assessments:

Lesson 2.3

Section 1 (1 hour)

- The teacher will present **Concepts**, **Key Terms**, and **Essential Questions** in order to provide a lesson overview.
- The teacher will explain the concept of sensors using the Robot Sensing and Control Demonstrations explained in **Lesson 2.3 Teacher Notes**.
- The teacher will present **Technological Systems.ppt.**
- Students will take notes in the appropriate section of their GTT notebook.
- **OPTIONAL:** Students will complete **Activity 2.3.1a "Beef" Up Your Technological Resources Understanding**.
- The teacher will assess 2.3.1a for completion and understanding.
- The teacher will use documents listed in Teacher Guidelines to assist with proper installation of the interface boxes.
- Students will use the appropriate engineering notebook template for daily entries.

Sections 2 - 3 (2 hours)

- The teacher will discuss the use of graphic icons in programming and other applications such as fast-food restaurants or road signs.
- Students will complete **Activity 2.3.1 Using Graphic Icons**.
- Students will complete **Activity 2.3.2 fischertechnik® Interface Connections** while the teacher demonstrates the setup of the RoboPro program interface, computer, and power supply using the **Interface Connections.ppt** presentation. If you are using the Robo TX Interface, use **Activity 2.3.2 fischertechnik® Robo TX Interface Connections** and Robo TX Interface Connections.ppt.
- The teacher will review concepts of Orthographic and Isometric Drawing using the **Sketching Review.ppt** (Note: If your students haven't been instructed in the Design and Modeling™ unit, refer to **Lesson 1.4 Sketching and Dimensioning Techniques.**)
- Students will take notes in the appropriate section of their GTT notebook.
- The teacher will demonstrate fischertechnik® programming using the **RoboPro.ppt** presentation.
- The teacher will introduce and explain troubleshooting using the **Troubleshooting a fischertechnik® Model** resource.
- The teacher will divide the class into teams of three students. The job responsibilities for each team member will be explained by the teacher. Members of each team will select a computer engineer, electrical engineer, and mechanical engineer for their team. The job responsibilities should be rotated as the students complete **Project 2.3.3 Automation through Programming.** Students should note their job on each of the lab sheets they submit for evaluation.
- Students will use the appropriate engineering notebook template for daily entries.

Sections 4 - 13 (10 hours)

- The teacher will explain the expectations for Project 2.3.3 Automation through Programming.
- Students will work in teams to complete the required problems in Project 2.3.3 Automation through Programming. Students will build the model, wire the model to the interface box, and write the computer program using the RoboPro program.
- Student teams will troubleshoot any malfunctions of their model.
- Students will complete a lab sheet, **Project 2.3.3a Automation through Programming Lab Sheets,** for each task. Students also must keep one Task Check Off sheet in their GTT notebooks for reference. If you have the new Robo TX Controllers you will use the **Project 2.3.3a Automation through Programming TX Lab Sheets**.
- Teachers will collect and evaluate each lab sheet for accuracy and completion. This must be done before a team can move on to the next task.
- It is not expected that all teams will complete all 11 tasks in the time allotted. Teachers should assign required and optional tasks or divide the tasks so that different teams perform different tasks, yet all students see a solution to each problem.

- The teacher will demonstrate the use of sensors as they are needed. See **Lesson 2.3 Automated Systems Teacher Notes** for suggestions.
- The teacher should remind students to put away all fischertechnik® parts when they have completed each problem.
- Students will use the appropriate engineering notebook template for daily entries.

Sections 14 - 16 (3 hours)

- The teacher will present **Fluid Power.ppt** and show one of the videos listed in **Lesson 2.3 Teacher Notes**.
- Students will take notes in the appropriate place in their GTT notebook.
- The teacher will demonstrate how a fischertechnik® compressor works with the solenoid valves and pneumatic cylinders.
- The teacher will demonstrate how the fuel cell and solar cell connect using fischertechniks.
- The teacher will review alternative energy concepts specific to using solar cells and fuel cells.
- The teacher will divide students into new teams and explain **Activity 2.3.4 Pneumatic Systems** and **2.3.4a Traffic Signal Alert**. Each team will choose one of the activities to complete.
- Students will work in teams to complete Activity 2.3.4 Pneumatic Systems or Activity 2.3.4a Traffic Signal Alert by building the model, wiring the model to the interface box, and writing the computer program using the RoboPro program.
- Students will complete a lab sheet and conclusion questions.
- Teachers will collect and evaluate the lab sheet based on accuracy and completion.
- Optional: The teacher may wish to assign **Key Terms 2.3 Crossword Puzzle** after all key terms have been introduced.
- Students will use the appropriate engineering notebook template for daily entries.

Sections 17 - 18 (2 hours)

- The teacher will explain flexible manufacturing systems (FMS) to the students and their use in an assembly line. See teacher notes for sample online videos to show.
- The teacher will explain the process of integration of each cell to form one complete factory assembly line.
- The teacher will create blocks to be used in the fischertechnik® factory. A **dimensioned .idw** of a sample block is provided.
- The students will be divided into groups of three. Using **Project 2.3.5 Simulated Factory Assembly Line,** teams will be assigned a work cell that will complete a machining process for a block of wood. If the drawing provided in the curriculum is used for the block, there are nine tasks to be performed. Some cells may perform multiple tasks, or the teacher may eliminate tasks depending on class size.
- Students in another class will work on the same factory cell project – one class should be 1st Shift, the other class 2nd Shift.
- The teacher will distribute and explain **Project 2.3.5a Engineering Project Notebook** which will be shared between teams from both shifts that are working on the same cell.
- Each team, from each shift, should have a student dedicated to the job of mechanical engineer, electrical engineer, and computer engineer. The entire team works together, so often students may perform the job of another engineer as they assist their team members.
- Students will brainstorm ideas for moving the block between stations.
- Students will use appropriate engineering notebook template for daily entries.

Sections 19 - 24 (6 hours)

- Students will build, wire, and write the program for their factory cell.
- Each day students will write their accomplishments, problems, and goals as well as sketch ideas in the project notebook to pass to the next shift.

- Students will coordinate the alignment of the conveyor belt with the factory cell before and after theirs to ensure smooth transitions.
- The teacher will encourage full team participation, help troubleshoot problems, and review project notebooks.

Section 25 (1 hour)

- Students will set up, run, and troubleshoot their factory cell.
- Students will evaluate themselves, their shift team members, and their partner from the other shift with the same job title using pages 4-5 in Project 2.3.5 Simulated Factory Assembly Line.
- Students will complete a lab sheet and turn in for grading.
- Students will use the appropriate engineering notebook template for daily entries.

Section 26 (1 hour)

- The teacher will lead the students in a discussion to evaluate the pros, cons, and changes they would implement to improve their factory cell.
- Students will store all fischertechnik® parts in their proper location.
- Students will use appropriate engineering notebook template for daily entries.
- Students will review activities completed in this lesson and enter best works in their GTT Portfolio.
- The teacher will evaluate student notebooks using the **GTT Notebook Grading Rubric**

Comments: