



TAACCT Subject Matter Expert Curriculum Review

Laboratory Technology Associate of Applied Science Degree (AAS)

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Summary: We have reviewed the Laboratory Technician (LBT) Program leading to an AAS degree at Waubonsee Community College and find it to be an outstanding program. The program is of an appropriate level for a two-year program and with content that is modern, up-to-date, and prepares students for successful entry-level employment as laboratory technicians in general chemistry and scientific laboratories. This review has focused on the subject matter in courses specifically designated as curriculum that was developed as part of a TAACCT-funded project. Specifically these courses are:

LBT100 Laboratory Safety	LBT260 Environmental Labs
LBT101 Fundamentals of Lab Technology	LBT270 Food Analysis Labs
LBT221 Lab Applications of Microbiology	LBT280 Current Issues in Chemical Labs
LBT251 Lab Instruments I	CHM202 Biochemistry
LBT252 Lab Instruments II	

In addition, both the overall program requirements and the recommended course sequence were reviewed. The results of our review are shown in the following pages grouped by specific categories relating to the overall program and rated as exceptional, very good, good, or ineffective, with detailed comments in each section.

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March 29, 2016

Date

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Review scale definitions:

Exceptional: Review component is a “best practice” and represents a model for replication.

Very good: Review component is complete and effective.

Good: Review component is adequate but presents opportunities for improvement.*

Ineffective: Review component is weak and in need of significant improvement.*

* A rating of Good or Ineffective requires a comment suggesting the appropriate opportunity or need for improvement.

Program/Student Learning Outcomes and Program Map	Exceptional	Very Good	Good	Ineffective
Effective program structure (prerequisites, course sequence, delivery methods, classroom/laboratory blend, stackable credential-structure provide a clear, logical “map” to completion for adult students)	x			
Outcomes aligned to occupational focus (industry skills and standards)	x			
Outcomes clearly stated	x			
Outcomes introduced/reinforced effectively	x			

Comments / Recommendations:

The new Laboratory Technician (LBT) program at Waubensee Community College is an exceptional example of a 2-year degree that focuses on preparing students for employment in science laboratories. The Program is heavily centered on chemistry skills, with supplemental training in microbiology, biochemistry, math, and communications. The content and sequence of learning objectives follow a logical, well-designed path that will provide graduates with a sound foundation in laboratory skills required by today’s modern chemists. The program exhibits excellent balance between lecture (theory) and laboratory (hands-on skills). This program will challenge students, requiring significant effort and discipline to successfully complete this degree. Students who follow and complete the program as outlined will graduate with a strong competence level as laboratory technicians and be highly competitive in the job market.

Effective program structure:

It is always challenging to compress all of the desired training for a science-oriented degree into the time available to students in an undergraduate educational setting. In this case, the development team has done an excellent job of identifying the most important skills and learning objectives and squeezing them into 60-65 semester hours, while still allowing some flexibility for students in their relatively short two years (four semesters) available. It is easy to identify more experiences that would be “nice” for students to have during their program, however, the new degree as described contains the important, foundational learning objectives that students need for entry-level employment in a variety of laboratories. Students who complete the program will be well-prepared to learn new techniques and specialized analytical methods that they will encounter where they work. All technology changes over time and an important aspect of college training is to prepare students so they can embrace and understand the basis of new technologies that will emerge during their careers. This LBT program provides this foundation.

Outcomes aligned to occupational focus:

The DACUM Research Chart for Laboratory Technician lists a number of panel members who represent a wide range of industries. These industries range from water treatment to coatings and foods to fragrances. It is clearly apparent in the course content developed for this degree that thoughtful input was received from industry. The types of testing and instrumental techniques that are taught are the foundational aspects of modern industrial laboratories. The concepts of quality assurance, careful record keeping, communication skills, and safety further validate the close connection with industry that the development team had during the design of this program. Even the field trips to let students see first-hand laboratory operations exhibit the importance they place on engaging students in a strong occupational focus throughout their training.

Outcomes clearly stated:

In virtually every unit and module of this LBT degree program, the objectives are clearly stated. Most of the modules are organized in such a way so that students clearly understand the link between the stated objectives and their learning activities.

Outcomes introduced/reinforced effectively:

Some learning objectives and outcomes are repeated multiple times in various courses throughout the degree program. For example, safety concerns are an important part of almost every laboratory activity and are clearly explained in each one. The use of laboratory notebooks and keeping careful records of their work is encouraged and reviewed by instructors throughout the program. Computer skills are also built into many learning activities, reinforcing the computer literacy skills required in one of the early prerequisites for the degree program. Electronic discussion groups teach both computer skills and modern communication skills throughout the program in almost every course.

Course Objectives	Exceptional	Very Good	Good	Ineffective
Appropriate to course level	x			
Clearly stated from student perspective	x			
Measurable	x			
Address/support one or more outcome	x			

Comments or recommendations:

The course objectives in this LBT program are exceptionally clear and easy to follow from a student perspective. (The concepts described in individual objectives may be new to the student, but each one clearly describes what the student is expected to learn or accomplish by completing an activity.) It is clear that faculty who wrote these objectives are experienced teachers and knowledgeable in their respective fields. The masterful writing and clarity attest to their individual expertise and experience in teaching.

Appropriate to course level:

The objectives are traditional, in that are standard historically-proven objectives that follow a time-tested progression from concept to concept and they are appropriate for the level of the course.

LBT100 Lab Safety is a stellar example of clear objectives, associated activities, and quizzes for each class day. Students have access to lecture presentations online, example government regulations, and clear expectations for students.

LBT221 Microbiology depends heavily on the accompanying text book to achieve all 19 course objectives. While this is a very different structure from LBT100, it is meant for more advanced students who have had more preparative courses as outlined in the LBT program. The assessment tools are not available for review, but the logical approach to the subject matter, its organization, and clarity are excellent.

LBT 270 Food Analysis is my favorite course. It no doubt has the potential to be the most popular course in this degree program. With five prerequisite courses, this course is one that students will be able to draw on prior skills and learning to apply their knowledge to the testing of foods. Hence, the objectives and learning activities are appropriately gauged for more advanced students.

Clearly stated from student perspective:

Most all of the course objectives are easily understood by students. For example, in LBT270 Food Analysis, one of the texts, "Product Testing: The Chemistry of Ice Cream," would no doubt be a most popular text among students. The only suggestion I could offer for this course is to have a taste test after lab is over.

Measurable:

Students are clearly informed about how they will be graded. For example in one course a variety of measurable outcomes are explained: assignments/projects, class discussions/participation, clinical/studio/lab performance, collaborative work, examinations, quizzes and tests. Similar measurable activities are listed in other courses as well.

Address/support one or more outcome:

It is clear that every class and course objective was designed with the overall program outcome in mind. For example, LBT100 is the introduction to the whole program and the first course objective stated in the syllabus is "practice professional workplace behavior" and is followed by "work safely with chemicals, using all of the appropriate personal protective equipment and safety equipment". Right from the beginning, outcomes are clearly in place to support the overall program. A spreadsheet document provided by Waubonsee clearly shows which classes fill specific program objectives. Review of these courses confirmed that desired outcomes and stated objectives were present in the respective course outlines and syllabi. Along with every objective being represented, there is an appropriate amount of effective redundancy in the coverage of program objectives. This will help reinforce the importance of these objectives.

Module or Unit Objectives	Exceptional	Very Good	Good	Ineffective
Clearly linked to course objectives	x			
Address one or more course objective	x			
Clearly stated from student perspective	x			
Measurable	x			
<p>Comments or recommendations: Overall, we found the program to do an excellent job at defining each module and unit objectives and gave students multiple opportunities to view and review them. They were included directly on the course website and referenced often within each day's work.</p> <p>Address one or more course objective: Modules we reviewed showed a clearly-organized approach to addressing multiple course objectives. For example, writing reports of laboratory activities requires a solid understanding of written communication skills, good English language skills, mathematical calculations, and conclusions. Additionally, it was noted that program goals and objectives were well-represented in multiple courses. For example, the concept of "Understanding Company Policy" is included in multiple LBT courses (LBT101, LBT221, LBT251, and LBT252). Similar skills and knowledge DACUM-charted objectives are contained across multiple courses.</p> <p>Clearly stated from student perspective: Most of the unit objectives are easily understood by students. For example, in LBT101, the first day's objective includes to "demonstrate an understanding of professional behavior." The objectives are clearly defined and to the point which is needed for students.</p> <p>Measurable: The unit objectives are included for each day's work which is assessed either by an experiment, a quiz, or builds into a discussion. All of these avenues are utilized as metrics of measurement for the objectives and are tied well into each day's objectives.</p>				

Instructional Materials and Lab Resources	Exceptional	Very Good	Good	Ineffective
Support stated course and module or unit learning objectives	x			
Meet/reflect current industry practices and standards	x			
Provide options for multiple learning styles		x		
Resources/materials are cited properly	x			
Evidence of innovation to support adult learner success	x			

Comments and recommendations:

Overall, the program has done an excellent job at preparing high quality instructional materials and lab resources. The lecture/course materials are well made and mostly all setup for the coming semesters. New faculty could jump into these programs on day one and be successful in the class. The laboratory resources are beyond what would normally be expected for a typical community college program and will serve their students better for it.

Support stated course and module or unit learning objectives:

LBT280 Current Issues in Chemical Labs appears to be a capstone-type experience and learning opportunity for students in this program. The course objectives for LBT280 include “demonstrate correct use of the main equipment found in a chemical lab, conduct analyses of samples to determine active ingredients and the percentage purity..., complete accurate and clear lab reports, journals, and research papers; demonstrate an understanding of state and federal regulations and current trends and issues in this field.” Certainly, these objectives are for more advanced students who are approaching graduation. They clearly describe expectations that students will be able to properly operate a variety of laboratory instruments. They are also expected to understand how to utilize the chemical literature as a resource for analytical methods used in the laboratory. This is an outstanding aspect of training that is often not taught to 2-year students, but is invaluable to their future success.

Meet/reflect current industry practices and standards: The Waubonsee Community College has obtained many high end analytical instruments that reflect well what is needed in industry, including an ultraviolet/visible light spectrometer, gas chromatograph/mass spectrometer, and liquid chromatograph. Additionally, they have invested in some portable field-based instrumentation for the environmental lab. We encourage future investment into more portable instrumentation.

Provide options for multiple learning styles:

It is difficult to offer multiple learning styles in a chemistry laboratory. Instrumentation and procedures are often complex and must be followed exactly to obtain accurate results. Failure to follow a procedure exactly may result in injury or failure of the test method. An integral aspect of training for laboratory technicians is to be exact in following directions and procedures. Hence, there is little room for multiple learning styles. To Waubonsee’s credit, a number of discussion groups and other types of activities are offered in selected courses to students where possible in the discussion of lecture topics. These types of activities allow students to express themselves and share ideas with their fellow students and professors.

Resources/materials are cited properly:

Throughout the learning materials, all appropriate credit is given to sources of learning materials. For example, the biochemistry (CHM202) module on carbohydrates cites every single drawing used in the lecture materials. It is easy for the reader to continue their readings by simply linking to the source materials.

Evidence of innovation to support adult learner success:

Typically, older students who are “returning” to school have extracurricular responsibilities off campus to a greater extent than younger, more traditional students. The extensive on-line components of many of the LBT courses provide these non-traditional students options to study and participate in discussions from off campus and during late-night hours when they can find time to focus on their studies. While these students still need to come to lab and traditional lectures, they can still accomplish a significant portion of their required activities through the online components of their courses.

Learning Activities	Exceptional	Very Good	Good	Ineffective
Promote achievement of stated module or unit objectives	x			
Materials are presented in a way that students understand purpose and use in industry settings		x		
Provide opportunities for interaction and active learning	x			
Provide options for multiple learning styles	x			
Linked to current industry practices and standards		x		
Evidence of innovation to support adult learner success		x		

Comments and recommendations:

Overall, we found the learning activities in the classes effective and valuable for their students. The connections to industry needs to be more prevalent in both lecture and laboratory, especially since this is an AAS program. Additionally, much of the classes were dependent on a textbook which was not made available to the reviewers, so connection to the text and the quality of the text could not be evaluated.

Promote achievement of stated module or unit objectives:

Because unit objectives are stated very clearly, it was easy to find connection between daily learning activities and the modules they help achieve. A great example of this is in LBT252. The unit objectives are stated at the beginning of each lab assignment in measureable language such as “explain the relationships between electronic excitation/relaxation to absorption/emission and to appearance of the associated atomic spectra”. The following class content directly addresses these concepts, both in lecture and in lab, including an experiment on the analysis of multivitamins for zinc and copper through atomic absorption/emission.

Materials are presented in a way that students understand purpose and use in industry settings:

While the program does a great job at preparing students with the needed knowledge of analytical tools, lab techniques, and fundamental understanding, the connection to industry wasn't always apparent. It is apparent that the faculty and program directors have a clear understanding of what is important to the local and broader industry, but the student may miss this in their education. This could be remedied by making sure that in individual lectures/labs that a connection is drawn by the instructor verbally, but better than that would be to have it included in official course documentation. A “why does this matter” or “how is this used in industry” section on individual labs/presentations would help highlight the fact that each day is building directly to their students' futures in industry.

Provide opportunities for interaction and active learning: The labs within this program offer great opportunities for interaction and active learning. As one example, LBT260 includes many field based labs which will engage students and teach them important techniques that many programs lack. In LBT 252, there are some labs which are given without step-by-step instructions, requiring students to “think on your feet in terms of safety and experimental design.” This is a wonderful example of requiring students to think critically and actively work with one another.

Provide options for multiple learning styles:

Typical classes provide many opportunities for learning which all complement each other, including PowerPoint presentations, selected sections from the course text, and laboratory exercises. Additionally, there are many opportunities for self-assessment within each class module including problems from the text, discussion board assignments, quizzes, and prelab and lab reports. All of these opportunities work well to accommodate multiple styles of learning.

Linked to current industry practices and standards:

The learning activities that have been created by the Waubensee program are certainly up to the standards placed by typical chemical industry for an AAS level graduate. Stress needs to be placed on making sure that students are aware of what these standards are and why they are important within their individual classes, so that it is not just taken for granted. Sometimes the reason for using specific protocols were not explained to students. It would be helpful to include an explanation regarding why some protocols are used for certain types of samples that may reflect industry standard(s).

Assessment Tools/Criteria for Evaluation	Exceptional	Very Good	Good	Ineffective
Measure stated learning objectives and link to industry standards		X		
Align with course activities and resources	X			
Include specific and descriptive criteria for evaluation of student work/participation	X			
Sequenced throughout instructional period to enable students to build on feedback	X			
Varied and appropriate to content	X			
Provide opportunities for students to measure their own learning progress	X			

Comments and recommendations:

Almost all learning activities are accompanied an assessment tool in the form of a quiz, exam, or grading of submitted assignments. The vast majority of these measurement tools are based upon the professor providing a grade for specific questions.

Measure stated learning objectives and link to industry standards:

The degree contains clear learning objectives that provide a strong foundation for learning skills and techniques needed in today's laboratories. However, while students will learn these and be well-prepared, the students themselves may not understand the link to industry standards until they begin working as employees in a non-college laboratory. It is clear that the faculty who wrote and teach these courses for this program do understand this linkage and the importance of the skills their students need to succeed in their careers. LBT 270 Food Analysis utilizes an excellent laboratory text, "Food Analysis Laboratory Manual, 2nd Ed., S. Suzanne Nielsen," wherein the most current, up-to-date methods for food analysis are given. The examples and activities are taken directly from standard methods approved by expert groups such as the Food Codex, AOAC Official Methods, and other FDA-recognized methods of analysis. The microbiology course (LBT221) also describes standard methods that are used extensively in manufacturing and processing of foods, personal care products, and drug industries.

Align with course activities and resources:

Although a site visit to Waubensee Community College was not possible given the time and resources for this review, it is clear from the laboratory activities that the college has the resources to support the laboratory activities described in these courses. For example, the instrumental courses discuss the procedures for use of various chromatographic instruments and spectrometers. From reading the lab activities for these courses, it is apparent that students will have the opportunity to get hands-on learning with the instruments described. The microbiology (LBT221) and biochemistry (CHM202) laboratory activities also would not be possible without access to the instrumentation and equipment necessary for students to conduct the experiments described.

Include specific and descriptive criteria for evaluation of student work/participation: Many classes include discussion assignments with clear and specific criteria for their evaluation. Additionally, in classes with a lab, including LBT251, a lab notebook is required which also have clear and specific criteria for their evaluation.

Sequenced throughout instructional period to enable students to build on feedback: Many classes are given daily assignments in which they may be initially evaluated and build on feedback from these assignments. Additionally, these classes include unit exams which can also be used for formative evaluation for students in preparation for a class final.

Varied and appropriate to content:

A significant number of the LBT courses have multiple aspects to their assessment tools. Some place more weight on formal exams, while others depend more on daily or frequent short quizzes. In addition, student participation in discussion groups contributes to their assessment. This varied approach to testing and assessment provide students with multiple ways to show their performance, which encourages students who perform better in non-traditional testing.

Provide opportunities for students to measure their own learning progress:

The vast majority of learning activities and assignments are presented through Blackboard, which provides a list of all student scores and points earned throughout the semester. Students also have excellent communication tools to interact with their professors for more detailed explanations of their progress. There are not a lot of learning activities described in which students can "practice" or "test" themselves outside of the formal tests and quizzes.