BODY OF KNOWLEDGE MODEL

Revised March 2014

The National Conference on Weights and Measures Professional Development Committee is proud to present this Body of Knowledge Model for use in documenting the learning objectives for the NCWM Professional Certification Program.

The idea for this model began with a grassroots movement of weights and measures educators who wanted to reverse deteriorating levels of quality and uniformity in education of weights and measures officials. The Committee chose to shift from the current textbook/topic approach in education to one that focuses on identifying desirable student outcomes articulated in ways that permit objective measurement of achievement. The model presented here is the result of efforts of PDC committee members and has made extensive use of the California Core Competency Model for the First Course in Accounting. That model was developed by the California Society of CPA's Committee on Accounting Education and was released in July 1995. The competency based concept and format for our model draws a great deal from that work.

The main focus of this revision was to revise terminology in the document to more closely mirror current usage in the fields of education and certification. For example, the term "curriculum" in the Accounting model is being replaced with "body of knowledge." The terms "competency" and "milestone" have been replaced with the terms "terminal objective" and "learning objective" respectively. It should also be noted that organizationally, the Committee has chosen to break the body of knowledge down into modules, or essentially courses, and will use the term "curriculum" to refer only to the list of courses.

The Committee will work with subject matter experts in the profession to use this model to articulate the expected outcomes of education and thus set a uniform standard that is developed through consensus. We hope this model will produce clearly stated learning objectives that will direct your weights and measures training, and will provide measureable standards that can form the basis of a robust certification program.

The hours of time volunteered for this project is an impressive example of professional volunteerism at its best. Even more impressive is the fact that when conflicts arise, committee members search for creative solutions that meet the needs of more than one point of view. Clearly, weights and measures educators consistently subordinated their individual views of the project to the greater good and for the improvement of education.

THE MISSION

The mission of this Committee is to improve the quality and uniformity of education within the Weights and Measures Profession. Since the state jurisdictions are such an integral part of the weights and measures education, our stated mission is to identify uniform, measureable learning outcomes for use in planning and delivering education endeavors. It will be up to each jurisdiction to determine how this will be implemented. The use of a certification based on a consensus standard will provide the means toward the uniformity we all desire.

GENERAL PHILOSOPHY ABOUT HOW TO USE THIS MODEL

Identifying learning objectives is an important step in the process of improving weights and measures education. Our intention is *not* to develop a "national lesson plan" for use by weights and measures trainers. Instead, we want individual states to be creative in implementing the common set of learning objectives described using this *model.* Moreover, we hope each state program will develop a set of outcomes and special competencies that will reflect the unique perspective of its state and the special needs of its students.

How training officers help students master these outcomes and competencies and how they simultaneously measure student mastery are equally important tasks. The Committee is also working with NIST Office of Weights and Measures on the issue of implementation in other documents. Thus, our philosophy encourages diversity. Although we want students to attain the educational objectives of the weights and measures education program, we do not expect them to attain these objectives in a particular prescribed manner.

The model is a "living document and it will be periodically re-evaluated to consider the evolving content.

THE PROFESSIONAL DEVELOPMENT COMMITTEE MEMBERS (2007)

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DEFINITIONS

The Body of Knowledge is a description of the knowledge and skills that are specific to an area of human activity, like the profession of weights and measures. The term can be used broadly to describe the knowledge and skills for the entire scope of activities within the profession, or narrowly to define a finite subset for a particular activity within the profession. The body of knowledge (BOK) for our use will consist of a system of modules organized in a hierarchy.

A Module is a document that defines a set of terminal objectives with their respective learning objectives that are common to a limited and specific area of responsibility within the profession, i.e. a subset of the Body of Knowledge. A module will contain terminal objectives and learning objectives related to the specific area of responsibility.

The Curriculum is the list of the Modules within the Body of Knowledge.

A Terminal Objective is "what" students are expected to achieve, stated in general terms. A terminal objective will have multiple learning objectives.

A Learning Objective describes "how" students can demonstrate meeting some part of the terminal objective. These will include specific activities designed to test that the terminal objective has been met.

> Think of a terminal objective as an end and a learning objective as a means to that end. *Terminal Objectives are the knowledge and skills required. Learning objectives are the specific activities used to measure a student's mastery of the knowledge/skills in the terminal objective.*

The learning objective approach is different from the traditional textbook/ topic approach to instruction. First, the choice of a textbook no longer dictates the organization and coverage of the course. Instead, the learning objectives become the driver and the textbook becomes their vehicle. A related difference is that the course is driven by an output measure (learning objectives) rather than an input measure (textbook/topics). Finally, instructors more clearly know the expected student outcomes and can be creative in choosing the precise activities they will use to deliver instruction.

STEPS IN IMPLEMENTING THE MODEL

The intent of the Committee is to promote the widespread acceptance of essential student learning objectives, while encouraging individual programs to implement these objectives in ways that best suit their own students. The following steps are used to evaluate progress in implementing this system for any given module:

STEP 1: break the wide range of material within the profession in to modules in a tree-like structure, or hierarchy, to manage the standards. (See either the Curriculum Outline or the Curriculum Work plan documents on the PDC pages of NCWM website.)

STEP 2: For each module, select a small group of subject matter experts to prepare an initial draft.

STEP 3: The small group begins by brainstorming expected student outcomes (knowledge and skills) appropriate to the subject area of the module to identify the necessary terminal objectives. These are then organized in a logical order of presentation.

STEP 4: The group then creates the related learning objectives for each terminal objective.

STEP 5: The draft is circulated to a wider group of subject matter experts for review, comment and editing to reach consensus. The review is aimed at ensuring that the objectives in the module are appropriate for the subject area and express that correct cognitive level in the expectations of the learning objectives.

STEP 6: The final version is approved by the PDC Committee and posted on the NCWM website, where it can be used by instructors in planning training efforts and used by the NCWM to create certification exams.

CHARACTERISTICS OF WELL-WRITTEN LEARNING OBJECTIVES

A well-constructed terminal objective has the following characteristics:

- it expresses one objective (The objective should be narrow in scope, such that there are generally between two and eight learning objectives. If necessary, break the terminal objective into multiple objectives to keep the number of learning objectives manageable.)
- it is specific

A well constructed learning objective has the following characteristics:

- it expresses one objective
- it uses a concrete verb to specify the desired activity that must be performed by the student to demonstrate competency

Example (Taken from the Module on Static Electronic Weighing Systems, General):

1. Classes, Tolerances and Performance requirements for Scales with a Class Mark

   A weights and measures professional should understand the classification system for static scales and be able to apply the performance standards under each class. To demonstrate this, the professional can:

   1.1. Explain how the basic tolerances, repeatability tolerances, agreement requirements, and General Code abnormal performance requirements all work together to specify limits to deviations in scale performance.
   1.2. Review how the concepts of accuracy, repeatability, linearity and hysteresis relate to scale performance.
   1.3. Describe the organization of accuracy classes for marked scales as specified in Tables 3.
   1.4. Explain how scale class is related to typical application in Table 7a in the Scales Code.
   1.5. Decide if a scale conforms to the class declared by the manufacturer.
   1.6. Decide if a given scale is suitable for weighing certain commodities based on Table 7.a.
   1.7. Compute tolerances for any class marked scale as per Table 6 of the Scales Code.
   1.8. Illustrate how to find either the acceptance or maintenance tolerance for any load on a scale given the scale class, capacity and division size.
   1.9. Illustrate how repeatability requirements apply to static scales.

Note that the terminal objective deals only with one subject i.e. classification system for scales. Also note that learning objectives 1.1 to 1.9 are specific and each begins with a concrete verb that defines a level of expectation. For example, the verbs explain, review, and describe require understanding of the material, while decide, compute and illustrate require ability to apply what you know.

Blooms Taxonomy is an accepted educational description of the cognitive skills involved in learning. It is used to describe how people gather and use knowledge in six cognitive levels; knowledge, understanding, application, analysis, integration and evaluation. In defining learning objectives for any subject you use action verbs consistent with the cognitive level of that knowledge or skill.

INVENTORY OF CONCRETE VERBS DENOTING ACTION TAKEN IN COMPETENCIES

The following suggested verbs are arranged in the six cognitive domains identified in Bloom's Taxonomy.

1. Knowledge		**2. Comprehension**		**3. Application**	
arrange	order	classify	record	apply	interpret
define	recognize	describe	report	choose	operate
duplicate	relate	discuss	restate	compute	practice
label	recall	explain	review	decide	schedule
list	repeat	express	select	demonstrate	sketch
memorize	reproduce	identify	tell	employ	solve
name		indicate	translate	engage	transfer
		locate		illustrate	use

4. Analysis		**5. Synthesis**		**6. Evaluation**	
analyze	differentiate	arrange	organize	appraise	evaluate
appraise	discriminate	assemble	plan	argue	judge
calculate	distinguish	collect	prepare	assess	predict
categorize	examine	compose	present	attach	rate
compare	experiment	construct	propose	choose	score
contrast	inventory	create	setup	compare	select
convert	question	design	suggest	debate	support
criticize	test	formulate	summarize	defend	value
diagram		justify	write	estimate	
		manage			