Project/Problem Based Learning Lesson Template

Created By: Amy M. Haney	**Topic: Sorting Machine**	**Grade Level or Subject: Computer Science, Principles of Manufacturing**
Science Standards: 8.ESS3.3: Human Impacts on Earth Systems Interpret data to determine how different human activities affect the biosphere, atmosphere, hydrosphere, and/or geosphere.		
Math Standards: 7.RP.A.2 Recognize and represent proportional relationships between quantities. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. 7.G.B.5 Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.		
ELA Standards:		
Computer Science Standards: MS.DA: Data Analysis Collect, analyze, transform, and refine computational data to make it more useful and reliable.		
CTE (Program of Study) Standards: 8.2 Data Analysis Identify common statistical processes to analyze data. Describe standard procedures for analysis to apply to manufacturing projects throughout the course and program of study. The procedures should include: a. Collection of data b. Analysis methods c. Interpretation of results		

6.1 Sketching and Drafting Define the differences in technique among freehand sketching, manual drafting, and computer-aided drafting (CAD), and describe the skills required for each. Create a two-dimensional orthographic (multiview) drawing incorporating labels, notes, and dimensions, using sketching/geometric construction techniques. Apply basic dimensioning rules and properly use different types of lines (e.g., object, hidden, center). The orthographic projections should include principle views of a simple object from top, front, and right sides. 2.2 Manufacturing Processes: Distinguish between primary and secondary processes involved in the manufacture of industrial goods into finished products. Explain how different processes make use of specific manufacturing applications, such as the use of welding in assembling processes. Relate the specific operations required to implement the following secondary processes: c. Separating (e.g., machining)

Additional Standards (Social Studies, Art, Physical Education, etc.):

PBL Summary: *Write a few sentences describing this PBL lesson/unit.*

Students will design and construct their own recycling sorting machines to separate shreds of paper from paper clips using various methods, such as magnets or puffs of air. This real-world engineering challenge allows students to research, analyze and improve the concept of single-stream recycling programs, where materials like paper, plastic, and metals are combined and need to be separated efficiently.

Multi-Dimensional/Driving Question: *Think of a relevant problem with multiple solutions that will drive student learning.*

- How can we as Industrial Engineers and Sustainability Specialists: design and construct effective recycling sorting machines that use various methods to separate shreds of paper from paper clips, while researching, analyzing, and improving the broader concept of single-stream recycling programs to enhance sustainability and resource recovery?

Tennessee Academic Standards for Science Connection		
Disciplinary Core Idea(s): **PS2.B: Types of Interactions.** Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively). **ETS1.B: Developing Possible Solutions.** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Science & Engineering Practice(s): **Constructing Explanations and Designing Solutions.** Apply scientific ideas or principles to design an object, tool, process or system. **Engaging in Argument from Evidence.** Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	Cross Cutting Concept(s): **Influence of Science, Engineering, and Technology on Society and the Natural World.** The uses of technologies and limitations of their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

21st Century Skills Addressed (circle all that apply):			
Creativity	Collaboration	Critical Thinking	Communication

Culminating Event: *What final student learning products will show student mastery of the content area standards?*
Students will present a final presentation (Live or Video) to Community/ Industry Partners detailing their process, solution, and data visualization.

Hook / CTSO Competition Event: *Develop an introductory activity that will spark student interest and further questions.*	**Industry/Community Partners:** *List potential business or industry partners that could add to the learning experience for students. Include websites or contact info.*	*What do you need from these partners (i.e. guest speaker, field trip, help facilitate an activity)?*
Hook: Local Recycling facility or Member of Keep Tennessee Beautiful will present to students about a local recycling issue and the need for better control over sorting materials. They will present to the students knowledge and lead them toward solutions for the driving question: How can we as Industrial Engineers and Sustainability Specialists: design and construct effective recycling sorting machines that use various methods to	**Recycle Center Locators** Nobody Trashes TN Keep Tennessee Beautiful TN Environmental Council	A Community/ Industry Partener to introduce the Driving Question and assist in the culminating event. As a Community/ Industry Partner it would be necessary for them to explain their job and responsibilities, how recycling is a process that requires work on the students, the community, and the industry. They will provide students with knowledge and understanding to excite them about researching

separate shreds of paper from paper clips, while researching, analyzing, and improving the broader concept of single-stream recycling programs to enhance sustainability and resource recovery? **TSA: Prepared Speech, STEM Animation. Construction Challenge. Energy Sources. Environmental Focus. Go Green Manufacturing. Inventions and Innovations, Problem Solving, Technical Design, Water Infrastructure**		information needed to form a solution to the driving question.
Daily Activities: *What activities will students complete to answer the multi-dimensional/driving question (that reinforces content from the standards)?* ● This PBL kicks-off with a visit from a Community/ Industry Partner who will provide insight into Recycling Centers, Manufacturing Processes, and what careers exist in this field. ● Throughout the PBL students will make connections to the math standards used in core classes by solving problems that correlate directly to real world problems in industry, specifically dealing with creating recycling sorting machines and the efficiency needed to run		**Resources/Materials Needed:** ● Article: Waste Management ● TN Recycles: Graphs and Charts ● Keep Knoxville Beautiful: Sustainability, Why? ● UN Global Goals - Video ● What Happens at a Materials Recycling Facility? - Video ● Teacher's Guide for this PBL

a recycling plant as well as making connections to sustainability of industry, Goal 13 of the 17 Global Goals. • Use the provided teachers guide to assist as you work through the PBL process. This is a 8-10 day PBL with a deep dive into the engineering design process as it pertains to Manufacturing Processes in preparation for students to connect to Mechatronics as a CTE Program of Study. • Students will research, brainstorm, prototype, and present in order to refine 21st Century Skills and prepare students for competitions. • Teacher's will work with the Math and Science teachers to enhance the knowledge of the students in making connections to core content and real world applications. All teachers involved should contribute to the success of the students and the work during the PBL. • Additional presentations at Open House, Science Fairs, or Community events are options for students to show what they know and educate others on the potential solutions.	• 3-D Printer • tinkerCAD/ CAD software • Cardboard • paper clips • magnets • variety of paper • hot glue • scissors • recycled water bottles, detergent bottles, containers, cardboard, ect. • tape • string/ yarn
Technology Integration: How is technology being utilized to support students in creating authentic learning experiences and/or products? How does technology enhance the learning experience? • Technology Integration is specific to the classroom and school. Basic technology such as but not limited to include: tinkerCAD or CAD program, 3-D printer, video equipment, ect.	

STEM/STE(A)M Career Connections: *What STEM/STE(A)M careers (within your region) can you connect to this PBL Unit of Study?*

- STEAM careers aligned directly to this PBL are numerous: Industrial Engineer, Sustainability Specialist, Mechanics, technicians, and machinery maintenance workers, Material recovery facility managers, and Sales representatives to name a few.

CTSO Connections: *What Career and Technical Student Organization connection can be made with this PBL Unit of Study?*

TSACompetitions:

- Biotechnology Design
- Engineering Design
- Environmental Engineering
- Manufacturing Prototype
- Technology Problem Solving
- Scientific Visualization (SciVis)
- STEM Animation
- Technology Bowl
- System Control Technology
- Inventions and Innovations (Middle School)

Capstone Presentation: *How will students present what they've learned publicly? This can be the culminating event if that event is presenting what has been learned publicly.*

- Students will present possible solutions in a 3-5 minute oral presentation using a slide deck, their prototype, and other visuals to Community/ Industry partners, invited guests, and teachers.
- Students will have the option to create a video production of their presentation.
- Zoom is an option to connect Community/ Industry Partners back to the classroom for presentations.
- Students can share their video presentations via school website, social media sources, or community event.

Industry Certification: *What industry certification opportunity is connected with this particular PBL Unit of Study?*

1. Certified Manufacturing Technologist (CMfgT)
    - This certification includes knowledge of statistical processes and quality control techniques, data collection, analysis methods, and interpretation.
2. Six Sigma Yellow Belt
    - Focuses on basic statistical analysis, data collection, and interpretation skills used in process improvement projects.
3. Microsoft Office Specialist (MOS) Excel
4. Autodesk Certified User (ACU) - AutoCAD
    - Validates skills in creating and interpreting technical drawings using AutoCAD, including orthographic projections and dimensioning.
5. Certified SolidWorks Associate (CSWA)
    - Includes proficiency in CAD software, creating detailed 2D and 3D models, and understanding of technical drawings and dimensioning.
6. National Occupational Competency Testing Institute (NOCTI) - Engineering Drafting
    - Covers skills in manual drafting and CAD, including orthographic drawing techniques and dimensioning.
    - Skills in data collection, analysis, and interpretation using Excel for various statistical methods.
7. National Institute for Metalworking Skills (NIMS) - Machining Level I
    - Certification that includes fundamental machining processes, understanding of primary and secondary manufacturing processes, and specific operations in machining.
8. Certified Production Technician (CPT)
    - Covers manufacturing processes, including knowledge of primary and secondary processes and specific applications like welding and machining.
9. American Welding Society (AWS) - Certified Welder
    - Focuses on welding processes, a specific manufacturing application used in assembling and fabricating products.

Performance Based Rubric

Standards	Developing	On-Target	Mastery
Science			
Math			
ELA			
Computer Science			
CTE (Program of Study)			
Additional Standards:			

This document is editable and can be customized to best fit your needs.