WAYNE STATE UNIVERSITY

STEM Day Lesson Plan

Lesson Plan Author(s) Names and Affiliation: This lesson plan is designed locally by two Ph.D. student from the department of Industrial Engineering and supervised by a faculty member from the department Mojahed Alkhateeb, Header Alrufaifi, and Dr. Jeremy Rickli

Title: Valve Disassembly and Reverse Engineering

Subject Area: Industrial & Systems Engineering

Learning Activity Description: Kids are curious of knowing how stuff function and how to fix them or make them better. The activity will ask students to reverse engineer a valve in order to introduce them to the concepts of product design, manufacturing, and disassembly. Students will disassembly an existing valve, record the components and order of disassembly, and identify manufacturing processes used to make individual valve components. The activity will give them a hands-on introduction to product design and manufacturing

Lesson Activity Objective: Students will learn about concepts in product design and manufacturing processes and give them a hands-on experience of disassembling an object and reassembling it using basic tools.

Lesson Activity Outcomes: Students will get the ability to identify a product and know how it is functioning. Also be able to identify how it was designed and what are the manufacturing processes that were involved in making the product. Also making them comfortable and not afraid of disassembling and reassembling any object in the future and giving them self-confidence on their ability to do so.

Materials/Supplies Listed: Plastic valve, Metal valve, screw drivers, wrenches.

Teacher Procedures: Presenting concept about reverse engineering, remanufacturing, and few manufacturing processes such as injection molding, casting, and machining. Then students will perform the following activities.

1. Form groups of two or three depending on the number of students.
2. Distribute two types of valves among the groups.
3. Students will collect the required tools to perform the disassembly activity
4. Students will fill up the sheet of paper provided and record observation
5. Students will exchange knowledge of the other types of valves and suggest improvements

Preparation Time for Learning Activity: The activity time will be divided between making the activity itself and listening to the small presentation and recording the observations for a total of 40 minutes:

Reverse engineering background	2 min
Manufacturing processes introduction	5 min
Disassembly operations background	2 min
Recording activity example	2 min
Measuring example	2 min
Disassembly activity and recording	20 min
Assembly and cleaning up	5 min

Room set-up: All the valves and tools will be on the table in the table along with the observation sheet. Student will be divided onto a team of two student per each team. Each team will be given a valve and an observation sheet. They will set on ground in the high bay and first listen to the presentation and then they will conduct the activity and record observation.

Group Strategies (example, group size, expected time for groups, etc.): Student will be divided onto a team of two student per each team. Each team will be given a valve and an observation sheet. The expected time to perform the activity is around 40 min. See appendix.

Student Products/Artifacts/work pages: There are two outcomes from the activity; the bill of material table to fill up and the precedence diagram see appendix.

Assessment Criteria/Rubric: The assessment will be based on the student ability to correctly fill out the bill of materials and the assembly sequence and understanding of the activity and their ability to disassembly, reassemble the valve and on their observations and their ability to fill up the table correctly.

Closing/Transition to next activity: when the students complete the activity, they will clean up and return the valves and the tools to the table exactly to where they get it from. Then will form groups with their leaders to move to the next activity.

Appendix

For plastic valve

Part number	Part Name/Description	Material	Manufacturing Process	Qty
1	Knob	Plastic	Injection Molding	1
2	Label	Paper	Print and cut	1
3	Screw	Metal	Machining	1
4	Shaft	plastic	Injection Molding	1
5	Bolt	plastic	Injection Molding	1
6	Seals	Rubber	Injection Molding	3
7	Main valve body	plastic	Injection Molding	1
8	Side release screw	Metal	Machining	1
9	Seal	Rubber	Injection Molding	1
10				

For metal valve

Part number	Part Name/Description	Material	Manufacturing Process	Qty
1	Bolt	Steel	Machining	1
2	label	Aluminum	Machining	1
3	Knob	Steel	Casting	1
4	Bolt	Steel	Machining	1
5	Seals	Rubber	Injection Molding	1
6	Shaft	Steel	Machining	1
7	Bolt cover	Steel	Casting & Machining	1
8	Seal for bolt cover	plastic	Injection Molding	1
9	Moving cylindrical moving part	Steel	Casting & Machining	1
10	Main valve body	Steel	Casting & Machining	1

For plastic valve

Part number	Part Name/Description	Material	Manufacturing Process	Qty
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Draw precedence diagram