

Bloom and Krathwohl Definitions of Levels and McBeath Action Verbs

Definitions:	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Bloom's Definition:	Remembering previously learned information	Grasping the meaning of information	Applying knowledge to actual situations	Breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized	Rearranging component ideas into a new whole	Making judgments based on internal evidence or external criteria	Sensitivity/willingness to receive (awareness w/o assessment, willingness to suspend judgment); Actively respond (comply, commit, internal satisfaction); Value (acceptance of worth, preference); Organize (when values conflict)
Verbs:	Arrange, define, describe, duplicate, identify, label, list, match, memorize, name, order, outline, recognize, relate, recall, repeat, reproduce, select, state	Classify, convert, defend, describe, discuss, distinguish, estimate, explain, express, extend, generalized, give example(s), identify, indicate, infer, locate, paraphrase, predict, recognize, rewrite, report, restate, review, select, summarize, translate	Apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate, schedule, show, sketch, solve, use, write	Analyze, appraise, breakdown, calculate, categorize, compare, contrast, criticize, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, model, outline, point out, question, relate, select, separate, subdivide, test	Arrange, assemble, categorize, collect, combine, comply, compose, construct, create, design, develop, devise, explain, formulate, generate, plan, prepare, propose, rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize, synthesize, tell, write	Appraise, argue, assess, attach, choose, compare, conclude, contrast, defend, describe, discriminate, estimate, evaluate, explain, judge, justify, interpret, relate, predict, rate, select, summarize, support, value	Accept, challenge, defend, respect, question, support, enjoy

References:

- Bloom, BS, MD Englehart, EJ Furst, WH Hill, and DR Krathwohl, *Taxonomy of Educational Objectives: Handbook 1: Cognitive Domain*, New York: Longman, 1956.
- Krathwohl, DR, BS Bloom, and BB Masia, *Taxonomy of Educational Objectives: The Classification of Educational Goals Handbook II: Affective Domain*, New York: McKay Company, Inc. 1956.
- McBeath, R. Ed, *Instructing and Evaluation in Higher Education: A Guidebook for Planning Learning Outcomes*. Education Technology Publications, Inc., 1992.

Outcome A: An ability to apply knowledge of mathematics, science, and engineering (Updated 01/30/00)

Definitions:	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Applying knowledge of mathematics	Recognizes functional relationships among independent and dependent variables. Describes mathematical and physical significance of functions, derivatives of functions, and integrals of functions.	Explains the role of mathematics as a tool for modeling systems and processes.	Applies mathematical principles to obtain analytical or numerical solutions to model equations. Chooses a mathematical model of a system or process appropriate for the required accuracy. Applies principles of numerical solutions to integrals and differential equations.	Identifies mathematical and physical assumptions that allow model to be developed and solved at the level of accuracy required. Applies concepts of integral and differential calculus and linear algebra to solve problems.	Combines mathematics principles to formulate models of chemical, physical, and/or biological processes and systems as relevant to area of concentration.	Evaluates validity and reliability of mathematical models by comparing model solutions to either known results for simplified cases (i.e. numerical solutions compared to asymptotic analytical solutions) or relevant empirical data. Interprets mathematical model results to estimate accuracy and reliability.	Accepts limitations of mathematical models to physical reality. Challenges predictions of mathematical models until independently verified.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Applying knowledge of science and engineering fundamentals	Describes fundamental scientific and engineering principles in chemical, physical, and/or biological processes and systems as relevant to area of concentration.	Identifies which fundamental scientific and engineering principles govern the performance of a given process or system.	Applies engineering science principles as relevant to area of concentration, e.g.: “Conservation” principles of total mass, species mass, linear momentum, angular momentum, energy, or charge to model chemical, physical, and/or biological processes or systems. Rate and constitutive equations to model relevant chemical, physical, and/or biological processes or systems. Thermodynamic principles to predict bounds on the performance of processes or systems. Materials principles to characterize behavior of physical, chemical, and/or biological processes or systems.	Analyzes modeling results of systems or processes using fundamental scientific and engineering principles. Analyzes data sets using statistical concepts.	Combines scientific and engineering principles to formulate models of processes and systems.	Evaluates validity and reliability of model solutions by comparing model predictions to either known experimental results for specific processes or systems or simplified theoretical results. Interprets physical significance of model predictions. Defends use of selected engineering science principles to model a specific process or system.	Accepts limitations of mathematical models in predicting the performance of chemical, physical, and/or biological processes or systems as relevant to area of concentration. Accepts the role of mathematical models in guiding engineering design work. Accepts variance between model predictions and process or system performance.

Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data (Updated 01/30/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Designing Experiments	Recognizes applicable analytical models, possible simulators (e.g. physical, digital, continuous, other format), testing apparatus, databases, models, etc. Identifies applicable theory and recognize the past history. Describes different measurement techniques and alternatives based on cost, etc. Gives examples of possible disruptions that may occur while conducting experiment that could affect experimental data. Discusses laboratory/experimental protocols. Understands the need for proper units.	Indicates how existing theory/history differs/complements current question. Selects the variables in question (controllable, level of variation, impact with other variables). Identifies the constraints and assumptions for the experiment - cost, time, equipment. Constructs an appropriate hypothesis or problem statement. Selects appropriate equipment, test apparatus, model, etc. for measuring variables in question. Is aware of orderliness and integrity of data	Uses existing theory/history to design an experiment. Chooses the measure(s) of effectiveness by which the outcome or the alternative will be evaluated – cost, quality, value, time to complete, feasibility. Formulates the control and evaluating alternatives of the experiment. Develops contingency plans. Applies constraints and assumptions into experimental design. Determines the data that are appropriate to collect. Specifies and justifies the assumptions given test conditions.	Predicts experimental uncertainties.	Combines information for experiment from multiple sources.		Accepts the limitations and extensions that an experiment built can be used to represent the system.

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Outcome: Element: Conducting Experiments		Is aware of measurement errors in instrumentation, human, environment. Anticipates and minimizes experimental disruptions via pilot study.	Acknowledges possible disruptions to existing surroundings and operations. Uses appropriate measurement techniques to collect data. Facilitates use of modern data collection techniques (computer for data logging). Follows ethical protocols when collecting data. Documents collection procedures such that experiment may be repeated. Anticipates and minimizes data errors via pilot study.				
Outcome Element: Analyzing Data		Selects and explains different methods of analysis (descriptive and inferential) and depth of the analysis needed. Identifies different audiences and their analysis/summary needs. Identifies artifacts/confounding elements that may result.	Uses appropriate tools to analyze data. Selects and uses appropriate, self-explanatory graph formats for data. Prepares analysis such that results can be replicated.	Applies statistical procedures where appropriate. Investigates possible artifacts with a balance of costs associated with the analysis.	Organizes information into meaningful categories		

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Outcome Element: Interpreting Data		Recognizes how results relate or differ from theory or previous results.	Verifies and validates experimental results.	Questions whether constraints hold in both experiment and real world. Relates and makes connections between the measured property and variables. Examines data with respect to measures of effectiveness. Considers risk.	Combines results of multiple experiments, history or data sources Clearly presents information in appropriate, usable formats (graph, numerical, text, etc.).	Considers possible extensions of results to other areas. Interprets results with respect to the assumptions and constraints. Interprets results with regards to how they relate the theoretical state of nature or system. Selects the most appropriate alternatives based on solution criteria. Assesses the accuracy and precision of the results. Interprets results with respect to the original hypothesis.	Respects and understands the need to consider results from different view points and audiences. Appraises how results can be used to make a decision. Recognizes experiment's limitations.

Outcome C: An ability to design a system, component, or process to meet desired needs (Updated 04/04/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Need Recognition Identifies stated and unstated wants and needs that motivate the design effort; converts them into a needs statement.	Recites definitions. Names established methods and lists their steps.	Describes differences among various methods. Carries out steps in a hypothetical design situation when asked.	Selects and performs appropriate method at a proper stage of a design project.	Analyzes perceived wants and needs to isolate the most relevant needs.	Produces a clear and unambiguous needs statement in a design project.	Assesses/verifies consistency of needs statement with customer's and societal needs.	Accepts that design effort benefits from a clear, unambiguous needs statement
Outcome Element: Problem Definition Determines design objectives and functional requirements based on needs statement. Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions.	Recites definitions. Names established methods and lists their steps.	Describes differences among various methods. Carries out steps when asked.	Selects and utilizes appropriate method for problem definition. Successfully produces problem definition at an appropriate stage of a design project.	Analyzes a needs statement to isolate information pertaining to problem definition.	Guides a design project by use of the produced problem definition.	Evaluates adequacy and consistency of produced problem definition with needs statement, reality.	Accepts that good problem definition assists the design process.
Outcome Element: Planning Development of a design strategy, including an overall plan of attack, decomposition of design problem into subtasks, prioritization of subtasks, establishment of timetables and milestones by which progress may be evaluated.	Recites definitions. Names and lists steps in design process. Lists established management strategies and their elements.	Describes differences among various design steps. Carries out steps when asked.	Selects and performs appropriate design stage at an appropriate point in a design project.	Analyzes progress of design in order to revise plan as needed.	Produces a design strategy and uses it to guide a design project.	Evaluates progress by comparing current design state to design plan.	Accepts that planning is important to design success. Supports planning efforts

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Outcome Element: Management Guidance of course of action during design and in response to changing conditions.	Names project monitoring techniques. Lists their elements and applications. Lists methods to modify design plans.	Describes differences among various techniques. Modifies a given design plan for a specific situation.	Selects and performs appropriate monitoring and/or modification process during a design project	Analyzes progress of design in order to revise plan as needed. Analyzes errors to determine proper reaction.	Maintains a design strategy during a design project.	Judges quality of monitoring. Judges quality of revisions to plan.	Respects changes in original plan. Accepts need for changes.
Outcome Element: Information Gathering Gathers information about the design problem, including the need for a solution, user needs and expectations, relevant engineering fundamentals and technology, and feedback from users.	Names and lists steps in information gathering. Lists established methods and their elements.	Uses specified information gathering method to research a specified design issue.	Recognizes need for information during a design project. Gathers information using an appropriate method.	Analyzes information needs to determine type of information to gather during a design project.	Employs gathered information in design decisions.	Judges quality of gathered information.	Accepts that information gathering is important to design success.
Outcome Element: Idea Generation Transforms objectives/ functional requirements into candidate solutions.	Names established idea generation methods. Lists their steps and attributes.	Describes differences among methods. Performs specified method in hypothetical design situation when asked.	Selects and performs appropriate idea generation methods in a design project.	Analyzes failed candidates to suggest new candidates.	Integrates generated ideas into design plan. Generates ideas creatively or ad hoc where established methods fail.	Judges completeness, quality of generated candidates.	Accepts that generation of multiple alternatives is important; respect alternate solutions.
Outcome Element: Modeling Employs models / representations / simulations of the physical world to provide information for design decisions.	Recites definitions. Names and lists modeling and simulation methods and representation techniques, their elements and applicability.	Describes differences among methods. Uses a specified representation to investigate a given design issue. Carries out steps of a specified method when asked	Selects and performs model or representation at an appropriate point in a design project.	Analyzes output of model or representation.	Incorporates output of model into the design project.	Evaluates quality of model, simulation, or representation and its output.	Accepts that modeling is important to design success.

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Outcome Element: Feasibility Evaluates feasibility of alternatives or proposed solutions by considering stated constraints as well as implied constraints such as manufacturability, cost, compatibility.	Recites definition of feasibility. Names and lists steps in feasibility analysis methods.	Recognizes feasible candidates among a selection of candidates (using a specified method).	Performs feasibility analysis at an appropriate point in a design project, selecting applicable method.	Analyzes performance results, modeling results, interfaces to determine source of failure.	Uses the result of feasibility analysis to choose a candidate. Employs insights gained.	Evaluates judgments of feasibility, particularly with respect to possible biases.	Accepts that recognizing feasibility is important to design success.
Outcome Element: Evaluation Objectively determines relative value of feasible alternatives or proposed solutions by comparing expected or actual performance to evaluation criteria.	Names and lists evaluation methods and their elements, applicability.	Describes differences among various methods. Carries out specified method when asked.	Selects and applies appropriate evaluation method at an appropriate point in a design project.	Analyzes results of evaluation to discern additional criteria.	Ranks or otherwise rates candidates based on evaluation results. Reports on expected performance of candidates.	Judges quality and comprehensiveness of evaluation, particularly by recognizing possible biases.	Accepts that evaluation is important to design success. Respects systematic, unbiased methods of evaluation.
Outcome Element: Selection / Decision Selection of most feasible and suitable concept among design alternatives.	Names established decision and selection methods and their steps and applicability. Lists common decision criteria.	Describes differences between decision and selection methods. Makes a decision or selection given a set of alternatives.	Selects and performs appropriate decision and selection methods at an appropriate point in a design project.	Analyzes feasible alternatives to identify bases for decision, selection.	Selects a candidate and proceed with design.	Evaluates quality of selection or decision, e.g. with respect to possible bias.	Accepts that timely selection, structured decision process is important to design success.
Outcome Element: Implementation Creating an instance of physical products and processes for purpose of testing or production.	Lists and outlines manufacturing and prototyping methods. Lists applications, strengths, weaknesses.	Describes differences among methods. Selects an appropriate method given a situation. Builds a prototype by a specified method.	Selects and implements fabrication or production for design project.	Analyzes output to suggest alternate methods of fabrication or production.	Builds a prototype or manufactures the artifact. Incorporates components into a final design.	Judges quality of prototype or product.	Accepts that prototyping and manufacturing are important to design success.

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Outcome Element: Communication Exchange of information with others, utilizing appropriate formats.	Names types of communication and their formats. Names and lists steps in communication methods. Lists difficulties, strengths, and applications.	Describes differences between various forms of communication. Carries out when asked. Identifies possible pitfalls in a hypothetical design situation.	Selects and performs appropriate form of communication at appropriate points in a design project.	Analyzes messages to identify implied information. Recognizes errors and means of remedy.	Communicates successfully throughout a design project. Directs received communications to proper recipient	Evaluates effectiveness of chosen format and message.	Accepts that good communication and group dynamics is important to design success.
Outcome Element: Documentation Produces usable documents of record regarding the design process and design state, including decision history and criteria, project plan and progress, intermediate design states, finished product and use of product.	Names common forms and purposes of documentation. Lists common targets of documentation, elements of good documentation.	Describes differences among forms of documentation. Documents a specific design action by a specific form when asked.	Selects and performs appropriate documentation at an appropriate point in a design project.	Analyzes design activity to locate targets of documentation.	Creates comprehensive history of design process as design proceeds.	Evaluates quality of produced documentation and choice of documentation format (e.g., given audience).	Accepts that diligent documentation is important to design success.
Outcome Element: Iteration Utilizes strategies to inform design decisions which may contribute to a change in a design state (e.g., the problem definition, problem solutions, or design process plan).	Recites definitions. Identifies strategies or procedures that generate information which may contribute to design decisions.	Describes iterative process models of design. Modifies, improves or elaborates a design state given a situation.	Selects and performs strategies to generate information that may be used to modify, improve or elaborate a design state.	Examines and critiques progress for opportunities to revise design state as needed. Analyzes violations, inconsistencies, or conflicts to determine proper response.	Incorporates and integrates feedback. Generates new knowledge about design problem. Develops new strategies or tools to monitor progress.	Critiques quality of monitoring, strategies and tools. Judges quality of revisions to design state.	Accepts and supports changes to original plan or product.

Outcome D: An Ability to Function on Multi-Disciplinary Teams (04/11/00)

Definitions:	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Collaboration/ Conflict Management: Team Development: <i>Basic principles of group development and interpersonal dynamics</i>	Defines stages of team development and the sequence in which they occur.	Recognizes distinctions between stages in team development. Identifies specific behaviors and skills that support team effectiveness.	Determines a teams current state of development.	Distinguishes effective team process relative to ineffective team process.	Formulates plans for helping a team develop from one stage to the next	Accurately evaluates a teams current state of development and prescribe plans for enhancing effectiveness.	
Outcome Element: Collaboration/ Conflict Management: Interpersonal style: <i>Recognizing and capitalizing on differences in style and perspective</i>	Recognizes differences in interpersonal style	Describes how differences in interpersonal style impact team behavior and performance	Modifies his/her own style to accommodate needs of others	Compares and contrasts differences in team members interpersonal styles	Capitalizes on individual differences in style and perspective to improve team performance	Evaluates the pros and cons of different style types relative to team performance	Respects differences in style, culture, experience or knowledge
Outcome Element: Collaboration/ Conflict Management: Conflict Management: <i>Principles of problem-based Conflict management.</i>	Defines principles of constructive conflict management; e.g., win-win; issues versus positions; objective criteria; interest based negotiation.	Describes how to use principles of constructive conflict management	Applies principles of constructive conflict management to interactions with others	Identifies underlying issues associated with conflicting positions	Effectively constructs solutions that integrate seemingly contrary positions	Evaluates conflict outcomes against objective criteria	Remains nonjudgmental when disagreeing with others Values alternative perspectives Maintains a neutral perspective when resolving differences between others
Outcome Element: Collaboration/ Conflict Management: Participation: <i>Understanding of and willingness to be fully involved in team efforts</i>	Defines what participation means in a team setting	Describes what one must do to participate fully in team projects	Shares responsibilities with other team members Demonstrates commitment to team goals Supports other team members in their assigned roles Flexible and responsive to others needs		Helps team create plans for ensuring/improving participation Encourages involvement from others		Cooperative and open with others Enjoys interacting with others to complete work Views problems as team issues not as things that affect only one or two people

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Outcome Element: Team Communication Active Listening: <i>Conveying understanding and using listening skills to move a conversation forward</i>		Describes active listening and its role in team effectiveness.	Restates what has been said to show understanding. Asks open-ended questions in order to encourage discussion. Summarizes main points of discussions before moving on to other topics. Asks questions to clarify misunderstandings. Conveys understanding of others perspectives.	Identifies relationships between actively listening and team performance.	Uses active listening skills to enhance knowledge and develop better understanding (e.g. to clarify design requirements)	Accurately assesses own/others ability to listen actively	Sensitive to other team members feelings and personal interests. Listens attentively to others without interrupting. Conveys interest in what others are saying
Outcome Element: Team Communication Feedback: <i>Giving and receiving constructive criticism</i>		Understands principles of constructive feedback.	Gives specific and constructive feedback to other team members. Appropriately balances negative comments with positive ones. Solicits feedback from others. Avoids judgmental language or cheap shots when giving feedback.	Identifies relationships between active listening and team performance.	Incorporates feedback from others into revisions/ improvements.	Accurately assesses own/others ability to give receive/ feedback.	Receptive to feedback and criticism from others. Sensitive to others reactions to feedback/ criticism
Outcome Element: Team Communication Influencing others: <i>Persuading others through well reasoned use of facts and clear conveyance of ideas</i>		Understands principles of how to influence others.	Articulates ideas clearly and concisely. Uses specific examples to make points and convey ideas. Persuades others to adopt his/her point		Develops plans and presentations that influence others	Accurately assesses own/others ability to influence others	Comfortably expresses alternative points of view

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Outcome Element: Team Communication Sharing Information: <i>Providing and reviewing information in a timely manner</i>		Describes important ways of sharing information in a team setting.	Shares information with others on the team. Provides information on time.	Differentiates between useful and unnecessary information.	Combines different kinds/sources of information to create solutions or new ideas.	Open to new information and ideas	
Outcome Element: Team Decision-making Defining a Problem: <i>Identifying and articulating the problem to be solved.</i>	Defines specific steps in the decision-making process.	Describes steps in decision-making process and how they relate to one another.	Applies a systematic decision-making process to solving problems.	Collects data to pinpoint problems. Analyzes problems objectively Tests assumptions underlying ideas, positions or statements	Recognizes interrelationships among problems and issues		
Outcome Element: Team Decision-making Innovation and idea generation: <i>Generating creative and viable solutions</i>	Defines innovation and idea generation.	Describes how innovation and idea generation are distinct and how they are similar. Understands tools and techniques for generating ideas.	Uses brainstorming and other idea generation techniques. Participates in the development of ideas.		Builds upon others ideas. Integrates information and ideas from varied sources to create new solutions		Conveys openness to new ideas. Comfortably deals with open-ended problems. Encourages “out of the box” thinking. Supports the ideas and viewpoints of others.
Outcome Element: Team Decision-making Judgment / Using facts: <i>Reaching conclusions based upon clear analysis of facts and ideas</i>	Recognizes tools and techniques for making judgements	Accurately describes how to use techniques for making judgments (fishbone, narrowing, histograms).	Makes decisions based upon facts rather than “gut-feel” or intuition. Discourages team members from rushing to conclusions. Presses team members for facts to support decisions	Establishes objective criteria against which to evaluate alternatives Accurately analyzes trends and patterns in order to reach conclusions	Evaluates alternatives in relation to objective criteria.		

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Outcome Element: Team Decision-making Reaching Consensus: <i>Ensuring buy-in and commitment to decisions reached</i>	Defines consensus-based decision-making.	Distinguishes consensus-based decision-making from other forms of decision-making.	Seeks buy-in from all team members before finalizing decisions. Polls team members for their opinions. Listens to opinions and feelings of other team members. Does not pressure others into accepting decisions. Accurately determines when to use consensus decision-making and when not to.	Considers alternatives from several points of view.	Alters solution so that all can support it.	Employs a devil's advocate to evaluate pros and cons of alternatives.	Sensitive to others' body language and or other non-verbal signs of agreement/disagreement
Outcome Element: Self-Management Establishing directions and standards: <i>Helping create plans and structure for the team.</i>		Describes how to use planning tools (e.g. goal setting, Gantt charts).	Establishes task priorities. Clearly states expectations regarding performance. Keeps the team focused. Records milestones and accomplishments.	Helps clarify conflicts regarding roles and responsibilities. Reconciles conflicting priorities.	Formulates action plans and timetables. Creates strategies and plans of action.	Evaluates team performance (task) relative to objectives.	Celebrates team and individual accomplishments. Comfortably attends to several issues at the same time.
Outcome Element: Self-Management Managing meetings: <i>Using principles of effective team meetings</i>	Defines a working agreement.	Describes the components of an effective team meeting.	Discourages side-conversations and or getting off track during discussions. Helps manage time during meetings. Assists in note taking / recording meeting minutes.	Helps monitor meeting progress and effectiveness.	Helps team develop a working agreement.	Evaluates team performance (process) relative to its working agreement.	

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Outcome Element: Self-Management Personal conduct: <i>Demonstrating personal responsibility to the team and respect for team members</i>		Understands what one must do to be effective in a team setting.	Follows through on commitments. Prompt for meetings and appointments. Does not criticize others behind their backs. Flexible and adapts to demands of situations and constraints. Maintains an appropriate balance between listening and speaking.	Differentiates between team membership and team leadership	Knows when to assume a leadership role and when to let others assume that role		Supports shared leadership amongst team members Treats others with courtesy and respect Conveys enthusiasm and support for others, especially when team is under stress Does not “point fingers” or blame others when things go wrong Shares accountability for team results

Outcome E: An ability to identify, formulate, and solve engineering problems (Updated 04/11/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Identifying problem and opportunities	Defines facts about current processes and procedures associated with the situation of interest. Recalls past experience as a foundation for identifying new ideas.	Identifies and describes issues associated with the situation of interest. Asks questions to gain knowledge in areas that are unknown. Classifies and manages known information to formulate the answer to unknown and open-ended questions. Distinguishes what is known and unknown about a particular situation or question.	Identifies areas where improvements can be made. Recognizes that a situation can be addressed from an engineering perspective. Proposes possible alternatives. Observes and size-up a situation.		Assembles new idea information from multiple sources. Combines observations, data obtained, other facts, and engineering judgments.	Evaluates current practices to determine their effectiveness and/or value. Assesses the effectiveness of each new idea. Judges new concepts/alternatives impartially.	Challenges the normal way things are being done . Shows a willingness to use the perspective and ideas of others . Supports the generation of new ideas to solve an engineering problem. Recognizes the importance of receiving new approaches to solve engineering problems. Respects and accepts the impact questions from users with a limited knowledge base. Seeks new opportunities, ideas, for continuous improvement.

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Outcome Element: Constructing a problem statement and system definition	Describes the engineering problem to be solved. Knows the elements of a system and the process of abstracting a problem to an operational definition.	Identifies the relevant engineering mathematics and science principles. Visualizes the problem through sketch or diagram. Specifies the problem scope.	Lists the facts that the user can be certain of. Outlines problem variables, constraints, resources and information given to construct a problem statement. Simplifies the problem and develop a toy model. Determines the boundaries, restrictions and measures of effectiveness to be used. States the problem in words. Identifies appropriate measures of effectiveness. Selects information useful in constructing a problem statement.	Isolates key aspects of the problem. Analyzes potential problem variables, constraints, etc. for inclusion in model abstractions.	Combines and relates variables, constraints, resource levels etc. into a problem statement.	Appraises the problem statement for objectivity, completeness, relevance, and validity.	
Outcome Element: Formulating problem and abstraction (Problem solving approaches)	Describes engineering problem solving approaches.	Understands the iterative nature of engineering problem solving. Recognizes that there are multiple approaches to any problem. Indicates how theory can be applied in practice.	Uses knowledge base to develop possible approaches. Distinguishes among realistic and unrealistic approaches. Uses knowledge and information (social sciences, engineering science, mathematical and physical sciences) to produce	Examines approaches to solving an engineering problem in order to choose the more effective approach. Balances level of effort required against level of accuracy required.	Sets-up a relation between an engineering problem and the new approaches developed to solve it. Generates potential alternatives or ideas to formulate and solve engineering problems.	Assesses the effectiveness of each approach and can apply multiple criteria.	Accepts the perspectives of others when developing problem solving approaches. Uses personal value system to augment traditional measures of effectiveness.

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			many ideas for possible problem formulation and solution generation.				
Outcome Element: Formulating problem and abstraction (variables, assumptions, constraints, measures of effectiveness and criteria)	Identifies applicable engineering principles necessary for developing the problem.	Identifies new criteria for the proposed problem. Classifies criteria used to evaluate proposed solutions. Describes the assumptions underlying relevant basic mathematical, basic science, engineering methods.	Uses basic mathematical, science, and engineering knowledge to formulate and support assumptions and problem element specification. Defines and lists key components that a proposed problem and later solution should consider.	Examines problem elements for completeness, consistency, dimensionality, etc. Separates facts from assumptions.	Uses engineering data and theory to further justify assumptions.	Assesses problem abstraction for completeness and redundancy. Assesses and evaluates assumptions relative to the needed accuracy of the situation.	
Outcome Element: Collecting data, resources, and information	Cites appropriate resources to obtain information for the problem/situation. Defines and describes type of resources needed. Draws upon past knowledge / experience as relevant to the problem at hand.	Indicates where additional information is needed. Understands the various methods for information gathering.	Uses the resources to obtain information. Designs and conducts data collection effort.	Selects appropriate resources needed to gather information. Collects needed information and data.	Combines observations/data, facts and engineering judgment.	Appraises resources and information needed.	Questions the quality and relevance of information.
Outcome Element: Modeling the problem: translation	Describes aspects and types of models. Relates different mathematical functions to each other.	Explains the relevance of the hypothesis and theory to the mathematical model. Discusses the problem's social and economic ramifications. Discusses the applicable mathematics and physical sciences principles to	Translates the results of the physical model to mathematical or computer model. Formulates a model with appropriate scope and level of detail. Formulates appropriate hypotheses to create mathematical, physical, computer,	Determines the needed level of accuracy for various components of the model. Investigates functional relationships for consistency and validity. Determines if the data supports the hypothesized relationships.	Generates a series of relevant functions of an engineering model and relates them to one another. Combines social, economic, and physical components of a problem into an appropriate model. Explains the complete physical model	Interprets the meaning of the relationships between functions. Validates an engineering model with mathematical principles. Validates an engineering model empirically. Evaluates the level of detail for appro-	Values the role of mathematics, engineering theory, and physical science as tools in modeling. Defends and critiques the model. Accepts and defends the level of detail of the model that is consistent with the available resources (time,

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		the problem at hand. Describes the relations among the physical model and the underlying principles.	etc. model. Introduces applicable social, economic, political factors into the model.	Breaks down components of a mathematical model, and analyze each section independently.	WRT basic principles of math and science.	priateness for the problem at hand.	cost, personnel and information or data) for problem solution.
Outcome Element: Validating	Recognizes the necessity of validating any resultant abstraction of the system (model). Describes the differences between face, construct, and content validity.	Describes various methods of validation. Determines the appropriate method(s) of validation needed for the problem at hand.	Validates the model and/or process. Uses theoretical representations and empirically obtained information to estimate outcomes or aspects of the model. Where appropriate, uses data to determine validity of model or process (pilot test). Includes decision maker(s) in validation process.	Appraises the results to determine if they are sufficient.	Combines different validation information methods and modes.	Reviews validation process to determine if it is appropriate for the problem at hand.	Respects the opinions of others as part of the validation process (face validity) .
Outcome Element: Designing experiments (see Outcome B)	Has knowledge of experimental design methodology (laboratory and statistical).	Determines the appropriate methods for the particular problem. Understands that experimentation helps to extend his/her engineering knowledge base. Recognizes the necessity of carefully designing experiments to obtain information and/or outcomes.	Designs and conducts the experiment for obtaining the information or outcomes (see Outcome B).	Analyzes the results of the experiment to obtain meaningful information (see Outcome B).	Combines information obtained from experiments of other sources to extend knowledge base (see Outcome B).	Assesses results to determine if conclusions are appropriate.	Defends problem solving process with facts .

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Solving or experimenting	(See outcome A.)	Understands that a descriptive model requires experimentation for solution and a prescriptive model requires an optimization, algorithmic or heuristic approach for solution. Describes possible solution (optimization) or experimentation techniques.	Manipulates relationships to facilitate solution. Determines bounds. Uses theoretical concepts to develop solutions. Uses computational or simulation methods for obtaining solutions or conducting experiments. Uses existing algorithms and/or experimentation methods. (See outcome A and K.)	Selects appropriate solution or experimentation methodology.	Assembles and synthesizes sub-problems in order to obtain an overall solution. Relates theoretical concepts to practical necessities. Develops algorithms or heuristics to obtain solutions.		Accepts the limitations of resultant solutions.
Outcome Element: Interpreting results (Evaluates potential solutions and selects solution.)	Lists possible solutions and solution criteria.	Describes the various solutions.	Generates possible solutions for a given engineering problem. Applies sensitivity analysis. Checks solutions for accuracy relative to dimensionality. Uses knowledge, information and judgment to rank and/or select the "best" solution.	Determines robustness of solutions. Identifies inconsistencies or errors in the proposed solutions. Uses theoretical concepts to interpret results. Compares and contrast solutions based on a set of criteria.	Draws conclusions and inferences from solutions. Supports conclusions with facts, engineering judgment, and information. Assembles a collection of solutions that adhere to the given solution criteria.	Evaluates feasibility of alternative solutions. Interprets solution and predict possible consequences. Assesses solutions relative to measures of effectiveness, feasibility, and how realistic is the solution to the original problem.	Supports and defends solution outcomes. Challenges the reason behind the conclusion. Accepts and supports chosen solutions. Motivates others to justify decision-making with information and data.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Implementing and documenting	Describes the implementation process and necessity of documentation. Describes different management techniques to facilitate implementation.	Outlines the responsibilities of management relative to problem solving in general and implementation specifically. Describes several modes of documentation and relates the appropriate mode for the problem at hand.	Applies management knowledge and teamwork skills (see Outcome D) to facilitate implementation and documentation. Communicates the recommended solution in writing (see Outcome G). Uses appropriate documentation for different audiences (see Outcome G).	Appraises the effectiveness of various management techniques to the problem at hand. Reviews and critiques documentation prepared by others to the problem. Locates problem solution within the appropriate phase of the product/system life cycle to facilitate implementation.	Considers relevant political and social factors when recommending one or more alternative solutions (see Outcome H). Uses a combination of management and teamwork approaches when implementing problem solution (see Outcome D).	Appraises alternatives from a managerial perspective. Evaluates the recommendations in light of the political and social factors (see Outcome H).	
Outcome Element: Using feedback and improving	Identifies appropriate information and sources for feedback. Describes the process improvement cycle (Plan-Do-Check-Act). Describes the iterative nature among the steps in the problem solving process.	Recognizes the importance for obtaining feedback as part of the continuous improvement process. Recognizes that there are positive and negative aspects of each of the alternatives.	Documents feedback and improvements. Creates a mechanism for obtaining and evaluating feedback. Provides feedback in a constructive manner (see Outcome D). Uses knowledge and information to improve upon current processes and procedures. Identifies possible alternatives for improvements.	Analyzes feedback to select appropriate areas for improvement. Compares and contrasts previous practices versus proposed improvements or solutions.	Combines various forms of feedback to obtain additional information and feedback. Reconstructs current practices integrating improvements where needed.	Appraises each alternative, including the option not to make a change, with respect to the decision criteria.	Is aware that other problems may arise as a result of the problem solving process. Respects both positive and negative feedback. Values the perspectives of all stakeholders.

Outcome F: An understanding of professional and ethical responsibility (Updated 01/30/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Demonstrating an ability to make informed ethical choices	Identifies a situation that is or could become an ethical dilemma.	Distinguishes concrete facts from intangible assumptions for a given ethical dilemma.	When making an informed ethical decision: Uses knowledge to identify specific information to consider; uses knowledge to identify the impacts (short-term and long-term); uses the perspectives of other people; uses knowledge to gain information; interprets the actions of others from an ethical perspective.	Separates facts from assumptions in order to distinguish when additional information is needed.	Combines newly acquired facts with the information surrounding the ethical decision being made.	Defends the newly acquired information in terms of its validity to support ethical decision making.	Defends or challenges the ethical decision being made with the support of factual components.
Outcome Element: Demonstrating knowledge of professional codes of ethics	Is aware of the codes of conduct that guide the professional practice of engineering.	Discusses the professional code of ethics applicable to his/her chosen field, and the NSPE code; has a general knowledge of the potential impact of these codes.	Applies relevant aspects of professional codes of ethics when considering possible alternatives decisions or solutions.	Identifies and analyzes components of a decision independently of each other in terms of ethical guidelines.	Formulates components of an ethical decision together in order to act consistent with his/her professional code of ethics.	Evaluates and judgets a situation and possible future actions in terms of his/her professional code of ethics.	Uses personal value system to challenge others to utilize a professional code of ethics during decision-making. Respects others' value systems.
Outcome Element: Evaluating the ethical dimensions of professional engineering and scientific practice	Identifies and defines ethical issues concerning a decision that can impact the individual, the client, the company and/or the public.	Describes ethical issues and how they affect the individual, the client, the company and the public.	Applies ethical decision making "tools" when practicing engineering or science in a professional environment.	Analyzes cost, schedule and risk components in ethical terms when evaluating professional engineering and scientific practice. Performs risk assessments and interpret the results.	Combines cost, schedule and risk components together to make an informed ethical decision.	Evaluates the value and credibility of information and the various sources used in order to make sound judgments.	Questions decision by incorporating the ethical impacts the decision can have on the individual, the client, the company and/or the public.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Demonstrating ethical practice	Uses information to identify knowledge gaps. Recognizes the cost, schedule and risk components of a given situation in terms of their ethical implications.	Explains the consequences of the various ethical components used in practice (cost, schedule and risk) along with that of their professional code of ethics.	Uses knowledge, information, and the perspectives of others to evaluate the impacts (short-term and long-term) when making an ethical decision. Practices team concepts.	Identifies where additional knowledge is needed in order to act competently. Communicates information in a responsible manner. Is aware of the risks to public safety concerns.	Combines ethical components (competence, responsibility, and public safety) of a decision to make an informed ethical choice.	Evaluates and judges a situation in practice, using facts and a professional code of ethics.	Uses personal value system to support actions. Accepts and/or challenges standards.

Outcome G: An ability to communicate effectively (Updated 01/30/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Communicating information, concepts, and ideas effectively in writing	Identifies and repeats standard formats; recalls and reproduces standard grammar and mechanics; recognizes elements of the writing process.	Summarizes and paraphrases accurately; keeps good written records; classifies various audiences and purposes.	Employs the writing process; produces a variety of documents using appropriate formats, grammar, and mechanics; uses discipline-specific conventions including citations.	Analyzes and criticizes arguments effectively; selects appropriate style and content for various audiences and purposes.	Constructs a logical argument using evidence for support. Writes and revises documents appropriate for various audiences and purposes.	Argues effectively and draws conclusions using evidence. Evaluates own and others' logic and organization. Selects appropriate format, content, organization, and tone for various audiences and purposes.	Has confidence using writing as a communication tool. Appreciates the role writing plays in one's academic and professional careers; respects writing as a learning and thinking tool.
Outcome Element: Orally communicating information, concepts, and ideas effectively	Recalls and repeats information in oral presentations, often from memory.	Paraphrases or summarizes information in oral presentations. Restates and/or gives examples when questioned.	Uses appropriate visual aids and presentation techniques to engage audience (e.g. maintains eye contact, modulates voice, does not use distracting gestures); uses process strategies to prepare presentations.	Identifies and selects appropriate material to include in oral presentation depending on analysis of audience and purpose. Analyzes and appraises when questioned.	Plans, prepares and delivers a well-organized, logical oral presentation; reconstructs, explains when questioned.	Listens carefully and responds to questions appropriately. Explains and interprets results for various audiences and purposes.	Has confidence in and respects oral presentations as a communication, thinking, and learning tool; appreciates the role oral communication plays in one's academic and professional careers.
Outcome Element: Graphically communicating information, concepts, and ideas	Recognizes and duplicates graphical conventions.	Selects and restates graphical conventions.	Uses professional graphics in written and oral presentations. Uses appropriate graphical conventions (e.g. formats, captions, titles, axes, legends, etc.). Uses visualization and sketching skills as needed.	Analyzes data using graphical techniques. Illustrates concepts using graphics. Identifies appropriate uses of graphics in written and oral presentations.	Creates effective professional graphics for a variety of audiences and purposes Explains complex concepts through graphics	Argues effectively using graphics. Uses graphics to explain, interpret, and assess information. Evaluates graphical arguments based on logic, evidence, and presentation.	Has confidence in and respects graphics as a communication, thinking, and learning tool. Appreciates the role graphics plays in one's academic and professional careers.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Acquiring and using information from a variety of sources, including electronic retrieval systems	Identifies various information sources.	Summarizes and reports information accurately. Identifies arguments or opinions.	Gathers information from a variety of sources. Uses information to produce technical documents and presentations and solve problems.	Analyzes information. Tests the credibility of information sources. Selects state-of-the-art information in his/her discipline.	Concisely and precisely summarizes and synthesizes information. Effectively assembles information and evidence to support arguments	Reads critically and evaluates the credibility of information sources including the effectiveness of claims and supporting evidence. Discriminates between various audiences and purposes and designs communications appropriate for them.	Values the ability to retrieve and use information. Has confidence in his/her ability to retrieve, use, and evaluate information.

Outcome H: The broad education necessary to understand the impact of engineering solutions in a global and societal context

(Updated 04/11/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Identifying Impacts: <i>This set of attributes deals with the general skill of identifying impacts of engineering solutions, apart from the societal or global knowledge that is used in the process</i>	States the steps in a method for identifying impacts of an engineering solution. Lists several types of impacts an engineering solution might have.	Discusses impacts of historical or “classical” engineering solutions. Describes certain principles governing the types of impacts that engineering solutions may cause. Discusses study abroad experience	Predicts potential impacts of a proposed engineering solution. Interprets potential short and long term impacts of engineering solutions.	Analyzes a specific engineering “failure.” Models the role that unanticipated factors played in the failure.	Combines knowledge of potential impacts into the design and problem solving processes.	Evaluates (trade-off) conflicting / competing values in order to make informed decisions about potential impact of an engineering solution.	

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Understanding the impact of engineering solutions in a societal context: <i>This dimension covers students' knowledge of societal issues – issues associated with the groups of people and their beliefs, practices, and needs. Concepts associated with culture and aesthetics fit into this dimension</i> <i>Example areas of impact include, but are not limited to, environmental, political, and economic.</i>	Describes the key features characterizing an individual's perspective. Defines key terms associated with understanding a societal context including society, culture, and global society. Lists the steps in a method for identifying the societal impacts of an engineering solution. States some differences in needs that result from diversity in society States some ways in which modern society is diverse. Identifies several facets by which an engineered solution impacts modern society (e.g. aesthetics)	Discusses the pertinent features of his/her own perspective (beliefs, practices, etc.). Distinguishes and explains perspectives different from his/her own. Compares various practices to identify similarities and differences. Describes the role that science, technology and engineering have played in the development of modern society. Describes how ideas and customs from other cultures have contributed to his/her discipline and/or modern society. Describes milestones in the evolution of the current "global society."	Uses acquired knowledge to interpret impacts of an engineering solution (i.e., can anticipate impacts). Applies knowledge of the ways in which ideas and customs from other cultures contribute to modern life. Relates this to the identification of the impact of engineering solutions. Employs the perspective of others (group, culture) to identify the impact of engineering solutions.	Differentiates the key attributes of a perspective different from his/'her own. Identifies and analyzes the mechanisms by which alternative practices achieve the same goals. Examines an engineering failure and analyzes the role that unanticipated societal impacts played in that failure.	Synthesizes the perspectives of multiple constituents in order to achieve an acceptable engineering solution. Explains engineering conflicts in terms of differences in perspectives. Collects knowledge of that society in which his/her engineering activity is situated.	Can critically evaluate the strengths and weaknesses of his/her own perspective and the perspectives of others. Can assess conflicting / competing perspectives in order to make informed decisions about engineering solutions.	Accepts perspectives different from his/her own.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Understanding the impact of engineering solutions in a global context <i>Global - referring to issues that cross national boundaries, cultures and/or societies.</i> <i>Example areas of impact include, but are not limited to, environmental, political, and economic.</i> <i>Global context represents the understanding that students need to have in order to reason about engineering solutions crossing these boundaries. The key issues here are the interrelationships among systems and societies and the specific reasoning that must be included in order to make informed, engineering decisions.</i>	States examples of how nations and peoples around the globe are related. Lists the steps in a method for identifying impacts of an engineering solution that crosses cultures or societies. Recognizes the engineering aspects of a global problem. States examples where solving one problem led to the development of other problems (e.g., antibiotics, why things bite back). Lists criteria to be considered when an engineering solution has global aspects (e.g., language, cultural, safety standards, political, etc.).	Discusses how society has become more global. Describes a particular situation in which modern technologies have had a global impact (e.g. global warming, chemicals in environment, telecommunications). Classifies the types of “global” impacts an engineering solution could have. Recognizes examples where solving one engineering problem led to the creation of other related problems (e.g., development of nuclear energy to reduce dependence on fossil fuel resulted in increased nuclear waste; development of antibiotics to treat bacterial infections resulted in the evolution of resistant strains of bacteria).	Predicts potential global impacts, both short and long term, of a proposed engineering solution. Applies knowledge about the interrelationships among peoples, their cultures and their environments to predict potential impacts of engineering solutions. Discovers anticipated and unanticipated “global” impacts in attempted and proposed engineering solutions.	Differentiates the actual impacts of an engineering solution. Infers the relevant groups of people and environmental systems that need to be considered when evaluating an engineering solution.	Combines the potential “global” impacts of engineering solutions to arrive at an overall effect. Formulates the engineering design process to include the learned knowledge of potential impacts.	Evaluates potential “global” impacts in terms of costs and benefits.	Respects the historical aspects of engineering approaches to “world” problems and their impacts. Actively seeks knowledge of the world events which his/her engineering activity likely will be impacted by or will impact.

Outcome I: A recognition of the need for, and an ability to engage in life-long learning (Updated 01/30/00)

Definitions:	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome element: Demonstrating reading, writing, listening and speaking skills	Lists the skills necessary for reading, writing, listening, and speaking.	Gives examples of where the skills for effective reading, writing, listening, and speaking lead to success in life.	Applies the skills necessary for reading, writing, listening, and speaking to each situation (i.e. school, job, everyday life).	Analyzes how the skills facilitate the communication process.	Develops and organizes the skills necessary for reading, writing, listening, and speaking in order to take in information and express it to others in a comprehensive manner.	Evaluates the effectiveness of the skills necessary for reading, writing, listening, and speaking as it relates to the communication process.	
Outcome Element: Demonstrating an awareness of what needs to be learned	Identifies the tools needed in order to conduct research and develop independent learning skills.	Explains how awareness of what has been learned will enhance research and independent learning skills.	Applies what has been learned to an actual project.	Examines what has been learned and point out how learning relates to project outcome.	Integrates learning outcomes.	Assesses the impact awareness has on the amount and quality of learning.	
Outcome Element: Following a learning plan	Defines the elements that go into developing a learning plan.	Selects elements of the learning plan and describe them.	Applies the learning plan to an actual research project or independent learning opportunity.	Analyzes the learning plan for effectiveness.	Develops a learning plan.	Evaluates alternative learning plans for future projects.	
Outcome Element: Identifying, retrieving, and organizing information	Recalls previously learned information.	Discusses the meaning of the information.	Uses the information learned in actual situations.	Identifies how the information is inter-related.	Organizes the information categorically.	Judges the information based on various criteria.	
Outcome Element: Understanding and remembering new information	Memorizes new information.	Converts the new information into own personal mode of understanding.	Applies the new information to an actual situation.	Compares and contrasts new information with previously learned information.	Integrates new information with previously existing information.	Summarizes and evaluates integrated information.	
Outcome Element: Demonstrating critical thinking skills	Memorizes facts, formulas, theories, etc.	Explains facts, formulas, theories, etc. in own words.	Applies the facts, formulas, theories, etc. to everyday situations.	Questions the meaning behind the facts, formulas, theories, etc.	Synthesizes all of the facts, formulas, theories, etc. into a comprehensive way of understanding.	Assesses extent of understanding of skills and ability to use them.	

Outcome Element: Demonstrating ability to reflect on own understanding	Recalls own understanding of information learned.	Identifies the ways in which information is learned.	Illustrates how information is applied in various situations.	Analyzes how well material is being learned and understood.	Modifies mental strategies for better understanding.	Evaluates thinking skills.	
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Outcome J: Knowledge of contemporary issues (Updated 01/30/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Knowledge of contemporary issues <i>Example: Ability to address the major socio-economic issues facing US and world</i>	Lists and describes major socio-economic issues; e.g., global warming; over population; depletion of natural resources; energy and water supplies; nuclear waste and proliferation; environmental pollution; disease; trade; human rights, etc.	Discusses , in-depth, several important issues Summarizes cogent aspects; recognizes consequences; takes and defends a position.	Interprets a specific scenario relative to one or more of these key issues. Discovers or illustrates by example possible implications.	Analyzes an issue from a “systems” perspective. Models (abstract) or breaks down the situation. Experiments with model to draw inferences ; assists in decision making.	Designs a system or strategy that addresses a particular issue in a given scenario or location. Proposes out-of-the-box alternatives. Formulates alternative solutions that consider important socio-economic issues.	Evaluates alternative solutions or scenarios using a series of different socio-economic measures – e.g., economic, quality of life; number of individuals affected; global ramifications; etc.	Accepts limitations of solutions. Challenges differences among alternatives. Respects qualitative dimension of the problems; can view from different perspectives.
Outcome Element: Knowledge of contemporary issues <i>Example: Ability to address political issues at nation, state and local levels</i>	Lists and describes major political issues at national, state and local levels. Lists major candidates – senators, representatives, governors, mayors. Describes their positions on important issues.	Discusses , in-depth, major political issues at national, state and local levels. Summarizes essence of several issues. Takes and defends a position on them.	Examines the ramifications of one or more major political issues on a specific population or cohort.	Analyzes a political issue from a “systems” perspective. Models (abstract) or breaks down the situation. Experiments with model to draw inferences ; assists in decision making.	Designs a system or strategy that addresses a particular political issue relative to a given scenario or location.	Evaluates alternative political solutions or scenarios using a series of different measures – e.g., economic, quality of life; number of individuals affected; political ramifications; etc.	Accepts limitations of political solutions. Challenges differences among alternatives. Respects the qualitative dimensions of the problems; can view from different perspectives.

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Example: Environmental Context: <i>This dimension refers to knowledge of the context of engineering solutions specifically related to geological and ecological issues (i.e., water, forest, and air).</i>	Defines key terms associated with understanding environmental centers including ecosystem, etc. Describes how ecosystems are related around the globe. Lists several of the harmful effects of technology on the environment. Names sources of environmental impact knowledge. Describes cases of technological intervention where environment considerations were paramount. Describes methods to explore ecological and environmental impacts.	Identifies environmental impacts of engineering solutions when asked. Uses knowledge of ecosystem in general to infer how ecosystems are related. Identifies engineering problems with potential environmental impact issues.	Uses info about ecosystems to identify impacts of engineering solutions, among other impacts (when the problem is simply to identify impacts).	Selects the ecosystem-related impacts from among a set of identified impacts in an engineering solution.	Uses ecosystem impacts along with other impacts to create a complete set of impacts of an engineering solution.	Judges the acceptability of the impacts of an engineering solution.	Actively and voluntarily seeks out information about environmental factors in determining impacts of an engineering solution.

Outcome K: An Ability To Use The Techniques, Skills, And Modern Engineering Tools Necessary For Engineering Practice

(Updated 04/11/00)

Definitions	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Valuation
Outcome Element: Using modern engineering techniques, skills, and tools such as computer software, simulation packages, diagnostic equipment, and technical library resources.	Lists available techniques, skills, and tools available to a specific engineering discipline.	Classifies the role of each technique, skill, and tool in identifying and solving engineering problems, studying the performance of existing processes or systems, and/or developing designs.	Uses engineering techniques, skills, and tools including computers to identify and solve engineering problems. Uses engineering techniques, skills, and tools including computers to monitor performance of engineering systems and/or create engineering designs. Uses engineering techniques, skills, and tools to acquire information needed for decision-making.	Compares results from computer software or simulators with system performance or results from alternative calculation methods including heuristics. Selects appropriate techniques and tools for a specific engineering task.	Combines the use of two or more tools and techniques to solve an engineering problem or develop an engineering design. Combines use of engineering tools plus system operating information to find optimal operating conditions. Combines results from heuristic calculations, graphical analysis, and computer simulation to support decision-making.	Evaluates which techniques or tools are most appropriate to complete a specific engineering task. Compares results from several engineering tools to determine which best explains "reality."	Accepts the utility and limitations of engineering tools to identify and solve problems or create engineering designs.