APPENDIX B

Thinking Skill Resources

Bloom's Revised Taxonomy: The Cognitive Process Dimension

Benjamin Bloom and colleagues created the original taxonomy in 1956. Anderson and Krathwohl (2001) revised Bloom's original taxonomy in their book, *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives,* by combining both the cognitive processes and knowledge dimensions. The following table provides examples on how this taxonomy could be applied in the classroom.

Cognitive Processes	Examples
Remember—Produce the right information from memory	
Recognizing	Identify frogs in a diagram of different kinds of amphibians. Find an isosceles triangle in your neighborhood. Answer any true-false or multiple-choice questions.
Recalling	Name three 19th century women English authors. Write the multiplication facts. Reproduce the chemical formula for carbon tetrachloride.
Understand—Make meaning from educational materials or experiences	
Interpreting	Translate a story problem into an algebraic equation. Draw a diagram of the digestive system. Paraphrase Lincoln's Second Inaugural Address.
Exemplifying	Draw a parallelogram. Find an example of stream-of-consciousness style of writing. Name a mammal that lives in our area.
Classifying	Label numbers odd or even. List the kinds of governments found in modern African nations. Group native animals into their proper species.
Summarizing	Make up a title for a short passage. List the key points related to capital punishment that the Web site promotes.
Inferring	Read a passage of dialogue between two characters and make conclusions about their past relationship. Figure out the meaning of an unfamiliar term from the context. Look at a series of numbers and predict what the next number will be.
Comparing	Explain how the heart is like a pump. Write about an experience you have had that was like the pioneers moving west. Use a Venn diagram to demonstrate how two books by Charles Dickens are similar and different.
Explaining	Draw a diagram explaining how air pressure affects the weather. Provide details that justify why the French Revolution happened when and how it did. Describe how interest rates affect the economy.

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Cognitive Processes	Examples
Apply—Use a procedure	
Executing	Add a column of two-digit numbers. Orally read a passage in a foreign language. Shoot a free throw.
Implementing	Design an experiment to see how plants grow in different kinds of soil. Proofread a piece of writing. Create a budget.
Analyze—Break a concept down into its parts and describe how the parts relate to the whole	
Differentiating	List the important information in a mathematical word problem and cross out the unimportant information. Draw a diagram showing the major and minor characters in a novel.
Organizing	Place the books in the classroom library into categories. Make a chart of often-used figurative devices and explain their effect. Make a diagram showing the ways plants and animals in your neighborhood interact with each other.
Attributing	Read letters to the editor to determine the authors' points of view about a local issue. Determine a character's motivation in a novel or short story. Look at brochures of political candidates and hypothesize about their perspectives on issues.
Evaluate—Make judgments based on criteria and standards	
Checking	Participate in a writing group, giving peers feedback on organization and logic of arguments. Listen to a political speech and make a list of any contradictions within the speech. Review a project plan to see if all the necessary steps are included.
Critiquing	After co-developing a rubric for the evaluation of a project, judge how well a project meets the criteria. Choose the best method for solving a complex mathematical problem. Judge the validity of arguments for and against astrology.
Create—Put pieces together to form something new or recognize components of a new structure	
Generating	Given a list of criteria, list some options for improving race relations in the school. Generate several scientific hypotheses to explain why plants need sunshine. Propose a set of alternatives for reducing dependence on fossil fuels that address both economic and environmental concerns. Come up with alternative hypotheses based on criteria.
Planning	Make a storyboard for a multimedia presentation on insects. Outline a research paper on Mark Twain's views on religion. Design a scientific study to test the effect of different kinds of music on hens' egg production.
Producing	Write a journal from the point of view of a Confederate or Union soldier. Build a habitat for local water fowl. Put on a play based on a chapter from a novel you're reading.

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Knowledge Dimension	Examples
Factual Knowledge—Basic information	
Knowledge of terminology	Vocabulary terms, mathematical symbols, musical notation, alphabet
Knowledge of specific details and elements	Components of the Food Pyramid, names of congressional representatives, major battles of WWII
Conceptual Knowledge—The relationships among pieces of a larger structure that make them function together	
Knowledge of classifications and categories	Species of animals, different kinds of arguments, geological eras
Knowledge of principles and generalizations	Types of conflict in literature, Newton's Laws of Motion, principles of democracy
Knowledge of theories, models, and structures	Theory of evolution, economic theories, DNA models
Procedural Knowledge—How to do something	
Knowledge of subject-specific skills and algorithms	Procedure for solving quadratic equations, mixing colors for oil painting, serving a volleyball
Knowledge of subject-specific techniques and methods	Literary criticism, analysis of historical documents, mathematical problem-solving methods
Knowledge of criteria for determining when to use appropriate procedures	Methods appropriate for different kinds of experiments, statistical analysis procedures used for different situations, standards for different genres of writing
Metacognitive Knowledge—Knowledge of thinking in general and your thinking in particular	
Strategic knowledge	Ways of memorizing facts, reading comprehension strategies, methods of planning a Web site
Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Different reading demands of textbooks and novels; thinking ahead when using an electronic database; differences between writing emails and writing business letters
Self-knowledge	Need for a diagram or chart to understand complex processes, better comprehension in quiet environments, need to discuss ideas with someone before writing an essay

Six Facets of Understanding

In *Understanding by Design*, Wiggins and McTighe (1998) detail the Six Facets of Understanding as part of a curriculum design process to help foster and assess in-depth student understanding.

Facet of Understanding	What Students Do	Performance Verbs
Explanation	• Provide thorough, supportable, and justifiable accounts of phenomena, facts and data • Provide sophisticated and apt explanations and theories, which provide knowledgeable and justified accounts of events, actions, and ideas.	demonstrate, derive, describe, design, exhibit, express, induce, instruct, justify, model, predict, prove, show, synthesize, teach
Interpretation	• Tell meaningful stories • Offer apt translations • Provide a revealing historical or personal dimension to ideas and events • Create interpretations, narratives, and translations that provide meaning	create analogies, critique, document, evaluate, illustrate, judge, make sense of, provide metaphors, read between the lines, represent, tell a story of, translate
Application	• Use knowledge effectively in new situations and diverse contexts	adapt, build, create, test, de-bug, decide, design, exhibit, invent, perform, produce, propose, solve
Perspective	• See and hear points of view through critical eyes and ears • See the big picture • Reveal a critical and insightful point of view	analyze, argue, compare, contrast, criticize, infer
Empathy	• Find value in what others might find odd, alien, or implausible • Perceive sensitively on the basis of prior direct experience • Able to identify with another person's feelings and worldview	assume role of, be like, be open to, believe, consider, imagine, relate, role-play
Self-Knowledge	• Have self-knowledge • Perceive the personal style, prejudices, projections, and habits of mind that both shape and impede one's own understanding • Be aware of what is not understood and why understanding is so hard • Understand how one's patterns of thought and action inform, as well as prejudice, understanding	be aware of, realize, recognize, reflect, self-assess

Compiled from Wiggins and McTighe's *Understanding by Design* (1998) and *The Understanding by Design Handbook* (1999), ASCD.

Web Resources for Models of Thinking

Bloom's Taxonomy of Thinking Skills

Bloom's Revised Taxonomy
http://coe.sdsu.edu/eet/articles/bloomrev/index.htm

Task Oriented Question Construction Wheel Based on Bloom's Taxonomy
http://coe.sdsu.edu/eet/articles/bloomrev/index.htm

Learning Domains or Bloom's Taxonomy
www.nwlink.com/~donclark/hrd/bloom.html

Applying Bloom's Taxonomy
www.teachers.ash.org.au/researchskills/dalton.htm

Marzano's Dimensions of Learning

Applying Standards-Based Constructivism: A Two-Step Guide for Motivating Students — Marzano's Dimensions of Thinking/Learning
www.learnercentereded.org/new/marzano.htm

Dimensions Of Learning
www.dsea.org/teachingtips/tips/dimensionlearn.html

Costa and Kallick's 16 Habits of Mind

What are Habits of Mind?
www.habits-of-mind.net/whatare.htm

A Thinking Pedagogy: Habits of Mind
www.i-learnt.com/Thinking_Habits_Mind.html

Habits of Mind – The Grange P-12 College
www.thegrange.vic.edu.au/home/thinking/HoM/

Wiggins and McTighe's Six Facets of Understanding

Applying Standards-Based Constructivism: A Two-Step Guide for Motivating Students — Understanding By Design
www.learnercentereded.org/new/understandingbydesign.htm

Teaching for Understanding
www.glencoe.com/sec/teachingtoday/educationupclose.phtml/49

Higher-Order Thinking Skill Resources on the Web

Higher Order Thinking Skills Question Templates
http://intranet.cps.k12.il.us/Standards/Programs_of_Study/Higher_Order_Thinking_Skills_Question_Templates.pdf

Effective Teaching: Improving Thinking
http://ltag.tased.edu.au/effectteach/Thinking/index.htm

Extending Children's Special Abilities – Strategies for Primary Classrooms
www.teachers.ash.org.au/researchskills/dalton.htm

Quellmalz Framework of Thinking Skills
http://intranet.cps.k12.il.us/Standards/Programs_of_Study/Quellmalz_Framework_of_Thinking_Skills.pdf

What is higher order thinking?
http://www.selu.edu/Academics/Education/TEC/think.htm

Critical Thinking & Problem Solving Skills
http://falcon.jmu.edu/~ramseyil/critical.htm

Activities at Various Cognitive Levels of Learning
http://ceaspub.eas.asu.edu/MAE-EC2000/blooms.htm

The Quest for Higher Order Thinking Skills
http://fic.engr.utexas.edu/how/files/FICdocs/Achieving%20Higher%20Order%20Thinking%20Skills.pdf

Appendix B References

Anderson, L., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives.* New York: Longman.

Wiggins, G., & McTighe, J. (1998). *Understanding by design.* Alexandria, Virginia: Association for Supervision and Curriculum Development.

Wiggins, G. & McTighe, J. (1999). *The understanding by design handbook.* Alexandria: Association for Supervision and Curriculum Design.