

## PROBLEM & DESIGN CLARIFICATION

	Expert	Proficient	Competent	Beginner	Novice
Examine context & define problem	<p><b>Poses pertinent questions</b> for clarification.</p> <p><b>Identifies and prioritizes sub-problems</b> (within the larger problem).</p> <p><b>Explores context.</b></p>	<p><b>Poses questions.</b></p> <p><b>Identifies sub-problems</b> but does not prioritize.</p> <p><b>Ignores context.</b></p>	<p><b>Asks some pertinent questions.</b></p> <p><b>Identifies key content.</b></p> <p><b>Defines problem adequately.</b></p> <p><b>Ignores context.</b></p>	<p><b>Expresses limited</b> knowledge of context or problem; problem is defined but needs clarification.</p> <p><b>Asks questions</b> but not pertinent and too few.</p> <p><b>Ignores context.</b></p> <p><b>Exhibits some indifference or frustration.</b></p>	<p><b>Tends to hone in on wrong problem</b>, isolated subset, or easiest part to solve.</p> <p><b>Begins to solve without clarification or questions.</b></p> <p><b>Doesn't see context.</b></p> <p><b>Exhibits considerable indifference or frustration.</b></p>
Develop, clarify, & negotiate constraints and criteria	<p><b>Explains key constraints</b> in detail.</p> <p><b>Tries to negotiate or circumvent constraints.</b></p> <p><b>Clarifies criteria</b> prior to solving problem or posing solutions.</p>	<p><b>Clarifies constraints</b> in detail; expresses their relationship to the problem solution.</p> <p><b>Engages in limited negotiation</b> of the constraints.</p>	<p><b>Clarifies constraints and accepts them</b> as presented and understood.</p>	<p><b>Recognizes constraints</b> but seeks minimal clarification. Accepts constraints as is.</p> <p><b>Clarifies constraints late in design process</b> as failures occur.</p>	<p><b>Does not identify constraints or criteria;</b> does not grasp the significance of constraints.</p> <p><b>Sees constraints as insignificant.</b></p>
Conduct research/gather pertinent information	<p><b>Consults several key sources.</b></p> <p><b>Evaluates information;</b> relates information back to problem and constraints.</p> <p><b>Uses refined search strategies.</b></p> <p><b>Researches sub-problems</b></p>	<p><b>Consults several key sources.</b></p> <p><b>Uses observational techniques.</b></p> <p><b>Cites references.</b></p> <p><b>Ignores sub-problems.</b></p>	<p><b>Uses search guides and locates at least 2 sources.</b></p> <p><b>Consults sources</b> with some direction and/or organization.</p>	<p><b>Conducts very limited research.</b></p> <p><b>Search restricted to easy-to-find and readily available resources.</b></p>	<p><b>Does not conduct research nor consult sources.</b></p> <p><b>Starts solving problem without information.</b></p>

## DEVELOP A DESIGN

	Expert	Proficient	Competent	Beginner	Novice
Generate and visualize possible solutions	<p><b>Generates creative and efficient solutions.</b></p> <p><b>All solutions meet constraints and address the original problem.</b></p> <p><b>Able to generate a number of different solutions.</b></p> <p><b>Is innovative</b></p>	<p><b>Generates feasible solutions</b>, but many are similar.</p> <p><b>Meets constraints.</b></p> <p><b>Uses resources efficiently.</b></p> <p><b>Proposes creative solutions.</b> Thinks “inside of the box”.</p>	<p><b>Generates solutions</b> that meet <b>most</b> of constraints.</p> <p><b>Establishes resources needed to implement solution.</b></p> <p><b>Generates several possible solutions within constraints.</b></p> <p>Thinks “inside the box.”</p>	<p><b>Identifies solutions</b> that meet <b>some</b> of the constraints.</p> <p><b>Some solutions are adequate to solve the problem.</b></p> <p><b>Solutions may/may not be feasible.</b></p> <p><b>Identifies single solution that meets constraints.</b></p>	<p><b>Cannot identify solutions or solutions are inappropriate</b> to framed problem.</p> <p><b>Does not appear to have an idea of where to begin.</b></p> <p><b>Solutions are disconnected from, or totally ignore, constraints.</b></p>
Select a design solution	<p><b>Provides detailed reasons for selecting solution.</b></p> <p><b>Provides backup or alternate solution</b> in case the first solution fails.</p> <p><b>Attempts to be innovative and wants best possible solution.</b></p> <p><b>Self-assured.</b></p>	<p><b>Selects solution on basis of efficiency and effectiveness.</b></p> <p><b>Checks against constraints.</b></p> <p><b>Provides basic rationale for selection.</b></p> <p><b>Tends not to have an alternative solution</b> in case the initial choice does not work.</p>	<p><b>Selects a reasonable solution based on criteria.</b></p> <p><b>Solution meets constraints.</b></p>	<p><b>Selects solution with limited attention to criteria.</b></p> <p><b>Can select solution.</b></p> <p><b>Solution may or may not be feasible.</b></p> <p><b>Is tentative and insecure in the selection process.</b></p>	<p><b>Selects solution according to personal preferences.</b></p> <p><b>Unable to decide solution.</b></p> <p><b>Solution may be unrealistic or impractical.</b></p> <p><b>Uses few if any criteria to evaluate solutions.</b></p> <p><b>Solution represents an easy way out.</b></p>

<p><b>Plan &amp; communicate design</b></p>	<p><b>Develops detailed design plan, drawings, and sketches.</b></p> <p><b>Devotes careful attention to constraints.</b></p> <p><b>Continuously revisits and refines the solution.</b></p> <p><b>Knows when to stop the refinement process.</b></p>	<p><b>Creates a plan</b> with supporting technical drawings.</p> <p><b>Maintains journal or log of daily activities.</b></p> <p><b>Meets constraints.</b></p>	<p><b>Creates an organized plan with sufficient detail. Identifies basic tools, resources.</b></p> <p><b>Visualizes using technical drawings.</b></p> <p><b>Ignores some constraints.</b></p>	<p><b>Explains design plan,</b> citing procedures, resources, and other requirements.</p> <p><b>Visualizes using technical sketches</b> without regard for scale.</p> <p><b>Ignores key constraints.</b></p>	<p><b>Explains design</b> in general terms and with little detail.</p> <p><b>Sketches are rough</b> and without sufficient detail. May attempt to move forward without drawings.</p> <p><b>Ignores constraints.</b></p>
---	---	---	---	--	---

## MODEL/PROTOTYPE

	Expert	Proficient	Competent	Beginner	Novice
<b>Select and use resources</b>	<p>Uses appropriate resources (i.e. tools, materials, and information) for developing and producing the solution.</p> <p>Accesses a variety of information sources (websites, manuals, technicians, electronic catalogs, etc.).</p> <p>Selects and adeptly uses resources.</p>	<p>Accesses and uses appropriate resources to solve the problem.</p> <p>Exhibits refined knowledge of tools, materials, and technological processes.</p> <p>Uses resources confidently.</p>	<p>Selects and uses appropriate resources related to most aspects of the problem.</p> <p>Displays some difficulty in accessing information.</p> <p>Selects appropriate tools for developing and producing the solution.</p> <p>Search for resources is limited to few sources.</p>	<p>Selects a limited range of resources.</p> <p>Some difficulty in choosing appropriate technological resources.</p> <p>Needs guidance in safe use of resources.</p>	<p>Limited ability to select and use basic resources.</p> <p>Selection of tools, materials, processes, and information may be inappropriate.</p> <p>Selected resources may not be feasible due to lack of availability, need for expertise, or cost.</p>
<b>Develop a plan for producing a model/ prototype</b>	<p>Develops a well detailed plan with references to design constraints and criteria.</p> <p>Includes testing and modification steps.</p> <p>Incorporates quality control measures.</p>	<p>Develops a detailed and systematic plan.</p> <p>Communicates information and processes needed to produce the model or prototype.</p> <p>Incorporates testing as a procedural step.</p>	<p>Develops a plan with logical and sufficient steps to develop and produce a solution.</p> <p>Plan needs quality control checkpoints.</p>	<p>Develops a plan with some gaps and insufficient steps to solve the problem.</p> <p>Connection with design criteria and constraints is marginal.</p>	<p>Develops a plan that lacks coherence and departs from design constraints and criteria.</p> <p>Plan contains gaps and does not flow logically.</p> <p>Procedures lack necessary detail.</p>
<b>Produce model/ prototype</b>	<p>Is adept with tools and resources, making continual adjustments to "tweak" the model/prototype.</p> <p>Demonstrates persistence with minor problems.</p> <p>Enjoys the challenge of refinements.</p>	<p>Uses tools and resources without guidance.</p> <p>Refines model to enhance appearance and capabilities.</p>	<p>Uses tools and resources with little or no guidance.</p> <p>May redo model/prototype parts to improve quality.</p>	<p>Uses tools and resources with some guidance.</p> <p>May have difficulty selecting appropriate resources.</p> <p>Refines work, but may prefer to leave model as first produced.</p>	<p>Needs guidance in order to use resources safely and appropriately.</p> <p>Crudely constructs model/prototype, with little or no refinement.</p>

## EVALUATE THE DESIGN SOLUTION

	Expert	Proficient	Competent	Beginner	Novice
Test and critique solution	<p>The solution fully meets the design constraints and criteria.</p> <p>Specific improvement ideas are generated and documented.</p>	<p>The solution meets most of the design constraints and criteria.</p> <p>Some general improvement ideas are generated and documented.</p>	<p>The solution addresses some design criteria completely but ignores others.</p> <p>Recognizes the need for improvement. Some ideas are generated, however only in concept.</p> <p>Documentation is sketchy.</p>	<p>The solution is only marginally connected with the design criteria.</p> <p>Shows little interest in improving the solution.</p>	<p>The solution fails to meet selected design criteria.</p> <p>In spite of problems detected during testing, no effort is made to refine the solution.</p>
Refine solution	<p>Solution is refined in a manner consistent with constraints and criteria.</p> <p>Solution is in constant refinement, based on continuous data gathering.</p>	<p>Solution is refined in a manner consistent with constraints.</p> <p>Changes represent some improvement to the quality and functionality of the solution.</p>	<p>Solution is refined to be consistent with design constraints and criteria.</p> <p>Refinements may be cosmetic and may not be significant.</p>	<p>Some minor refinement of the original solution.</p> <p>Refinements are primarily cosmetic in nature and contribute only marginally to the quality or effectiveness of the solution.</p>	<p>Solution is accepted "as is".</p> <p>Criteria and constraints are not referenced.</p> <p>No data is collected to evaluate the solution.</p>
Documentation/ Technical Reporting	<p>All aspects of the design process are well documented, including the processes used, design details, and resources.</p> <p>Documentation package is well organized, highly reflective, technically accurate, and communicates effectively to others.</p>	<p>The design process is documented including the processes used, design details, and resources.</p> <p>Drawings are technical and provide essential information</p> <p>Documentation is fairly organized. Some insights concerning design changes and refinements are detailed.</p>	<p>Documentation of design processes are factual and includes all components.</p> <p>Drawings are technical and provide essential information.</p> <p>Reflections are limited to facts, with limited depth.</p>	<p>Some attention to documentation with a preference for graphically depicting the design.</p> <p>Little evidence of a clear organizational scheme.</p> <p>Some design stages may not be documented.</p>	<p>Little documentation is done of either the product design or of the design process.</p> <p>Documentation is limited to hand-drawn sketches and sketchy, handwritten notes.</p>