LBMS CTE

Strand 5: Pre-Engineering: Design and Development

Learners apply principles and design and development related to the design process, sketching and visualization modeling drafting materials and production and process design

Outcome 5.1-The Design Process

Use the engineering design process and quality assurance principles to analyze and solve design problems.

Competencies	LBMS Grade Level Covered	Lesson
5.1.1 Describe the role of research, development and experimentation in design problem solving	7, 8	7: Reverse Engineering, Junior Solar Sprint, Stop-Motion Animation 8: Architecture, GotSolar?, KidWind
5.1.2 Conduct an investigation to identify customer needs, constraints and criteria.	8	8: Robotics, Architecture
5.1.3 Develop multiple solutions and select an approach	7, 8	7: Design process/problem solving; Junior Solar Sprint, 3D Design/Printing 8: Architecture, GotSolar?, Kidwind
5.1.4 Develop a design proposal and make a model / prototype.	7, 8	7: Junior Solar Sprint 8: Architecture; KidWind
5.1.5 Evaluate and redesign a prototype using collected data.	7, 8	7: Junior Solar Sprint 8: Architecture; KidWind
5.1.6 Utilize process planning and improvement tools to manage the life cycle of a product.	8	8: Architecture
5.1.7 Compare and contrast design considerations for product recycling or disposal for the end of a product life cycle.	7, 8	7: Junior Solar Sprint, Reverse Engineering 8: Architecture
5.1.8 Maintain an engineering journal to document progress and capture ideas during the development phase.	7	7: Design process/problem solving 8: Architecture

Outcome 5.2 Sketching and Visualization

Conceptualize and sketch design projects and components

Competencies	**LBMS Grade Level Covered**	**Lesson**
5.2.1 Compare and contrast technical sketching and drawing.	7, 8	7: Sketching 8: GotSolar?

5.2.2 Sketch possible solutions to end existing design problem.	7	7: Sketching; Design/Problem Solving
5.2.3 Use tolerancing techniques when dimensioning.	7, 8	7: Junior Solar Sprint 8: KidWind
5.2.4 Apply annotations on sketches and drawings.	7, 8	7: Sketching; Design/Problem Solving, Junior Solar Sprint, Reverse Engineering,
5.2.5 Create sketches using integration sketching techniques and styles.	7	7: Sketching; Design/Problem Solving
5.2.6 Apply coordinate systems (e.g., absolute, relative, user, cylindrical, Cartesian).	8	8: KidWind
5.2.7 Sketch geometric forms and shapes.	7, 8	7: Sketching; Design/Problem Solving, Junior Solar Sprint, Reverse Engineering 8: GotSolar?; KidWind
5.2.8 Describe geometric constraints.	7, 8	7: Sketching; Design/Problem Solving, Junior Solar Sprint, Reverse Engineering 8: GotSolar?; KidWind
5.2.9 Select a view to graphically communicate a design solution.	7	7: Sketching; Design/Problem Solving, Junior Solar Sprint

Outcome 5.3 Computer-Aided Modeling

Create models to illustrate the design of projects and components

Competencies	**LBMS Grade Level Covered**	**Lesson**
5.3.1 Apply manufacturing processes (eg, casting, molding, forming, separated, conditioning, assembling, finishing, rapid prototyping).	7, 8	7: 3D Design/Printing 8: KidWind
5.3.2 Evaluate a sketch and generate a model utilizing three-dimensional modeling software and techniques.	7	7: 3D Design/Printing
5.3.3 Compare and contrast conceptual, physical and mathematical design models used to check proper design.		
5.3.4 Perform part manipulations during the creation of an assembly model.	7	7: 3D Design/Printing

5.3.5 Analyse assembly constraints to successfully construct a multi-part object.	7	7: 3D Design/Printing
5.3.6 Utilize part libraries effectively during the assembly modeling process.	7	7: 3D Design/Printing
5.3.7 Employ sub-assemblies during the production of assemblies.	7	7: 3D Design/Printing
5.3.8 Verify drive constraints that simulate the motion of parts and assemblies.	7	7: 3D Design/Printing
5.3.9 Apply adaptive design concepts during the development of sketches, features, parts and assemblies.	7	7: 3D Design/Printing
5.3.10 Translate a three dimensional drawing or model into corresponding orthographic drawing views.	7	7: 3D Design/Printing
5.3.11 Evaluate the accuracy of math properties calculations.		
5.3.12 Evaluate a model for design imperfections.	7	7: 3D Design/Printing

Outcome 5.4 Computer-Aided Drafting

Interpret and prepare technical drawings.

Competencies	**LBMS Grade Level Covered**	**Lesson**
5.4.1 Create and interpret auxiliary views, orthographic projection, isometric drawings, oblique drawings and perspective drawings.	7	7: Sketching; Design/Problem Solving
5.4.2 Create a sectional view drawing.		
5.4.3 Illustrate the types of brakes and symbols used in drawing sectional views.		
5.4.4 Produce a reverse engineered drawing from a solid object.		
5.4.5 Add technical elements (e.g., parts list, title, finishes, tolerances, specifications, hidden surfaces) to drawings.		

Outcome 5.5 Materials

Select materials for design projects and components.

Competencies	LBMS Grade Level Covered	Lesson
5.5.1 Compare and contrast the advantages and disadvantages of organic materials, metals, polymers, ceramics and composite based on physical properties.	8	8: KidWind; Architecture
5.5.2 Determined the production processes used to create products from categories of materials.	8	8: KidWind; Architecture
5.5.3 Evaluate the types and magnitude of stresses and forces.	8	8: KidWind
5.5.4 Analyze material properties by destructive and nondestructive test.	7, 8	7: Junior Solar Sprint 8: KidWind
5.5.5 Select materials for a given application based on specified criteria (e.g., cost, availability, manufacturability).	8	8: KidWind
5.5.6 Analyze the strength of a design using simulation soft modeling software (e.g., finite element analysis).		

Outcome 5.6 Productions and Process Design

Plan, set up, monitor, analyze and control integrated systems.

Competencies	LBMS Grade Level Covered	Lesson
5.6.1 Identify the planning and process procedures for production (e.g. corrective/preventive actions, audit documentation, process failure mode effective analysis).		
5.6.2 Use process planning an improvement tools (e.g., flow charts, diagrams, design for manufacturability).		
5.6.3 Employed project scheduling techniques		

(e.g., critical path methodology, project evaluation and review technique).		
5.6.4 Identify criteria and constraints and determine how those will affect the design of the production process.		
5.6.5 Estimate time, tooling, product packaging and material cost.		
5.6.6 Monitor performance against time, tool and material cost estimates.		
5.6.7 set capacity to account for fluctuation in demand.		
5.6.8 Adjust the plan is necessary to respond to variations (e.g., process, demand, material).		
5.6.9 Evaluate final solutions and communicate observations, processes and results.		
5.6.10 Develop a packaging design that prepares a product for shipping.		