Problem 2.3.1 Work Assistant Checklist and Rubric

For instructions to use this form, see Checklists and Rubrics for Engineering Essentials in the Engineering Essentials Teacher Guide.

Problem Checklist

Reviewer Name _____ **Date** _____

Problem Contents	Reviewer Comments	Approved
Deliverables and Presentation ☐ Full product website ☐ Product proposal developed and evaluated following the Engineering and Experimental Design processes ☐ Documentation of team member roles and responsibilities ☐ Description and illustration of mechanical system, including concept sketches, 3D model, and physical model ☐ Description of ergonomic improvements achieved with justification for each ☐ Approximate cost per package ☐ Test pan ☐ Completed project schedule ☐ Reflection on impacts and risks (trade-offs) of product		

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Problem Submittal Rubric

The following criteria will be assessed through the project submittals.

D = Domain; O = Objective; KS = Knowledge or Skill

D1 Professional Mindset

Basic	Proficient	Advanced
O: Demonstrate creativity, flexibility, and adaptability to change.		
KS: Reflect critically on past experiences to inform future progress.	Considers each event to be separate, with no connections to what came before or what comes after unless explicitly reminded about prior learning by others.	Uses previous knowledge, data, theories, or processes to solve challenges (applies previously learned brainstorming techniques or applies systems thinking in a new situation).	Abstracts meaning from an experience and applies it to a new, unrelated situation. Can explain how the previous experience relates to the new situation.

D2 Design Process

Basic	Proficient	Advanced
O: Apply an iterative design process to creatively address a need or solve a problem.		

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	Basic	Proficient	Advanced
KS: Develop a solution and implement a plan to test and evaluate a potential solution to verify that it meets all constraints and complies with all design criteria.	Proposed solutions have limited documentation of iterations. Documentation, if any, displays significant gaps in student knowledge. Some documentation of the prototype or model is presented but not complete. Prototype or model cannot be replicated from documentation. Prototype or model can only be tested to satisfy a limited number of requirements. Significant requirements cannot be tested with the prototype or model. Testing plan does not sufficiently define the procedure, conditions, and methodologies used. Tests are documented, but gaps exist for important data. Presentation of test results is either lacking or demonstrates gaps in student understanding of how to analyze and interpret data.	Proposed solutions, including significant iterations, are documented with technical writing and engineering best practices. Multiple iterations of a prototype or model are documented. Prototype or model is generally documented to allow for replication; there are only minor omissions. Prototype or model can be tested to satisfy most requirements, including all important requirements. Testing plan sufficiently defines the procedure, conditions, and methodologies used. Tests are documented and key data are recorded and presented in a clear format. Presentation of test results demonstrates competent understanding of how to analyze and interpret data. Tables, graphs, and/or equations are used to represent the data and communicate test results.	Proposed solutions, including all iterations, are comprehensively documented with technical writing and engineering best practices. Multiple iterations of the prototype or model are comprehensively documented. Prototype(s) or model(s) are sufficient to validate compliance with design requirements when tested. Prototype(s) or model(s) are documented precisely to allow for replication. If necessary, more than one model type is created to test all aspects of the design effectively (mathematical, computer 3D solid, physical, graphical, conceptual). Detailed and comprehensive testing plan defines procedure, conditions, and methodologies used. If appropriate, multiple iterations of the tests are performed. All tests are documented; data is recorded and presented in a clear format. Presentation of test results demonstrates a complex understanding of how to analyze and interpret data. Tables, graphs, and/or equations used to communicate test results are complete, easy to understand, and tailored to the audience.

D6 Modeling

	Basic	Proficient	Advanced
O: Develop models and simulations to represent information, processes, and/or objects to an appropriate level of abstraction for the intended purpose.			

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	Basic	Proficient	Advanced
KS: Develop a model to accurately represent information or important characteristics of an object, data, process, or design idea for an intended purpose. Notes on scope: Intended purpose may vary and could include organizing information to show relationships; providing a visual representation of the object/design to demonstrate how the object might "look"; functional model to demonstrate the operation; or prototype of a specific component to test fit, performance, durability, or compatibility with other components in a system. Model could be conceptual, mathematical, computer/virtual, or physical, as appropriate for the testing scenario.	Develops a specific type of model according to instructions. Cannot justify use of a model over alternative types or configurations of models based on purpose or merits and limitations of the models.	Develops a model that (within expectations) represents the information or important characteristics of an object, data, system, process, or design idea. Provides evidence that the model meets the expectations for its intended purpose.	Strategically chooses a specific type of model based on purpose, merits, and limitations to represent, investigate, or predict each characteristic or aspect of an object, system, or phenomenon. Justifies use of the chosen model and its configuration over other types/configurations of models as the better option to investigate a given characteristic. Analyzes model performance related to the intended purpose to evaluate precision and accuracy. If necessary, revises model to more accurately represent information or important characteristics or behavior of the real object, data, process, system, or design idea, and to better serve the intended purpose. Moves flexibly between model types based on merits and limitations of each.
O: Use spatial visualization to interpret graphical representations of physical objects.			
KS: Build a physical representation of an object, system, or environment. (Includes building solid objects, electrical circuits, mechanical devices, and complex systems according to technical drawings.)	Produces inefficient physical representation to resemble the design intent.	Produces relatively efficient physical representation in enough detail to demonstrate design intent.	Produces highly efficient physical representation in enough detail to demonstrate design intent.
O: Create and interpret a computer model or simulation of simple objects, assemblies, or systems to inform engineering decisions and solve problems.			
KS: Correctly build and constrain three-dimensional solid computer model to accurately represent physical characteristics and behaviors of a design idea or real object. Scope: This could include the appropriate application of geometric (horizontal, vertical, parallel, perpendicular, tangent, concentric) and dimensional constraints, as well as modeling other physical properties (density, color, texture.)	Produces inefficient three-dimensional solid computer model to accurate size that resembles the design intent.	Produces efficient three-dimensional solid computer model in enough detail to demonstrate design intent.	Produces highly efficient three-dimensional, solid computer model using precise dimensions.

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D7 Systems Thinking

	Basic	Proficient	Advanced
O: Apply systems thinking to consider how an engineering problem and its solution may be thought of as containing subsystems and being a subsystem of a larger system.			
KS: Describe a system in terms of its components and/or subsystems and their interactions (Describe components of an electronic circuit, including source, path, and load; describe how an electronic circuit provides power to a larger system to produce mechanical motion; describe subsystems of a building, including power, communication, lighting, ventilation, water, sewer, safety, social, transportation, and structural; describe how the water system and sewer system interact in your home.) Predict what effect making a change to a component of a system will have on the system as a whole.	Distinguishes between a system and systems thinking. Describes the purpose of a particular system. Explains that change happens if you add or take away a part of a system. Accurately identifies the components and/or subsystems of a system or device.	Accurately describes the purpose of each component or subsystem of a system and the interaction between components or subsystems. Lists the inputs and outputs of a system. Makes reasonable predictions of the effect of making a change in one part of a particular system or device on the behavior or output of the system or device as a whole.	Provides evidence of changes to a system that result from a change in a part of the system. Purposefully manipulates the behavior of a system or device by making strategic changes to components or subsystems.

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D9 Project Management

	Basic	Proficient	Advanced
O: Apply project management tools when designing and developing a solution to successfully deliver a product using available resources.			
KS: Define the project deliverables and constraints, such as scope, time, cost, quality, resources, and risk.	Identifies project deliverables and constraints.	Demonstrates understanding of and can define the project deliverables and constraints.	Thoroughly understands and defines the project deliverables and constraints along with the impact constraints have on potential solutions.
KS: Develop a project schedule (with critical path identified), allocate tasks among team members, and track progress for successful completion of the project.	Lists tasks with a verb and who is responsible to complete, but the workload is not equitably divided.	Develops a project schedule that provides an overview of all tasks to complete the project with start and end dates. Documents formal tasks with an action verb, ways to quantify successful completion, and who is responsible to complete each task. Tasks are equitably allocated among available resources. Clearly documents the tasks involved in the critical path sequence. Identifies the impact to the project success if one or more of the critical tasks is not completed on schedule.	Develops a project schedule with all tasks listed including projected start and end dates, and with clearly defined interdependencies between tasks. Collaboratively develops clear and formal tasks and shows how they relate to project deliverables. Tasks are equitably allocated among available resources with primary leader identified, while considering team member strengths. Clearly documents tasks involved in the critical path sequence and identifies the projected start and end dates for the critical path. Identifies the impact to project success if one or more critical tasks are not completed on schedule, along with a resolution strategy to successfully complete the project on time.

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D12 Communication

	Basic	Proficient	Advanced
O: Communicate effectively with an audience based on audience characteristics.			
KS: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	**Building Presentations** *Audience*: Little evidence that the speech/presentation was designed for the target audience. Little attempt to connect with the audience. Little attempt to explain things at the audiences level. *Content*: Most required content is included. Unnecessary and distracting information is included. *Organization*: Speech is somewhat disorganized and sometimes difficult to follow. Ineffective opening. Ineffective closing. *Purpose*: Purpose of the speech is not completely clear to most listeners. *Mechanics*: Multiple occurrences of incorrect grammar, spelling or punctuation. Words are used incorrectly.	**Building Presentations** *Audience*: Speech/presentation is designed with the audience in mind. Evidence of attempts to connect with the audience (with audience-specific content/contexts). One or two points could be better explained for this audience. *Content*: All required content is presented. Some extraneous information may be included but does not detract from the purpose. *Organization*: Speech/presentation is effectively organized. Engaging opening creates interest from the audience. Organized body makes sense to audience. Effective closing. *Purpose*: Intended purpose of the speech is clear. *Mechanics*: Correct grammar, spelling and punctuation. Words are used correctly and in the correct context.	**Building Presentations** *Audience*: Speech/presentation is perfectly designed for this audience. Several clear connections to the audience. All key points are understandable from the audience perspective. *Content*: Evidence of extensive research. Content includes interesting and impactful information beyond the required content. *Organization*: Can explain strategic choice of organizational structure (problem/solution, compare and contrast, order of importance, sequential). Opening catches audience attention. Powerful closing inspires the audience. *Purpose*: Speech/presentation accomplishes the intended purpose. *Mechanics*: Correct grammar, spelling and punctuation. Words are used correctly and in the correct context.
	Technical Writing (all forms) For the criteria to meet this KS at Basic, Proficient, and Advanced levels, see the complete, updated Technical Writing rubric in General Student Resources.		

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	Basic	Proficient	Advanced
KS: Present information, findings, and supporting evidence clearly, concisely, and logically, such that listeners can follow the line of reasoning, and the organization, development, substance, and style are appropriate to purpose, audience, and task.	*Appearance*: Adjusts appearance for the occasion. *Poise*: Appears ill at ease. Displays many distracting behaviors. *Voice*: Difficult to hear and understand words. *Eye Contact*: Makes minimal eye contact with audience. Reads script. *Gestures*: Minimal body movements, gestures, and facial expressions. *Speed*: Too slow or too fast to hold audience's attention and interest.	*Appearance*: Looks sharp and is dressed appropriately for the occasion. *Poise*: Appears calm. *Voice*: Voice is clear and at an appropriate volume. Good verbal expression with some emotion. *Eye Contact*: Makes eye contact with audience during most of the speech. *Gestures*: Displays some facial expressions and appropriate body language. No distracting behaviors. *Speed*: Good pacing.	*Appearance*: Looks sharp and is dressed appropriately for the occasion. *Poise*: Exhibits confidence. *Voice*: Voice is clear and at an appropriate volume. Verbal expression enhanced with emotion contributes to interesting delivery. *Eye Contact*: Continuous eye contact; student looks at each member of the audience. *Gestures*: Facial expressions and body language contribute to meaning. *Speed*: Varies pacing to enhance the message. Uses pauses for dramatic effect.
KS: Make strategic use of digital media (textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence, and to add interest.	Visual aids are only marginally relevant. Visual aids do not add to presentation, but merely represent what is said. Visual aids are not appropriate for the intended audience or presentation environment.	Visual aids are relevant and enhance understanding of the information. Visual aids are neat, attractive, and add interest. Appropriate for the audience. Most of the audience can easily see and interpret the visual aids.	All digital media and visual aids are relevant, well designed, and enhance understanding. Visual aids provide clarity and convey important ideas clearly and concisely (perhaps more effectively than words). Visual aids provide evidence that the presentation environment was considered, and the presentation was built and/or revised appropriately.

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