

# The University of Texas at Dallas



*Assessment Workbook:  
A Resource for Departments and Programs*

JoyLynn Hailey Reed

[joylynn@utdallas.edu](mailto:joylynn@utdallas.edu)

SACS Leadership Team

[sacs-team@utdallas.edu](mailto:sacs-team@utdallas.edu)

March 1, 2006

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UTD Assessment Workbook: A Resource for Departments and Programs

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## Introduction

With a new President, a new strategic plan, a growing student population, and an expanding campus, UTD stands poised to enter its most exciting phase yet. This workbook contributes to UTD's march toward becoming one of the nation's premier, public research universities by introducing an important, research-based shift in pedagogical strategy that provides us a means for documenting our increasing commitment to remaining current in both our own research and our focus on student achievement, accountability, and institutional effectiveness. This workbook is designed to supply tools to assist all instructional staff in developing effective student learning goals, program and course objectives, and student learning outcomes. The workbook also identifies specific, targeted strategies for measuring the success of each of those targets. With an initial emphasis on academic programs, UTD's assessment-based approach will be expanded over the next three years to include administrative and educational support programs.

Simply stated, assessment is a means to an end. Our goal is to demonstrate our commitment to our students and their success as well as to develop a research-orientation to our own teaching. Through the development of carefully targeted programmatic goals and objectives, we as a faculty can enhance the image of the university, develop effective strategies for exceeding program review and accreditation standards, and provide our students and community with a quality education that can be measured.

Assessment, at its core, is a systematic and recurring cycle of setting goals, measuring the degree to which those goals are achieved, and using the results of those measurements to make informed choices about how to improve performance of both students and faculty alike. Beginning in the spring term of 2006, UTD offers a method for developing and tracking such objectives, goals, measurements, and plans. Using WEAVEonline, a product developed by Virginia Commonwealth University, faculty will be able to walk through the process VCU labeled as WEAVE:

**W**rite expected outcomes  
**E**stablish criteria for success  
**A**ssess performance  
**V**iew assessment results  
**E**ffect improvements.

The WEAVE acronym is a simple mnemonic device for remembering the steps involved in our assessment efforts. These steps can be reduced further, rather easily, to three basic questions: (1) What are we trying to do? (2) How well are we doing it? (3) How are we using what we learn about our process and results to guarantee that we can improve on it further?

The first question—What are we trying to do?—is the beginning of the assessment process. It is here we define the goals, one of which is to improve our own effectiveness. Because evaluation is formative, our assessment strategies begin with a target that leads to a process providing feedback. That feedback can be evaluated to determine how to improve further. The second question—How well are we doing it?—requires an answer more detailed than mere end-of-course grades. Rather, the kinds of assessment activities required focus on specific, targeted goals and objectives that are derived from the answers to the first question.

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Assessment activities, for our purposes, focus on programs and units, not on individual faculty members. As such, assessment targets and goals can cross sections of courses or even departments within a school. For example, a target of assessment could be conducted on the prerequisite, lower division courses in a major to determine whether they are adequately preparing students for their junior and senior-level studies.

The third question—How are we using the results?—is what constitutes the “closing the loop” part of the process: It is here faculty members draw upon their skills as researchers and academicians to reach conclusions not only about the effectiveness of what has occurred but also about the small or large changes that must be effected to improve future results. It is also the answer to the third question that provides the most effective arguments for desired changes in curriculum, funding, staffing, and/or technology.

Just as our focus on assessment will identify programs, not faculty members, our assessment strategies also focus on groups of students, or classes of students, not individual students. While we clearly evaluate the work of individual students when we assign a grade, assessment asks that we go beyond the grade and focus on the degree to which a group of students meet a target of: a learning objective, or a learning goal. Individual students may perform well or poorly on any given task; it is the performance of the group that helps us evaluate our success in providing a quality education within our own disciplines.

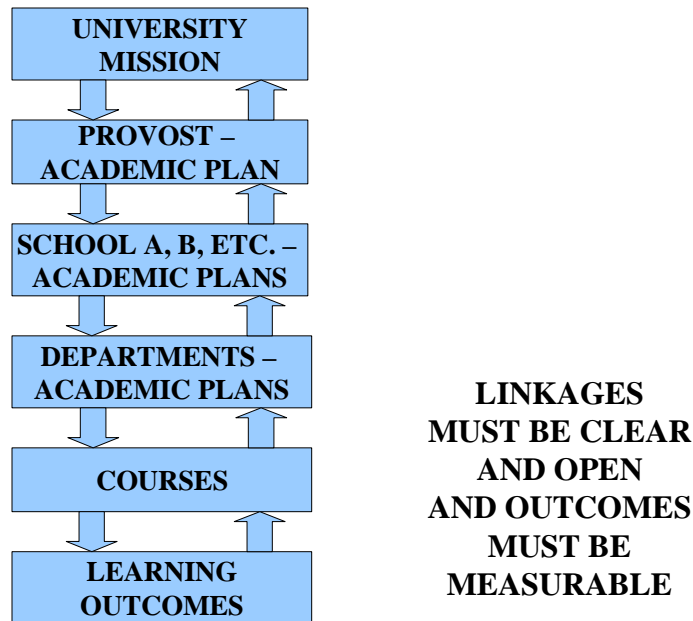
As our Strategic Planning cycle continues to evolve over the years, we must always focus our programmatic goals on both the needs of the students and the mission of the university overall. To that end, our program goals and objectives need to align with UTD’s mission. The 2006-2011 mission of UT Dallas supports the vision statement: To be one of the nation’s best public research universities and one of the great universities of the world.

*UTD serves the Metroplex and the State of Texas as a global leader in innovative, high quality science, engineering, and business education and research. The University is committed to*

- *Producing engaged graduates, prepared for life, work, and leadership in a constantly changing world*
- *Advancing excellent educational and research programs in the natural and social sciences, in engineering and technology, in management, and in the liberal, creative, and practical arts*
- *Transforming ideas into actions that directly benefit the personal, economic, social, and cultural lives of the citizens of Texas.*

To be consistent with our mission statement, it is important that program and even course goals include and make public to the university community the objectives and student learning outcomes that focus on the preparation for the students' future, the use of research strategies in all areas where practicable, and the use of teaching strategies that focus on higher-order thinking, creation, evaluation, analysis, and application.

Dr. Lawrence Redlinger, Executive Director of the Office of Strategic Planning and Analysis, has devised a visual model for how the mission must interact with the academic programs.



This model helps to reinforce the idea that this assessment model focuses not on individuals—faculty or students—but on the academic program overall, the schools, the departments, the courses, and the groups of students with whom we interact both inside and outside the classroom.

## Why now?

Just as many of our programs engage in a periodic accreditation review, the university as a whole is working toward its reaffirmation of accreditation by the Commission on Colleges of the Southern Association of Colleges and Schools. As a part of the SACS reaffirmation process, UTD is examining its overall effectiveness in a number of areas. One of those areas is the effectiveness of its instructional design, delivery, and evaluation. This internal evaluation of our own instructional effectiveness requires a strategic approach so that we can use the assessment model to provide a framework for such an approach.

According to the Principles of Accreditation for SACS:

*2.5: The institution engages in ongoing, integrated, and institution-wide research-based planning and evaluation processes that incorporate a systematic review of programs and services that (a) results in continuing improvement and (b) demonstrates that the institution is effectively accomplishing its mission.*

*3.3.1: The institution identifies expected outcomes for its educational programs and its administration and educational support services; assesses whether it achieves these outcomes; and provides evidence of improvement based on analysis of those results.*

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*3.4.1: The institution demonstrates that each educational program for which academic credit is awarded (a) is approved by the faculty and the administration, and (b) establishes and evaluates program and learning outcomes.*

Documentation to support Principle 2.5 above includes such items as minutes of various unit meetings, budgetary goals and processes, annual and programmatic reports, and any other “evidence” that demonstrates our efforts to link our university mission to the operation of the university as a whole and of each individual program and department.

In its *Resource Manual for the Principles of Accreditation: Foundations for Quality Enhancement*, the Southern Association (2005) provides this rationale for Principle 3.3.1 cited above.

*This standard addresses the process of assessment that supports the institution’s administrative and educational support services and serves as the cornerstone of institutional effectiveness. For academic programs and for administrative and educational support services, institutional effectiveness focuses on the design and improvement of educational experiences to enhance student learning. (p 34)*

Included as elements for consideration are the degrees to which the outcomes are clearly defined and measurable, the evidence available, the periodic review of programmatic outcomes (“such as retention, graduation rates, employer and alumni satisfaction, and the like assessed, reviewed, and used for improvement”), and the use of that review of results to make improvements (p 35).

UTD meets the first half of Principle 3.4.1 through its program approval process, requiring faculty involvement as well as administrative, committee and Senate approval. The second half, however, is an extension of Principle 3.3.1 and will require the assessment model be adopted by all academic areas. SACS includes in the *Resource Manual* the following “Rationale and Notes” for this principle.

*The tradition of shared governance within American higher education recognizes the importance of both faculty and administrative involvement in the approval of educational programs. Approval by the faculty ensures that programs contain appropriate courses reflecting current knowledge within a discipline and that they are appropriate for the students enrolled. Approval by the administration affirms that educational programs are consistent with the mission of the institution and that the institution possesses both the organization and resources to ensure the quality of its educational programs.*

*The expectation is that the institution will engage in ongoing planning and evaluation to ensure that, for each academic program, the institution develops and assesses student learning outcomes.*

*Program and learning outcomes are grounded in the faculty’s knowledge of the content and coherence of the discipline as well as in the learning process and reflect expectations for performance consistent with the level of the program and the mission of the institution. Program and learning outcomes specify the knowledge, skills, values, and attitudes students are expected to attain in courses or in a program. Methods for evaluating the extent to which students*

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*achieve these outcomes are appropriate to the nature of the discipline and consistent over time to enable the institution to evaluate cohorts of students who complete courses or a program. Shared widely within and across programs, the results of this evaluation can affirm the institution's success at achieving its mission and can be used to inform decisions about curricular and programmatic revisions. At appropriate intervals, program and learning outcomes and evaluation methods are evaluated and revised as appropriate. (pp 35-36)*

The kinds of questions we must consider in addressing Principle 3.4.1 include the process by which we develop and approve our programs, the “program and learning outcomes” for all of our educational programs, the methods by which we evaluate student success, and the use of such evaluations for further improvements or enhancements. Evidence for Principle 3.4.1 can include our own policies and procedures documents, minutes from any number of meetings (including departments, CEP, Senate), and reports describing the results and improvements planned or implemented.

At the core of our entire reaffirmation process is the degree to which UTD engages in the Institutional Effectiveness model. Assessment of academic programs is but one small, yet crucial, part of that model. Our ability to demonstrate how our current processes already work within this framework and to demonstrate how we may change part of our processes to improve them will serve as the foundation of our reaffirmation efforts.

Because the use of institutional effectiveness and assessment modeling form the basis of virtually all the Principles of Accreditation, institutional effectiveness and assessment become the responsibility of every UTD employee. Since the primary business of a university is its research and education of the students, the faculty becomes the most visible segment of the university community in our reaccreditation efforts. For this reason if for no other, we need all faculty members to engage in the extensive process of identifying the existing programmatic goals and objectives and the student learning outcomes as well as the enhancement of those goals and objectives where necessary.

As UTD advances toward world-class status, we will commit ourselves to the process of assessment for improvement. This commitment is important for our own growth, important for our students' learning, and important to satisfy accreditation criteria. As researchers and academics, this process will become not only what we do as an institution; it will also become part of who we are as scholars, examining our teaching and administration with as much rigor as we engage in our own disciplinary inquiry.

### **What is SACS and Why Should I Care?**

The Southern Association of Colleges and Schools (SACS) is the accrediting body for UTD. If you have been here over 10 years, you have probably been on campus during one of the 10-year accrediting cycles. In the past, most of accreditation was handled by administrators who prepared compliance reports on issues such as number of credit hours for degree programs.

## **SACS: The New Model**

You are going to be involved in the current SACS process because it has changed in the past few years since we last received re-accreditation. In order to effectively promote student learning in higher education, the process of accreditation, now called reaffirmation, involves efforts from all members of the campus community. All of these efforts need to go toward making sure that students learn what they need to learn in our programs. You will hear a lot about learning outcomes and assessment of those learning outcomes. The campus will be involved in writing a Quality Enhancement Plan (QEP), which is a type of learning-based research project aimed at improving an aspect of student learning on campus.

### **So What?**

Failing to receive SACS reaffirmation is not only embarrassing, it affects whether or not we can receive federal moneys and offer student aid. However, the main reason to be interested in SACS is that through this 5-year process, aspects of our campus will change in positive ways. The way we teach will change. The way we think about students and their roles at our institution will change. We will become much more like the top-tier schools we aspire to have in our institutional comparison cohort.

The SACS projects will:

- Involve viewing learning in new ways
- Involve teaching differently: More efficiently and more effectively
- Mean updating and revising course syllabi
- Mean updating and revising programs
- Be the impetus to focus on continuous improvement in learning and teaching at UTD
- Begin conversations among colleagues about the learning culture on campus
- Highlight what we are already doing that is noteworthy
- Underscore what we can start doing that will enhance our stature among universities
- Take a lot of work
- Be exciting.

Here is Duane Buhrmester's excellent explanation of SACS in a letter to BBS faculty:

*We are rapidly moving toward the SACS accreditation visit. UTD's Compliance Certification report is due September 1, 2007. That report must document a history of practices that are in compliance with SACS expectations. So, we all have some certifiable history to create and fast!*

*SACS accreditation criteria have changed substantially over the past few years. A key statement in the new Principles of Accreditation is: "The institution demonstrates that each educational program for which academic credit is awarded (a) is approved by the faculty and administration, and (b) establishes and evaluates program and learning outcomes." In practice, SACS is taking this latter criterion very seriously, with some high caliber institutions (like Georgia Tech) being placed on probation for failure to have adequate evaluation procedures in place.*

*What does SACS really want? Apparently in an effort to prevent the "No Child Left Behind" accountability legislation from being extended to colleges, SACS wants universities to have in place meaningful evaluation loops that include goals-assessments-feedback-interventions-assessments.*

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*SACS believes that the way to prevent mandated national yardsticks is for universities to come up with individualized methods of assessing their unique missions and learning goals, and then showing that the information gained from the assessments is used to improve educational methods. Thus, the emphasis is on demonstrating that each program has a meaningful evaluation process in place. The focus is not on evaluating students, but rather on evaluating whether our program methods live up to the program goals we have set for ourselves.*

*Not only does SACS want an evaluation process in place, but they want to make sure that the process was generated with bottom-up participation and full buy-in from faculty. They believe that it is a bad idea to have the process come from top-down mandates from state agencies or local administrators. So, in addition to coming up with an evaluation process for Psychology, we must also document that faculty (and perhaps students) were/are involved in the development process.*

### **Reasons Learning Objectives and Learning Outcomes Assessment Are Important for Faculty**

1. Without learning outcomes definition and assessment, faculty have no way of knowing whether students who complete courses and programs learned what faculty intended those students to learn. Without learning outcomes assessment, faculty cannot answer the question, "Do our graduates have the knowledge, skills, and experiences we want them to have?"
2. Faculty time spent planning classes, courses, and programs might not be spent efficiently if faculty do not know whether students are learning what faculty intend to teach.
3. Students who know clearly what faculty intend to teach will learn more effectively.
4. Students will take up more of a faculty member's time if there are no clear learning goals and measures of those learning goals (outcomes assessment). When students do not know about goals and assessments, faculty are subjected to students' arguments about grades, points, and fairness.
5. Faculty members who set clear learning objectives and measure the outcomes of student learning can improve their courses and programs to be more effective and efficient. These improvements can make teaching more satisfying as well as free faculty time to be spent on research and service.
6. In most universities, it is likely that faculty will be increasingly held responsible for student learning through measurement of student learning at the end of programs. Being able to use learning outcome assessment to improve courses and programs will be crucial to faculty members' positions at universities.
7. Ethical treatment of students dictates that faculty set learning expectations and then examine students based on those objectives. Learning outcomes assessment should provide feedback to students about how well they learn as well as feedback to faculty about how well they facilitated students' learning. Furthermore, responsible faculty members use this feedback for continuous improvement of courses and programs.

## Definitions for Student Learning Outcomes Assessment

**Assessment Plan** — "a document which outlines when the evaluation will take place and how it will be conducted. An assessment plan included program mission or course/activity purpose, goals as appropriate, intended outcomes, methods for gathering, analyzing data, and interpreting data for providing evidence to inform decision making."

**Assessment Instrument** — "any tool used to discern if the intended outcomes have been achieved."

**Assessment Method** — "the process employed to gather data."

- **Direct Assessment Method** — "any process employed to gather data which required subjects to display their knowledge, behavior, or thought processes." These methods are directly observable. Direct assessment methods are preferred ways of documenting learning outcomes.
- **Indirect Assessment Method** — "a process employed to gather data that are a reflection (e.g. survey, reflective essay, interview) of what a person thinks he/she thought, learned, or did as well as data using demographic and numerical descriptions. Indirect assessment methods are used primarily to corroborate and as support for learning outcomes.

**Course/Activity** — "any curricular or co-curricular effort which imparts knowledge, either through one event or a series of events or classes, and is directed by one or more faculty or staff members."

**Data** — "a collection of factual information, especially information from which conclusions may be drawn to make decisions."

**Learning Goals** — General statements about what is included in a course. A learning goal is generally phrased, "Students will learn about..." Usually learning goals are included in course descriptions. Most courses have between 3 and 10 learning goals.

**Learning Objectives** — Statements about what a student will gain from a course or activity. These are specific statements about exactly what a student should know, be able to do, or value as a result of accomplishing a learning goal. Learning objectives form the basis for curriculum and course development as well as testing.

**Learning Outcomes** — A concrete action that a student demonstrates as a result of learning. A learning outcome is a demonstration of knowledge, a skill, or a value. Generally, learning outcomes are assessed at the course and/or program levels.

**Mission Statement** — "A concise statement outlining the purpose of the unit, program, course, or activity." Mission statements are written so that stakeholders understand the unit, program, course, or activity.

**Outcomes** — "Detailed, specific, measurable or identifiable, and personally meaningful statements that are derived from the goals [and learning objectives that] articulate what the end result of a unit, program, course, activity, or process is."

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**Program** — A course of study from which a student will receive a degree and/or a certificate. Programs can be interdisciplinary and should not be conceptualized narrowly. However, departments may have multiple programs: undergraduate degrees, graduate degrees, and certificates, all in the same focused area of study.

**Program Assessment** — "An iterative and ongoing process of purposeful reflection and planning, where one systematically evaluates a program, course, or activity in order to identify strengths and areas for improvement and then uses the results from the evaluation as data to inform decision-making"

**Program Learning Outcomes** — Concrete actions that students demonstrate as a result of the cumulative learning from a program of study or another type of program incorporating coherent activities.

**Purpose Statement** — "A concise statement outlining the essence of a course/activity to students." Purpose statements contain reasons and specific outcomes to be achieved as a result of engaging in the course or activity.

Note, the quoted definitions are from Bresciani, M. & Fackler, J. (2005). Common Language for Evidence Based Decision Making at Texas A&M University. Presented at the SACS Conference, Atlanta, December.

### Nine Principles of Good Practice for Assessing Student Learning

1. **The assessment of student learning begins with educational values.** Assessment is not an end in itself but a vehicle for educational improvement. Its effective practice, then, begins with and enacts a vision of the kinds of learning we most value for students and strive to help them achieve. Educational values should drive not only **what** we choose to assess but also **how** we do so. Where questions about educational mission and values are skipped over, assessment threatens to be an exercise in measuring what's easy, rather than a process of improving what we really care about.
2. **Assessment is most effective when it reflects an understanding of learning as multidimensional, integrated, and revealed in performance over time.** Learning is a complex process. It entails not only what students know but what they can do with what they know; it involves not only knowledge and abilities but values, attitudes, and habits of mind that affect both academic success and performance beyond the classroom. Assessment should reflect these understandings by employing a diverse array of methods, including those that call for actual performance, using them over time so as to reveal change, growth, and increasing degrees of integration. Such an approach aims for a more complete and accurate picture of learning, and therefore firmer bases for improving our students' educational experience.
3. **Assessment works best when the programs it seeks to improve have clear, explicitly stated purposes.** Assessment is a goal-oriented process. It entails comparing educational performance with educational purposes and expectations--these derived from the institution's mission, from faculty intentions in program and course design, and from knowledge of students' own goals. Where program purposes lack specificity or agreement, assessment as a process pushes a campus toward clarity about where to aim and what standards to apply; assessment also prompts attention to where and how program goals will be taught and learned. Clear, shared, implementable goals are the cornerstone for assessment that is focused and useful.

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4. **Assessment requires attention to outcomes but also and equally to the experiences that lead to those outcomes.** Information about outcomes is of high importance; where students “end up” matters greatly. But to improve outcomes, we need to know about student experience along the way--about the curricula, teaching, and kind of student effort that lead to particular outcomes. Assessment can help us understand which students learn best under what conditions; with such knowledge comes the capacity to improve the whole of their learning.
5. **Assessment works best when it is ongoing, not episodic.** Assessment is a process whose power is cumulative. Though isolated, “one-shot” assessment can be better than none, improvement over time is best fostered when assessment entails a linked series of cohorts of students; it may mean collecting the same examples of student performance or using the same instrument semester after semester. The point is to monitor progress toward intended goals in a spirit of continuous improvement. Along the way, the assessment process itself should be evaluated and refined in light of emerging insights.
6. **Assessment fosters wider improvement when representatives from across the educational community are involved.** Student learning is a campus-wide responsibility, and assessment is a way of enacting that responsibility. Thus, while assessment efforts may start small, the aim over time is to involve people from across the educational community. Faculty play an especially important role, but assessment’s questions can’t be fully addressed without participation by student-affairs educators, librarians, administrators, and students. Assessment may also involve individuals from beyond the campus (alumni/ae, trustees, employers) whose experience can enrich the sense of appropriate aims and standards for learning. Thus understood, assessment is not a task for small groups of experts but a collaborative activity; its aim is wider, better-informed attention to student learning by all parties with a stake in its improvement.
7. **Assessment makes a difference when it begins with issues of use and illuminates questions that people really care about.** Assessment recognizes the value of information in the process of improvement. But to be useful, information must be connected to issues or questions that people really care about. This implies assessment approaches that produce evidence that relevant parties will find credible, suggestive, and applicable to decisions that need to be made. It means thinking in advance about how the information will be used, and by whom. The point of assessment is not to gather data and return “results”; it is a process that starts with the questions of decision-makers, that involves them in the gathering and interpreting of data, and that informs and helps guide continuous improvement.
8. **Assessment is most likely to lead to improvement when it is part of a larger set of conditions that promote change.** Assessment alone changes little. Its greatest contribution comes on campuses where the quality of teaching and learning is visibly valued and worked at. On such campuses, the push to improve educational performance is a visible and primary goal of leadership; improving the quality of undergraduate education is central to the institution’s planning, budgeting, and personnel decisions. On such campuses, information about learning outcomes is seen as an integral part of decision making, and avidly sought.
9. **Through assessment, educators meet responsibilities to students and to the public.** There is a compelling public stake in education. As educators, we have a responsibility to the publics that support or depend on us to provide information about the ways in which our students meet goals and expectations. But that responsibility goes beyond the reporting of such information; our deeper obligation--to ourselves, our

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students, and society--is to improve. Those to whom educators are accountable have a corresponding obligation to support such attempts at improvement.

These principles were developed under the auspices of the AAHE Assessment Forum with support from the Fund for the Improvement of Postsecondary Education with additional support for publication and dissemination from the Exxon Education Foundation. Copies may be made without restriction. The authors are Alexander W. Astin, Trudy W. Banta, K. Patricia Cross, Elaine El-Khawas, Peter T. Ewell, Pat Hutchings, Theodore J. Marchese, Kay M. McClenney, Marcia Mentkowski, Margaret A. Miller, E. Thomas Moran, and Barbara D. Wright. Reproduced by permission of the publisher. Copyright © 1991, The American Association for Higher Education and Copyright © 2005, by Stylus Publishing, LLC. *This article was copied from:* <http://www.iuk.edu/%7Ekoctla/assessment/9principles.shtml> Indiana University at Kokomo on January 10, 2006 and included in this workbook with written permission from A.W. Astin, 2-2006.

## Seven Principles for Good Practice in Undergraduate Education

### **Introduction**

The “Seven Principles for Good Practice in Undergraduate Education” were created by Arthur W. Chickering and Zelda Gamson. These principles and the suggestions for implementation were distilled from decades of research on learning in higher education. The project received support from the American Association of Higher Education (AAHE), the Association of American Colleges (ACE), and the Johnson and Lilly Foundations. The investigators are leading scholars in faculty and student development who, amongst other things, solicited the ideas of hundreds of faculty members and administrators in North American colleges and universities.

Seven Principles was originally published in 1987; it is based on an underlying view of education as active, cooperative, and demanding (Chickering, p. 5). The goals of the authors are first, to identify practices, policies, and conditions that would result in a powerful and enduring undergraduate education, and second, to offer a set of research-based principles that would help sustain debate and action regarding undergraduate learning (Chickering, p. 13).

### **Summary of Seven Principles**

#### **1. Good practice encourages student-faculty contact**

Frequent student-faculty contact in and out of class is the most important factor in student motivation and involvement. Faculty concern helps students get through rough times and keep on working. Knowing a few faculty members well enhances students' intellectual commitment and encourages them to think about their own values and future plans.

#### **2. Good practice encourages cooperation among students**

Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions improves thinking and deepens understanding.

**3. Good practice encourages active learning**

Learning is not a spectator sport. Students do not learn much just sitting in classes listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives. They must make what they learn part of themselves.

**4. Good practice gives prompt feedback**

Knowing what you know and don't know focuses learning. Students need appropriate feedback on performance to benefit from courses. In getting started, students need help in assessing existing knowledge and competence. In class, students need frequent opportunities to perform and receive suggestions for improvement. At various points during college, and at the end, students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves.

**5. Good practice emphasizes time on task**

Time plus energy equals learning. There is no substitute for time on task. Learning to use one's time well is critical for students and professionals alike. Students need help in learning effective time management. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty. How an institution defines time expectations for students, faculty, administrators, and other professional staff can establish the basis for high performance for all.

**6. Good practice communicates high expectations**

Expect more and you will get it. High expectations are important for everyone--for the poorly prepared, for those unwilling to exert themselves, and for the bright and well motivated. Expecting students to perform well becomes a self-fulfilling prophecy when teachers and institutions hold high expectations for themselves and make extra efforts.

**7. Good practice respects diverse talents and ways of learning**

There are many roads to learning. People bring different talents and styles of learning to college. Brilliant students in the seminar room may be all thumbs in the lab or art studio. Students rich in hands-on experience may not do so well with theory. Students need the opportunity to show their talents and learn in ways that work for them. Then they can be pushed to learning in new ways that do not come easily.

*By Arthur W. Chickering and Zelda F. Gamson, abridged from <http://www.byu.edu/fc/pages/tchlrnpages/7princip.html#2>. Accessed on February 1, 2006.*

## What Is Learning?

Why is a definition of learning important in learning outcome assessment? To write successful learning objectives and to assess adequately learning outcomes, it is crucial to understand learning because not recognizing all of the aspects of learning can result in structuring less than successful experience for students. Cognitive and educational psychologists have made research careers studying how people learn. For the purposes of SACS work, broadening one's definition of learning will make it easier to write learning objectives, propose learning outcomes, and determine ways to assess learning. The definition below is simple but not simplistic and expands how most people talk about and view learning.

Learning is a systematic, non-random process of changing one's prior knowledge through adding new knowledge, fine-tuning existing knowledge, or restructuring existing knowledge. Learning is not directly observable; however, it is inferred through behaviors that exhibit patterns assumed to be based on specific knowledge.

Deconstructing this definition:

1. **Systematic, non-random:** A student who has never studied math **could** take a math final exam and score 100% but it is not likely. Such a result would be explained as a random occurrence. A non-random event would be a student who is enrolled in a math course taking a final exam and being able to answer all or most of the questions because of studying and understanding the material.
2. **Process:** Learning never ends. The mind is continually fitting and re-fitting knowledge into cognitive structures. Because of this, what a student learns in one class is and will be influenced by what was learned in the past and what is learned in other classes.
3. **Prior knowledge:** From birth, humans store memories, visual information, kinesthetic data, concepts, and many other types of knowledge. Learners, therefore, come to classes knowing a lot, whether true or false in the context of the course material. For example, a physics student may have an erroneous idea about dark matter from watching the sci-fi channel. Even though she has a misconception, this student has prior knowledge that is relevant (but in this case not helpful) to her success in learning in a physics class.
4. **Adding new knowledge:** This is typically what people think is learning. Current research in learning theory has found that students add new knowledge most readily and meaningfully when it is related in some way to prior knowledge.
5. **Fine-tuning existing knowledge:** Learning often involves adding details, examples, and instances to knowledge. For example, suppose a student in a history class learned some facts in high school about the Civil War. In a UTD course, he reads primary source accounts that relate to those decontextualized facts. Reading these texts will fine-tune the student's extant knowledge with specific instances in the form of first-person accounts.

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6. **Restructuring existing knowledge:** Students sometimes memorize facts (adding new knowledge) without contexts. Other times, students have misconceptions based on prior learning. Still other times, students change their paradigms about the world. All of these experiences involve a type of learning in which existing knowledge is restructured. A biology student in a scientific writing class, for instance, might begin by believing that an original research paper is merely a term paper. When she reads her professor's assignment, however, she might realize that original research is designing and developing a laboratory experiment. In comparing what she knows about term papers as well as what she learned in her lab classes, she forms a new category of knowledge about the scientific research process.
7. **Inferred through behaviors:** As any experienced faculty member knows, it is impossible to know exactly what and how much students have actually learned. A student who does very well on an exam might have learned something, or he might be a good test-taker, or he might have cheated. Faculty ask students to write papers, complete projects, and take exams and quizzes in order to gauge how much students might have learned. It is never possible to reflect exactly and precisely everything that a student did or did not learn. Faculty can only infer learning from course-related behaviors.

## Differences between Teaching-Centered and Learning-Centered Classrooms

<b>Teacher-Centered</b>	<b>Learner-Centered</b>
Focus is on the teacher	Focus is on the student
Teacher's knowledge is highlighted	Student's prior knowledge informs how information is presented
Teacher expects students to learn everything she says during class	Teacher wants students to interact, ask questions, and learn what is possible given students' starting positions relative to course materials
Teacher lectures most of the time	Students work in teams, have class discussions, have some but limited lectures, interact in online discussions
Teacher uses his framework of and context for course material as the starting point for learning expectations	Teacher assesses students' frameworks and conceptualizations of course materials and related prior knowledge as starting points for learning expectations

### ***Why does this matter?***

When writing learning objectives, it is important to do so from a learner-centered perspective. SACS expects learning outcome assessments to be based on learner-centered teaching philosophies.

When writing learning objectives and measures of learning the focus must be on what the student knows, can do, and values rather than on content the faculty intended to teach. Students should be asked to exhibit higher-level knowledge rather than only memorizing rote facts (see Bloom's levels for an explanation).

## Writing Effective Learning Objectives

### *What is a Learning Objective?*

- A statement of how you expect your students to demonstrate what they have learned.
- A specific, targeted statement about what learners (not teachers) should:
  - Be able to do
  - Know
  - Value
- A statement that specifies the level of learning the student should achieve in terms of Bloom's levels (see next page).
- A statement that, when referring to a program, specifies the criteria for satisfaction in terms of percentage of students who will successfully meet the objective (e.g., 80% of students will be able to identify prokaryotic cells) or when referring to a course gives the percentage accuracy the student will demonstrate learning (e.g., students will be able to perform successfully at least 5 of 7 steps in this lab assignment)
- A statement that can be directly translated into a measure of learning outcomes.

### *Parts of Effective Learning Objectives:*

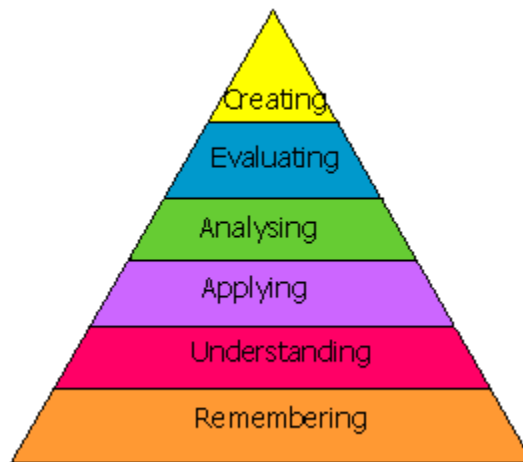
<b>General Goal for Learning (program or course level)</b>	<b>Specific Condition for Learning</b>	<b>Specific Verb from Bloom's Levels of Learning</b>	<b>Criteria for Success</b>
<i>Example 1:</i> Students will learn about multivariate statistics	Given a description of a complex organizational situation	Students will design self-report questionnaires	With subscales measuring at least three management styles
<i>Example 2:</i> Students will understand nuclear medicine as it applies psychological problems	Given SPECT images of normal brains and severely depressed patients' brains	Students will compare and contrast regions	Identifying at least three brain regions that correspond to depression

Note, that the general goal in the first column is NOT part of the learning objective. Rather, the first column sets forth a general goal that a school, program, or a course may have. This table demonstrates ways that those general goals can be translated into more specific learning objectives.

## Bloom's Levels of Learning

Bloom developed his "taxonomy" of learning in 1956. In the 1990's, one of his students re-conceptualized it to better reflect current learning theories. The purposes of these levels of learning are (1) to help teachers understand the depth of learning students will experience with different tasks; (2) to help teachers specify exact verbs when writing learning objectives; and (3) to help teachers determine appropriate learning outcomes assessments congruent with levels of learning.

This graphic representation of Bloom's Taxonomy shows the levels of learning with the deepest, most complex level at the top and the least complex level forming the base of the pyramid. The assumption in this diagram is that the higher levels of learning build upon skills learned in the lower levels.



Source: [http://web.odu.edu/educ/lischult/blooms\\_taxonomy.htm](http://web.odu.edu/educ/lischult/blooms_taxonomy.htm)

An explanation of these levels is found in (Anderson & Krathwohl, 2001, pp. 67-68), retrieved from <http://www.coe.uqa.edu/epltt/bloom.htm#end> on February 1, 2006.

These terms are defined as:

- **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- **Understanding:** Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- **Applying:** Carrying out or using a procedure through executing, or implementing.
- **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.

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- **Evaluating:** Making judgments based on criteria and standards through checking and critiquing.
- **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

**Example Verbs and Outcome Measures**

This table lists the levels of Bloom's Taxonomy along with verbs that are appropriate and specific enough to use in learning objectives

<b>Level</b>	<b>Verbs</b>	<b>Outcome Measures for Assessment of Learning</b>
<b>Creating</b>	Compose, construct, create, develop, hypothesize, implement, speculate, write,	Detailed plans, papers with new ideas/original research, art
<b>Evaluating</b>	Assess, choose, conclude, defend, grade, judge rate, score, support, validate	Self-evaluation, developing criteria lists, listing pros/cons
<b>Analyzing</b>	Analyze, arrange, break down, classify, compare/contrast, debate, deduce, differentiate, diagram, interpret, illustrate, test	Constructing spreadsheets, applying statistical methods, diagramming
<b>Applying</b>	Apply, calculate, classify, complete, demonstrate, develop, graph, modify, operate, predict, solve, teach, transfer, use as a template	Simulations, solving problems, using templates in new situations
<b>Understanding</b>	Compute, describe, discuss, explain, generalize, give examples of, interpret, outline, restate, paraphrase, solve, tell	Summaries, paraphrased sentences; equivalent equations/programs
<b>Remembering</b>	Define, describe, identify, list, memorize, name, outline, quote, recall, recognize, underline	Worksheets, fact charts, lists, multiple choice rote questions, matching questions

## Writing Learning Objectives Exercise

Given learning objectives, faculty should be able to diagnose how well the objectives meet the previous criteria for effectiveness and edit every one that falls short of optimal wording.

For each of the following learning goals, note whether it meets the criteria for effectiveness (mark it with an E) or whether it needs revising (mark it with an R).

Learning Objective	E	R
Given a paper to write, students will understand the causes of the Civil War		
Given descriptions of prokaryotic and eukaryotic cells, students will construct tables comparing and contrasting these structures including at least three differences and three similarities.		
Given the text of Bill Clinton's first inaugural speech, students will determine its effectiveness.		
Based on an article from a medical journal, students will evaluate its effectiveness in reaching its intended audience.		
Students will explain how prime numbers are used in encrypting software.		

## Explanations and Answers

Learning Objective	E or R	Explanation
Given a paper to write, students will understand the causes of the Civil War	R	This has a specific condition (given a paper to write) although it could be more specific (given a 10-page analytic essay incorporating 3 authors from class readings). "Understand" is a vague verb, and there is no criterion for success.
Given descriptions of seven prokaryotic and eukaryotic cells, students will construct tables comparing and contrasting these structures including at least three differences and three similarities.	E	This objective has a specific condition (descriptions of seven....cells), specific verbs (construct, comparing, contrasting), and criteria for success (three differences and three similarities)
Given the text of Bill Clinton's first inaugural speech, students will determine its effectiveness.	R	There is a specific condition (Bill Clinton's speech); however, the verb is too vague and there are no criteria for successfully noting effectiveness of a speech.
Based on an article from a medical journal, students will evaluate its effectiveness in reaching its intended audience.	R	Like the previous example, there is a specific condition but no clear verb and no specified criteria.
Students will explain how prime numbers are used in bank security encrypting software.	R	This is another example of criteria for effective learning objectives not being met. There are no conditions, no specific verb, and no criteria for success.

### **Revisions:**

Given 5 primary source documents to read, students will outline at least three causes of the Civil War. (Bloom's level: understanding)

Given the text of Bill Clinton's first inaugural speech, students will rate its effectiveness based on Toulmin's rhetorical model. (Bloom's level: evaluating)

Given an article on obesity from JAMA, students will judge how well it is written for its intended audience based on the 5 criteria of audience analysis discussed in class. (Bloom's level: evaluating)

Given a description of requirements for data security, students will write basic code for bank security software using prime numbers for encryption. (Bloom's level: creating)

## What Do Learning Objectives Have to Do With Assessment?

Once learning objectives are written for individual courses and programs, it is important to choose methods of assessing how well students will meet those learning objectives. Assessment methods are ways that students can demonstrate that they learned the course material and information intended for them to learn in a class or program. When developing learning objectives and subsequent assessment measures, it is helpful to think in terms of:

- What do you want your students to KNOW?
- What do you want your students to be ABLE TO DO?
- What do you want your students to VALUE (as demonstrated by their behaviors and habits)?

When aligning learning objectives with assessment measures, there are two essential aspects.

First, it is important to determine a level of success. Take, for instance, the following learning objective from the examples above:

*Given descriptions of seven prokaryotic and eukaryotic cells, students will construct tables comparing and contrasting these structures including at least three differences and three similarities.*

A biology faculty member might decide that it is acceptable if 80% of the students meet this objective successfully.

Second, there should be at least three assessment measures for each learning objective. For example, this learning objective could be measured with a question on an exam, measured with a homework assignment, and measured with an in-class exercise. If all of those assignments are kept as data, this learning objective will be considered to have been measured effectively. Note, that generally there should not be more than five learning objectives for a course, so the burden of assessing the learning outcomes will not be as onerous as one might first imagine.

## Differences between Direct Assessments and Indirect Assessments of Student Learning

SACS prefers that learning outcomes are assessed primarily by direct measures. In review (please see Definitions), direct assessment methods use a faculty member's first-hand observation of a student's demonstration of learning. Indirect assessments use students' reflections about what they learned, attitudes toward the learning experience (e.g. course instructor surveys), or even demographic data (e.g. number of students admitted into medical school). This chart should help clarify and provide ideas for types of assessments.

This page was adapted from A Guide to Choosing a Feasible (and Useful) Assessment Plan for Student Learning Outcomes (2005) By Dr. Abigail Panter, Academy of Distinguished Teaching Scholars , Dr. Ed Neal, Center for Teaching and Learning , and Dr. Lynn Williford, Institutional Research & Assessment, UNC. Table extracted from the American Psychological Association's Task Force on Psychology Undergraduate Major Competencies: Psychology Major Learning Goals and Outcomes (2002). Available online at <http://www.apa.org/ed/pcue/taskforcereport2.pdf>.

<b>Direct Assessments</b>	<b>Indirect Assessments</b>
<p>Expert panel of independent judges using a predetermined set of criteria (a rubric) to rate and evaluate a random sample of:</p> <ul style="list-style-type: none"> <li>• Individual projects or other written projects</li> <li>• Oral presentations</li> <li>• Graphic tests and posters</li> <li>• Group and team projects</li> <li>• Research projects</li> <li>• Structural/situational assessments</li> <li>• Portfolios from either courses or programs</li> </ul> <p>Other Assessment Approaches</p> <ul style="list-style-type: none"> <li>• Classroom Assessment techniques (e.g., thought papers, muddiest point explanation)</li> <li>• Embedded questions and assignments-- essay exams, objective exams</li> <li>• Transcript analysis of class conversations</li> <li>• Capstone Course projects/assignments</li> <li>• Portfolio Assessment</li> <li>• Locally-developed exams</li> <li>• Passing national or regional standardized or certifying exams</li> <li>• Pre/post test data</li> </ul>	<ul style="list-style-type: none"> <li>• Self-assessment/reflection--reflective essay</li> <li>• Attitudinal surveys of students, alumni</li> <li>• Focus groups</li> <li>• Archival measures--student and alumni databases</li> <li>• Syllabus audit</li> <li>• Exit interviews</li> <li>• Transfer and retention data</li> <li>• Time to degree data</li> <li>• SAT/ACT/GRE scores (except subject-specific tests which are direct)</li> <li>• Alumni job placements</li> <li>• Acceptance rates into medical and professional schools</li> </ul>

## Assessment Methods Explanations and Analyses

Method	Description	Strengths	Weaknesses
Expert Panel Judging with a Rubrics (Direct)	Judges who are well-versed in the content and performance areas use criteria (rubrics) to judge individual projects or other written projects, oral presentations, graphic tests and posters, group and team projects, research projects, structural/ situational assessments portfolios from either courses or programs, capstone projects or papers.	Outside raters lend credibility and validity, considered opinions other than faculty members, involvement of colleagues in assessment processes, corroboration of judging.	Inter-rater reliability might be low so outcome measures might not be accurate, rubrics require rater training and familiarity, time-consuming.
Classroom Assessment Techniques (Direct)	Students are asked to produce brief written feedback on the spot during class.	Allows faculty to discover what students are thinking during the classroom experience, gives students the opportunities to ask questions and express confusions.	Do not give students time to reflect on their learning--may be a knee-jerk reaction, may vary a great deal in classes with students of disparate abilities.
Course - Embedded Assessment (Direct)	Course-embedded assessment refers to methods of assessing student learning within the classroom environment, using course goals, objectives and content to gauge the extent of the learning that is taking place. This technique generates information about what and how students are learning within the program and classroom environment, using existing information that instructors routinely collect (test performance, short answer performance, quizzes, essays, etc.) or through assessment instruments introduced into a course specifically for the purpose of measuring student learning.	This method of assessment is often effective and easy to use because it builds on the curricular structure of the course and often does not require additional time for data collection since the data comes from existing assignments and course requirements.	Course-embedded assessment does, however, take some preparation and analysis time; and, while well documented for improving individual courses, there is less documentation on its value for program assessment.

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<b>Method</b>	<b>Description</b>	<b>Strengths</b>	<b>Weaknesses</b>
Transcript analysis of class conversations (Direct)	Class sessions are taped (audio or video) and transcribed. The conversations are followed and may be analyzed for instructional effectiveness.	Transcripts provide records of actual classroom talk. Often faculty and students forget or remember selectively what was discussed so transcripts provide reliability checks for classroom content.	Transcripts are difficult to produce because of time to transcribe as well as difficulty with recording fidelity. Also, transcripts may be interpreted differently by different participants and need explanation for those not participating in classes.
Capstone Course Projects/ Assignments (Direct)	These may include capstone course(s), projects, papers, senior/honors theses, internship, or graduate theses/dissertations that offer students the opportunity to apply knowledge and skills acquired in the major, provide a final common experience, and offer faculty a way to assess student achievement. Culminating assignments are typically taken the semester before graduation.	Colleges and universities use culminating assignments to collect data on student learning in a specific major, program, general education or core requirement.	A comprehensive capstone course and appropriate assessment methods may be difficult to develop.
Portfolio Assessment (Direct)	Portfolios are collections of student work over time to demonstrate student growth and achievement. Portfolios may be used for certification, licensure, or external accreditation reviews. Portfolios may contain: research papers, process reports, tests and exams, case studies, audiotapes, personal essays, journals, self-evaluations and computational exercises. For the most valid and reliable assessment ratings, portfolios are rated with rubrics/criteria by more than one faculty member.	Portfolios can be valuable resources when students apply to graduate school or employment. Portfolios encourage students to take greater responsibility for their work.	Portfolios may be costly and time-consuming; require extensive effort for both students and faculty; and may be difficult to assess and store.

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<b>Method</b>	<b>Description</b>	<b>Strengths</b>	<b>Weaknesses</b>
Standardized and Local Test Instruments (Direct)	Standardized instruments (developed outside the institution and applied to a large group of students using national/regional norms and standards) or locally-developed assessment tools (created within the institution/program/department for internal use) may be selected depending on specific needs and available resources. Knowing what to measure is key to successful selection of standardized instruments. It is also important to administer the assessment to a representative sample to develop local norms and standards. Locally, test instruments can be tailored to measure local needs regarding specific performance expectations for a course or group of students.	Local test instruments are directly linked to local curriculum and can assess student performance on a set of local criteria.  Standardized tests can be administered immediately and thus less expensive than developing and creating local tests. Results can be tracked and compared to norm groups and subjectivity/misinterpretation is negligible.	Developing a reliable and valid local tool along with a scoring key/method is time-consuming and expensive. Performance cannot be compared to state or national norms.  Standardized measures may not relate to local curricula and costs can be substantial. Test results may not contain locally-relevant information to be useful.
Pre-test / Post-test Evaluation (Direct)	Locally developed tests and exams administered at the beginning and end of a course or program to monitor student progress and learning. Results identify areas of skill deficiency and track improvement within the time frame.	Pre- and post-tests can effectively collect information on students upon entry and exit of a program/course and can assess student knowledge quickly to allow comparisons between different student groups or the same group over time.	Pre- and post-tests require time to develop and administer. Tests should measure what they are intended to measure over time; in line with program learning objectives and have consistency in test items, administration and application of scoring standards.
Self-assessment/ reflection-- reflective essay (Indirect)	These essays are used in many different contexts. As assignments in classes, students might be asked to reflect on their learning. In other contexts, such as exit surveys, students might be asked to reflect on broader experiences.	Reflection is valuable as a learning tool because it asks a student to remember learning and apply it and its importance to a general context. Faculty and program heads can read such essays and determine patterns about what students found helpful, noteworthy, interesting, and confusing.	Reflective essays might not give specific information about instruction. Also, retrospective memory is selective. Because people tend to remember the very positive and very negative aspects of situations, these essays might not provide much information about general experiences. Reading and analyzing reflective essays is time intensive.

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<b>Method</b>	<b>Description</b>	<b>Strengths</b>	<b>Weaknesses</b>
Attitudinal surveys of students, alumni (Indirect)	Surveys and interviews ask students to respond to a series of questions/ statements about their academic experience. Questions can be open-ended or close-ended. Surveys and interviews can be written or oral. Survey types include in-class, mail or telephone questionnaires/ interviews. Interviews may be structured; in-person interviews or focus group interviews.	Surveys can be inexpensive and easy to administer and are best suited for short and non-sensitive topics. They can be used to track opinions. Data is easy to collect and tabulate. An interview can explore topics in-depth and collect rich data.	Items may be ambiguous and poorly written and not generate enough detail for decision making. Information may be distorted if the respondent feels a lack of privacy and anonymity. The success of interviews depends on the skills of the interviewer.
Focus Groups (Indirect)	Focus groups are in-depth qualitative interviews with a homogeneous group of 6-10 individuals brought together by a moderator to discuss a specific issue and emphasizing insights and ideas.	Focus groups provide data about participants' experiences, attitudes, views and suggestions in a nurturing environment. These groups allow a small number of individuals to discuss a specific topic in detail, in a non-threatening environment.	The number of questions may be limited; data collected is not useful for quantitative results. Moderators must be well trained and highly skilled.
Archival measures-- student and alumni databases (Indirect)	A variety of student data are routinely collected. Data can track program history, student academic progress and graduation and retention rates.	Data are easily accessible and readily available through Institutional Research and on the University web page. Data offer both current and longitudinal information.	Data sets may be large and difficult to sort through. The information collected is general (age, gender, race, etc.) and may not directly relate to program goals and objectives.
Syllabus audit (Indirect)	Syllabus audits (review of textbooks, exams and curricular material) involve review of current course syllabus (written or oral assignments, readings, class discussions/ projects and student learning outcomes) to determine if the course is meeting the goals/objectives of the instructor/ department.	Stated learning objectives need to be clarified; Differences/ similarities between course sections should be explored; the effectiveness of instructional materials should be assessed. Syllabus analysis can provide information to enhance assessment plans.	The review is time consuming and may result in inconsistency in collecting and analyzing the data when there is more than one reviewer.

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<b>Method</b>	<b>Description</b>	<b>Strengths</b>	<b>Weaknesses</b>
Exit interviews and exit surveys (Indirect)	Surveys and interviews ask students to respond to a series of questions/statements about their academic experience. Questions can be open-ended or close-ended. Surveys and interviews can be written or oral. Survey types include in-class, mail or telephone questionnaires/interviews. Interviews may be structured; in-person interviews or focus group interviews.	Surveys can be inexpensive and easy to administer and are best suited for short and non-sensitive topics. They can be used to track opinions. Data is easy to collect and tabulate. An interview can explore topics in-depth and collect rich data.	Items may be ambiguous and poorly written and not generate enough detail for decision making. Items might not relate to the program objectives. Information may be distorted if the respondent feels a lack of privacy and anonymity. The success of interviews depends on the skills of the interviewer.
Transfer and retention data (Indirect)	A variety of student data is routinely collected, usually in admissions and IR offices. This data can provide students' entering status, courses transferred, courses needed, graduation and retention rates	Data are easily accessible and readily available through Institutional Research. Data offer both current and longitudinal information. Trends about types of students can be discerned from prior institutions they attended.	Data sets may be large and difficult to sort through. The information collected is general (age, gender, race, etc.) and may not directly relate to an academic program. Further information may be needed to make statements about the types of students transferring.
Time to degree data (Indirect)	This data is straightforward in that it notes how long a student took to earn a degree from matriculation to graduation by providing beginning and graduating dates.	Data are available in IR or the registrar's office. These data can suggest programmatic issues such as regularity of course offerings needed to help student progress through degree programs as well as highlighting characteristics of students who succeed in graduating on time versus those who take longer than necessary.	Different data sources might be needed to provide a full picture of issues hampering student progress through a curriculum. Simply looking at numbers of students who enter as a cohort and graduate 4 or 5 years later might not provide much information about the reasons for student success or problems.

**UTD Assessment Workbook: A Resource for Departments and Programs**

<b>Method</b>	<b>Description</b>	<b>Strengths</b>	<b>Weaknesses</b>
SAT/ACT/GRE scores (Indirect except subject-specific tests which are direct)	These scores are traditionally used as criteria for admission into university programs. Standardized exams are nationally-normed and administered in controlled situations to minimize testing error.	Correlations exist between SAT/ACT/GRE scores and success in university programs. These scores can be assumed to correlate to a proficient level of prior academic achievement.	These scores do not suggest or imply discipline-specific knowledge and cannot be used to gauge how well suited a student's talents are for pursuing a specific program of study. In addition, other factors such as motivation, metacognitive skills, and family issues can contribute more to the variance of a student's likelihood of success.
Alumni job placements/employer surveys (Indirect)	Alumni job placements and employer surveys help determine if graduates have the necessary job skills. These sources of data may indicate other skills employers value that graduates are not acquiring as well as information about the curriculum, programs and student outcomes that other methods cannot.	Employer surveys and job placements provide external data and help faculty and students identify the relevance of educational programs	Ambiguous, poorly worded questions will generate problematic data. Data collected may provide valuable information on current opinion but may not provide enough detail to make decisions. It may be difficult to determine who should be surveyed, and obtaining an acceptable response rate can be costly and time intensive.
Acceptance rates into medical and professional schools (Indirect)	Numbers of students accepted to continuing study in medical and professional schools provide feedback to programs about how competitive those students are with graduates from other programs and schools. For programs with high numbers of graduates accepted, these numbers can be expressed as proportions of graduates.	Acceptance rates can be considered benchmarks of success for programs preparing students to attend medical and professional training. These rates can tell faculty and program heads about how well students are learning the requisite knowledge and thinking processes to succeed in entrance exams.	Factors other than student success in courses contribute to acceptance. For example, interviews as well as MCAT/GMAT and other exam scores are factors in acceptance at medical and professional schools. Care must be made to avoid direct correlations between academic program success and student acceptance rates.

*This chart was adapted and expanded from the Institutional Effectiveness Practitioner's Manual at Texas A&M International University: <http://www.tamtu.edu/adminis/iep/pdf/TAMTU-IE-Practitioners-Manual.pdf>*

## Rubrics are Helpful for Assessing Learning Outcomes

Many faculty consider using rubrics when looking for ways to grade, give feedback, and assess learning outcomes. Below is an explanation of rubrics followed by an example from a UTD course. Keeping rubrics from students' evaluated work (as well as copies of the work itself if possible) is an important way to collect assessment data.

### ***What is a rubric?***

For most educators, a rubric is a printed set of scoring guidelines (criteria) for evaluating work (a performance or a product) and for giving feedback. A rubric answers the questions:

1. By what criteria will the work be judged?
2. What is the difference between good work and weaker work?
3. How can we make sure our judgments (or scores) are valid and reliable?
4. How can both performers and judges focus their preparation on excellence?

### ***Why are rubrics used?***

The rubric and criteria design process must be more centered on teaching and learning than scoring. Beyond scoring, there are six reasons for using rubrics:

1. Focus instruction---intentionally.
2. Guide feedback---descriptively.
3. Characterize desired results---objectively.
4. Operationalize performance standards---purposefully.
5. Develop self-assessment competence---constantly.
6. Involve students---thoughtfully.

We believe that when focusing upon "quality quantifiers" and "quality learning continuums", new habits of mind emerge.

### ***What are the critical components of a rubric?***

1. Performance Element: the major, critical attributes which focus upon best practice.
2. Scale: the possible points to be assigned (high to low).
3. Criteria: the conditions of a performance that must be met for it to be considered successful.
4. Standard: a description of how well the criteria must be met for the performance to be considered "good".
5. Descriptors: statements that describe each level of the performance.
6. Indicators: specific, concrete examples or telltale signs of what to look for at each level of the performance.

**Rubric Example: NATS 4310: Scientific Writing  
Standards for the NSF Proposal Major Project**

	<b>Paper Grade 21-25 points</b>	<b>Paper Grade 14-20 points</b>	<b>Paper Grade 7-13 points</b>	<b>Paper Grade 0-6 points</b>
<b>Sections of the Proposal</b>	All sections are included and elaborated well.	All sections are included but not elaborated or some are not elaborated while others are over-written.	Some sections are missing.	Most sections are missing.
<b>Research Project Idea</b>	The project is viable and justified well. There is no doubt that the project would have merit.	The project seems viable but is not well-justified. There is a question about the reason for or value of the research.	There is little justification for this research. It is unclear whether this project would further scientific inquiry or benefit anyone practically.	There is no justification or clear description of the research and its rationale.
<b>Audience Analysis</b>	The proposal is written at a high level without containing unnecessary or undefined jargon. It is obvious that the intended audience is a group of scientists who may not be familiar with the writer's specific sub-discipline. There are logical links between ideas so the writer's thought process is apparent.	The proposal is written at a high level without containing unnecessary or undefined jargon. It is obvious that the intended audience is a group of scientists who may not be familiar with the writer's specific sub-discipline. There are logical links between ideas so the writer's thought process is apparent.	The proposal is not written at an appropriate level because it is either too dense with too much jargon or it is at too low a level to be meaningful to scientists. The intended audience is unclear. There are few logical links between ideas so the writer's thought process is not readily apparent.	The proposal is not written at an appropriate level because it is either too dense with too much jargon or it is at too low a level to be meaningful to scientists. The intended audience is unclear. There are few logical links between ideas so the writer's thought process is not readily apparent.
<b>Organization</b>	This proposal does not merely answer the questions in the NSF description. The writer states a purpose and develops the research proposal in an interesting way that conforms to the NSF call for proposals.	This proposal does not merely answer the questions in the NSF description. The writer states a purpose and develops the message in an interesting way that conforms to the NSF call for proposals.	This proposal merely addresses by rote the NSF description. There is no coherence or logic to the proposal other than the order of the sections in the NSF proposal description.	This proposal does not incorporate the sections listed in the NSF call or it is incomplete.
<b>Style and Mechanics</b>	The writer of this proposal exhibits knowledge and control of sentence and paragraph structure. There are effective transitions. The style is efficient and clear. There are no grammar, spelling, or punctuation errors.	The writer of this memo exhibits knowledge and control of sentence and paragraph structure. There are effective transitions. The style is a bit awkward but acceptable. There are very few grammar, spelling, or punctuation errors.	The writers of this memo do not have much knowledge and control of sentence and paragraph structure. There are not many if any transitions. The style is awkward—maybe too wordy or too terse. There are several grammar, spelling, or punctuation errors.	The writers of this memo do not have the ability to write logically linked sentences or paragraphs. There are no transitions. There are many grammar, spelling, and/or punctuation errors.

## Writing Mission Statements

After learning objectives are set for courses and programs and assessment methods for those objectives have been selected, it is important to align the program's mission with the school's mission, which must in turn align with UTD's mission. This worksheet will help with that alignment.

***The new UTD Mission Statement:***

*The University of Texas at Dallas serves the Metroplex and the State of Texas as a global leader in innovative, high quality science, engineering, and business education and research.*

*The University is committed to (1) producing engaged graduates, prepared for life, work, and leadership in a constantly changing world, (2) advancing excellent educational and research programs in the natural and human sciences, in engineering and technology, in management, and in the liberal, creative, and practical arts, and (3) transforming ideas into actions that directly benefit the personal, economic, social, and cultural lives of the citizens of Texas.*

***The parts of the UTD Mission statement that might apply to my program are:***

- 1.
- 2.
- 3.

***For each part that applies to my program, the way/reason it applies is:***

- 1.
- 2.
- 3.

## Examples of Mission Statements

*The following statements are examples from other academic and service departments. Some are very detailed others are not. Since the value of a mission statement is its unique application these statements are meant to serve only as samples – neither good nor bad – for you to examine.*

### ***The University of Iowa Department of English Departmental Mission Statement***

<http://www.depts.washington.edu/ctpmail/>

A strong English department is central to liberal arts education because it helps students become more incisive critical thinkers, more effective communicators, and more sensitive and intelligent interpreters of texts of all kinds.

As a department, our aims are:

- To maintain an attractive literature, writing, and cultural studies curriculum crucial to an excellent liberal arts education.
- To support a general education program that teaches reading and writing, and undergraduate program that bridges the gap between teaching and research, and a graduate program that responsibly trains professionals for teaching, research, and leadership in higher education and elsewhere.
- To support research and publication of original scholarship which advances the fields of English study and nonfiction writing.
- To conduct research and develop courses in tandem with interdisciplinary, cross-departmental initiatives that add value to the institution.

### ***State University of West Georgia, Department of Geosciences Mission Statement***

The primary mission of the Department of Geosciences is:

1. To maintain a high quality, intellectually stimulating, open and realistic educational environment
2. To produce skilled, employable geoscientists, earth science teachers, candidates for graduate school and/or competent, reasoning college graduates
3. To improve faculty teaching effectiveness and personal growth through continued personal study, research, publication, and participation in professional activities and associations.

### ***University of Illinois, Department of English - Writing Center Mission Statement***

<http://www.english.uiuc.edu/cws/mission.html>

The Center for Writing Studies is an interdisciplinary academic unit that facilitates research and promotes graduate study in the areas of written composition, language, literacy, and rhetoric. For

## UTD Assessment Workbook: A Resource for Departments and Programs

graduate students pursuing M.A. or Ph.D. degrees in participating departments, the Center offers a program leading to a specialization in writing studies. Faculty and graduate students from several departments across the university comprise the Center and come together to attend courses, discuss teaching, share research, and participate in the Center's colloquia. The Center's mission is to sustain a community of scholars in writing studies and to provide graduate students with opportunities to study various practices and discourses related to written communication.

### ***Texas Tech, Department of Agriculture Mission Statement***

The Department of Agricultural Education and Communications' mission at Texas Tech University is to generate, integrate, create, broaden, and diffuse knowledge bases in the human dimension of the agricultural sciences and natural resources. To positively affect behavioral change for the improvement of social, economic, and/or environmental conditions of all individuals touched by our agricultural and natural resource systems, we display an outward focus, and enthusiastically receive input from our key stakeholders including practitioners in agricultural communications, public school agricultural teachers, and extension professionals. This in turn enables us to provide premier academic programs, effective outreach, and encourages relevant scholarship.

### ***Auburn University at Montgomery, Department of Physical Sciences Mission Statement***

We in the Department of Physical Sciences strive to:

- Provide courses for the university core requirement in the sciences that include primary topics in the physical sciences.
- Provide chemistry and physics courses that support other science curricula, professional studies, and pre-professional studies.
- Provide courses and an overall curriculum for the physical science major that will provide the skills needed and the opportunity for entry into the world or postgraduate study.
- Provide opportunities for physical science majors to participate in undergraduate research projects with faculty members in the department, and for pre-health students to obtain appropriate clinically-related experience.
- Provide timely advising for physical science and pre-health science students.
- Provide professional services in the university and in the local, state, and national community within the context of the overall needs of the department and the university.
- Participate in research and other scholarly activities commensurate with the needs, interests, resources, space, and schedule of the department.
- Encourage the securement of outside funding for the support of departmental teaching, research, development, and service activities.
- Continually review the mission statement and activities of the department to ensure that they are appropriate to the needs of the students and university.

### ***Texas State Technical College, Office of Student Success Departmental Mission***

The Office of Student Success was established to advise and guide students during their academic career and to provide pertinent information to TSTC administration, faculty and staff to determine student success, retention and persistence to graduation.

Retrieved from [http://www.bc.cc.ca.us/budget/examples\\_of\\_mission\\_statements.htm](http://www.bc.cc.ca.us/budget/examples_of_mission_statements.htm) on February 1, 2006.

## Guidelines for Writing a Mission Statement



College / School / Division: \_\_\_\_\_  
Program / Unit: \_\_\_\_\_  
Academic Year: \_\_\_\_\_  
Date Prepared: \_\_\_\_\_

The purpose of this checklist is to help you develop your mission statement.

### What do you do? What are your primary functions and activities?

- ⊕ Educate students
- ⊕ Conduct research
- ⊕ Other \_\_\_\_\_

### Why do you do these activities? What is your purpose?

- ⊕ So students can get jobs or go to graduate school
- ⊕ Advance the state of knowledge
- ⊕ Other \_\_\_\_\_

### Who do you do them for?

- ⊕ Students
- ⊕ Industry
- ⊕ Other \_\_\_\_\_

### Write your Mission Statement:

“The mission of (your office name) is to (your primary purpose) by providing (your primary functions or activities) to (your stakeholders).” (Additional clarifying statements

## Institutional Effectiveness and Budgeting

Aligning course and program mission statements, learning objectives, and assessment strategies with UTD's new mission is the beginning of campus-wide alignment initiatives. The work of all offices and operations at UTD will relate back to our new mission statement. This alignment includes budgeting. As the University prepares to focus on integrating the new Strategic Plan into its budgeting and operating cycle, each budgetary unit should align its operational goals, objectives, and assessment strategies with the institutional priorities for the planning cycle. To that end, the templates used for planning and reporting have changed to work in concert with the online assessment reporting tool being used as a part of the SACS reaffirmation process. These templates will help program personnel focus on the key elements of their operations in better serving our student population and the university at large.

The template on the following pages is taken from our new WEAVEonline system. As explained above, this system will help everyone at UTD align goals, strategies, missions, and operations to enhance institutional effectiveness at all levels. We include these WEAVE budgeting templates to demonstrate how learning objectives, assessment, and budgets are linked.

**UTD Assessment Workbook: A Resource for Departments and Programs**

**Annual Reporting for Institutional Effectiveness & Budgeting**  
**For Academic Programs and Administrative & Academic Support Units**  
*Planning Document for Fiscal Year*

**Program/Unit Identification**

<i>Program or Unit Name</i>	<i>School or University Division</i>
<i>Program or Unit Director</i>	<i>Supervising Vice President</i>

**Program or Unit Purpose or Mission Statement**

*Your mission statement or purpose should be in alignment with the university's mission.*

**Major Goals / Priorities / Objectives / Outcomes**

*Program or Unit Objectives or Outcomes should be in alignment with the university's goals and institutional priorities. Your priorities should be reflected in and linked to budget documents. Each element should have measurable performance objectives aimed at supporting the achievement of the university's strategic intentions and institutional priorities.*

**Objective/Outcome # 1**

**ASSESSMENT MEASURES, CRITERIA FOR SUCCESS, AND TIME TABLE**

#	Assessment Activity	Criteria: What Constitutes Success	Timeframe / Time Table
1			
2			
3			
4			
5			

**Objective/Outcome # 2**

**ASSESSMENT MEASURES, CRITERIA FOR SUCCESS, AND TIME TABLE**

#	Assessment Activity	Criteria: What Constitutes Success	Timeframe / Time Table
1			
2			
3			
4			
5			

**Annual Reporting for Institutional Effectiveness & Budgeting**  
 For Academic Programs and Administrative & Academic Support Units  
*Planning* Document for Fiscal Year

Objective/Outcome # 3

ASSESSMENT MEASURES, CRITERIA FOR SUCCESS, AND TIME TABLE

#	Assessment Activity	Criteria: What Constitutes Success	Timeframe / Time Table
1			
2			
3			
4			
5			

Objective/Outcome # 4

ASSESSMENT MEASURES, CRITERIA FOR SUCCESS, AND TIME TABLE

#	Assessment Activity	Criteria: What Constitutes Success	Timeframe / Time Table
1			
2			
3			
4			
5			

Objective/Outcome # 5

ASSESSMENT MEASURES, CRITERIA FOR SUCCESS, AND TIME TABLE

#	Assessment Activity	Criteria: What Constitutes Success	Timeframe / Time Table
1			
2			
3			
4			
5			

---

*Annual Reporting for Institutional Effectiveness & Budgeting*  
*For Academic Programs and Administrative & Academic Support Units*  
*Reporting Document for Fiscal Year*

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Objective/Outcome # 1

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ASSESSMENT FINDINGS FOR OBJECTIVE/OUTCOME # 1

#	Findings or Results
1	
2	
3	
4	
5	

USE OF THE FINDINGS OR RESULTS FOR PROGRAM/UNIT IMPROVEMENT FOR OBJECTIVE / OUTCOME # 1

#	"Closing the Loop"
1	
2	
3	
4	
5	

## **Annotated Listing of Websites for Further Information and Direction on Assessment and Learning**

### ***General SACS sites — How Other Schools Have Done It***

SACS: Principles of Accreditation — These are the principles UTD must meet for reaffirmation.  
<http://www.sacscoc.org/principles.asp>

Auburn University: <http://www.auburn.edu/administration/specialreports/sacsdocuments.html>

Georgia Tech: <http://www.assessment.gatech.edu/SACS/index.php>

UNC Chapel Hill: [http://www.unc.edu/inst\\_res/SACS/sacs.html](http://www.unc.edu/inst_res/SACS/sacs.html)

Texas A&M International University: <http://www.tamtu.edu/sacs/>

### ***Helpful Guidance and Information on Assessment***

<http://www.bridgew.edu/AssessmentGuidebook/>

This is an excellent guide on assessment developed by the faculty at Bridgewater State University. Particularly helpful are Chapter 4: Establishing Learning Outcomes, Chapter 5: Assessment Tools (good explanations of various indirect and direct assessment methods with clear examples), and examples of Rubrics.

<http://www.skidmore.edu/administration/assessment/faq.htm#academicassessment>

In this area of Skidmore College's website, you will find brief answers to questions about the rationale of assessment. The jargon is explained clearly and concisely. Two questions and answers are particularly interesting and helpful: The question about primary trait analysis (also related to developing rubrics) and the question about the connection between assessment of majors and assessment of general education.

<http://home.okstate.edu/homepages.nsf/toc/EDUC5110iep14>

Here is an excellent site that provides effective and ineffective examples of how to write assessment items (exam questions).

<http://www.k-state.edu/assessment/manual/index.htm>

Kansas State's Office of Assessment has one of the best and most user-friendly faculty manuals available. A brief, one-page tips sheet is found under the "Assessment Tips" link.

<http://www2.acs.ncsu.edu/UPA/assmt/resource.htm>

This is a metasite for assessment resources.

### **Sites for Bloom's Taxonomy:**

*Note: There are two versions of Bloom's Taxonomy. The revised version is the one that SACS expects schools to use. Some of these websites list only the original (1956) version. They are listed here anyway if the website is extremely helpful in presenting background or explaining levels of learning.*

<http://www.coe.uga.edu/epltt/bloom.htm#end>

This is the best thorough and up-to-date explanation of Bloom's Taxonomy on the internet. There is an animation that shows verbs along with types of assessment for each level of Bloom's classification system. In addition, readers can click on a PowerPoint "test" to practice using this classification system.

<http://faculty.washington.edu/krumme/guides/bloom1.html>

This website links to a compendium of information and literature explaining Bloom's Taxonomy.

[http://web.odu.edu/educ/lischult/blooms\\_taxonomy.htm](http://web.odu.edu/educ/lischult/blooms_taxonomy.htm)

This site contains an excellent explanation of the differences between Bloom's first taxonomy and the newer, revised version.

[http://eprentice.sdsu.edu/J03OJ/miles/Bloomtaxonomy\(revised\)1.htm](http://eprentice.sdsu.edu/J03OJ/miles/Bloomtaxonomy(revised)1.htm)

The chart at the end of this site is very helpful. It includes activities and products that students could do based on Bloom's levels.

<http://www.kurwongbss.qld.edu.au/thinking/Bloom/blooms.htm>

This site is designed for public school teachers but it contains many links to explanations of Bloom's revised levels as well as excellent science examples in different areas.

### **Help With Writing Learning Objectives**

[http://www.utsouthwestern.edu/vgn/images/portal/cit\\_56417/2/53/191454Learning\\_Goals\\_&\\_Obj\\_Web.pdf](http://www.utsouthwestern.edu/vgn/images/portal/cit_56417/2/53/191454Learning_Goals_&_Obj_Web.pdf)

This PowerPoint presentation from UT Southwestern provides a helpful introduction to learning objectives.

<http://edweb.sdsu.edu/Courses/EDTEC540/objectives/ObjectivesHome.html>

This site contains a helpful tutorial on writing learning objectives.

[http://www.missioncollege.org/workforce/work\\_experience/learning.html](http://www.missioncollege.org/workforce/work_experience/learning.html)

Although this website is oriented toward writing objectives for workforce purposes, it provides helpful and easy-to-follow steps that could easily be used for classroom learning.

[http://tlt.its.psu.edu/suggestions/research/Write\\_Objectives.shtml](http://tlt.its.psu.edu/suggestions/research/Write_Objectives.shtml)

This website from Penn State gives details about common problems faculty have when writing learning objectives.

[http://captain.park.edu/facultydevelopment/writing\\_learning\\_objectives.htm](http://captain.park.edu/facultydevelopment/writing_learning_objectives.htm)

The resource links and references at the end of this website are helpful.

## Example SACS Process Documents From Physics

The following documents show UTD's Physics department's progress through the process of writing a mission statement, specifying department goals, outlining and explaining degree programs, and writing learning objectives for each course. In addition, rubrics for helping Physics faculty through this process are included.

*Note that any text in italics is not from the Physics department but was completed as an example.*

***This example includes the first three pages of a 26-page document in which the UTD Physics department faculty list their mission, goals, degree program requirements, and learning objectives for every course.***

### ***DRAFT***

#### ***Physics Department***

BOX 830688 MS FO23 RICHARDSON, TEXAS 75083-0688  
2601 N. Floyd Road, Richardson Texas 75083  
<http://www.utdallas.edu/nsm/physics/>  
(972) 883-6409, FAX (972) 883-2848

#### **Mission:**

- To provide a quality education leading to Bachelors, Masters, and Doctoral degrees in Physics.
- To offer students the opportunity to learn the fundamental principles that underlie all modern technological innovations.
- To continually develop and nurture internationally recognized research programs involving students, faculty, and research staff.

#### **Goals and Objectives:**

The Physics Department is dedicated to provide:

- the best in fundamental physics education.
- forefront physics research with student participation.
- strong student-faculty interactions.

#### **Degree Programs:**

The science of physics seeks understanding of the behavior of matter and energy at the most general and fundamental level. The physicist is trained to explore the physical universe in which people live and seeks interpretations of the natural phenomena found there. While much is known about the physical universe, many phenomena still remain to be investigated, understood, and exploited to the ultimate benefit of humankind. This is the challenge that a modern physicist faces.

#### **Undergraduate Degree Programs in Physics**

UTD Physics Department offers the Bachelor of Arts and the Bachelor of Science degrees.

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### Graduate Degree Programs in Physics

The goal of the Graduate Program in Physics is to develop individual expertise and to foster creativity in the fields of physics. In pursuit of this objective, study in the program is strongly focused on research. Students are encouraged to begin participating in ongoing research activities from the beginning of their graduate studies.

#### **DRAFT**

UTD Physics Department offers three graduate degrees: a Ph.D., a Master of Science, and a Masters of Science in Applied Physics.

### **Liaisons for Physics Degree Programs**

BS and BA in Physics:	Professor John Hoffman (jhoffman@utdallas.edu, x2846)
MS in Applied Physics:	Professor Greg Earle (earle@utdallas.edu, x6828)
MS and Ph.D. in Physics:	Professor Roy Chaney (chaneyr@utdallas.edu, x2887)
Issues and Questions:	Professor Xinchou Lou, (xinchou@utdallas.edu, x6409)

The Bachelor of Arts program provides a strong base in physics for students wishing to pursue graduate studies (non-physics) in, for example, medicine, business administration, biophysics, oceanography, and patent or high technology law. Students seeking certification as high school teachers with physics as a major specialization and those seeking employment in industry, government service, and computer technology have the opportunity to obtain the necessary physics background through this program. The lower-division course requirements for the B.A. degree are the same as those for the B.S. degree. At the upper-division level, 26 hours of physics and 15 hours of science electives are required, making a total of 122 credit hours.

### **Core/Major Physics Courses (43 hours)**

- PHYS 1100 Fun of Physics
- PHYS 2303 Contemporary Physics
- PHYS 2325/2125 Mechanics and Heat with Recitation/Laboratory
- PHYS 2326/2126 Electromagnetism and Waves with Recitation/Laboratory
- PHYS 3125 Electronics Lab
- PHYS 3311 Theoretical Physics
- PHYS 3312 Classical Mechanics
- PHYS 3325 Electronics
- PHYS 3330 Numerical Methods in Physics and Computational Techniques
- PHYS 3352 Modern Physics I
- PHYS 3416 Electricity and Magnetism
- PHYS 4311 Thermodynamics and Statistical Mechanics
- PHYS 4373 Physical Measurements Laboratory
- PHYS 4399 Senior Honors in Physics

### **Core/Major Non-physics Courses (61 hours)**

- A. Communication
  - 3 hours Communication (RHET 1302)
  - 3 hours Communication Elective
- B. Social and Behavioral Sciences
  - 6 hours Government (GOVT 2301 and 2302)
  - 6 hours American History
  - 3 hours Social and Behavioral Sciences Elective
- C. Humanities and Fine Arts
  - 3 hours Fine Arts (ARTS 1301)
  - 3 hours Humanities (HUMA 1301)

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- D. Mathematics and Quantitative Reasoning
  - 6 hours Calculus (MATH 2417 and 2419)
- E. Science
  - 8 hours Chemistry (CHEM 1311, 1111, 1312, 1112)
- F. Mathematics
  - MATH 2417 Calculus I
  - MATH 2419 Calculus II
  - MATH 2420 Differential Equations with Applications
  - MATH 2451 Multivariable Calculus with Applications
- G. Major Related Courses
  - 15 hours Science Electives

### Elective Courses (18 hours)

Advanced Electives (6 hours)

### Free Electives (12 hours)

## Goals and Objectives

*PHYS 1100 Fun of Physics* The course covers Short history of modern physics from Newton to Einstein, Schrodinger, Heisenberg, Pauli, Schwinger, Feynman, Weinberg, Glashow and Witten. Students will be introduced to various aspects of Physical sciences and the history as well as meet with physics faculty members to learn about their research activities.

*Upon completing this class, students will:*

- *Be able to converse with faculty about research.*
- *Be able to explain what makes a science a physical science.*
- *Be able to develop a timeline of major events in physics.*
- *Differentiate between various types of research in physics.*
- *Know how to identify and classify famous physicists based on their research.*
- *Know how to identify and classify departmental faculty members' current research.*
- *Support physics research by committing to observing at least 4 hours in a lab.*

*PHYS 2303 Contemporary Physics* A course designed for the cohort of entering undergraduate physics who are prepared for college-level physical derivations, but may have a preparation in calculus. The course covers geometric optics, physical optics, special relativity and an introduction to modern physics. Topics are chosen to compliment the calculus-based core physics classes that follow.

*Upon completing this class, students will:*

- *Be able to develop and explain the theory describing image formation by spherical mirrors and lenses.*
- *Be able to determine the location and magnification of images by single and multiple element optical trains, both by ray tracing and by algebraic formulae.*
- *Know how to compute requirements for various optics systems.*
- *Be able to explain in their own words the theory of diffraction and interference as applied in, single, double, and multiple slits, diffraction gratings, thin films, and interferometers.*
- *Know how to derive time dilation and length contraction, and relativistic velocity addition as a consequence of the constancy of the speed of light for observers in all frames.*
- *Be able to describe the basics of quantization of energy levels in hydrogen.*

## UTD Assessment Workbook: A Resource for Departments and Programs

*PHYS 2325/2125 Mechanics and Heat with Recitation/Laboratory* An introductory course on the basic fundamentals of physics. This is a calculus based course which will include some basic integration, differentiation, and discussion of the use of differential equations. Students will learn about the following topics: space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, simple harmonic motion, waves, and basic thermodynamic laws. PHYS 2125 is lab course.

*Upon completing this class, students will:*

- *Will be able to compute addition, scalar multiplication, and vector multiplication of vectors.*
- *Be able to analyze and explain the components of linear motion (displacement, velocity, acceleration) especially motion under conditions of constant acceleration.*
- *Be able to apply different forces and work force problems, Newton's laws and energy.*
- *Use the conservation of energy to work problems.*
- *Be able to define impulse, momentum and collisions, center of mass and rigid bodies motion.*
- *Be able to give examples of rotational variables and the relationship between linear and rotational variables.*
- *Solve problems using rotational and linear variables.*
- *Work with static equilibrium situations.*
- *Explain simple harmonic motion and waves including their properties.*
- *Identify and describe fluids in motion and at rest.*
- *Be able to tell about heat and heat transfer mechanisms in non-technical terms.*
- *Interpret the three laws of thermodynamics.*
- *Perform physics experiments to verify the physics laws and principles.*

### UTD Assessment Workbook: A Resource for Departments and Programs

This is the first page of many showing learning goals for the BA and BS in physics (required Physics courses) listed by the courses covering specific goals. Physics faculty will place checks where the goals and courses overlap. Ideally, learning goals will happen in more than one course across the program.

	Understand the scope of physics	Know the history of physics	Know about physics faculty members' research	Understand image formation including refraction and mirrors	Understand quantization and energy levels	Know how to use vectors in mathematical operations	Understand linear motion	Understand motion and acceleration	Understand Newton's laws of energy
Phys 1100									
PHYS 2303									
PHYS 2325/2125									
PHYS 2326/2126									
PHYS 3311									
PHYS 3312									
PHYS 3325/3125									
PHYS 3330									
PHYS 3352/Phys 3311									
PHYS 3416									
PHYS 4311									
PHYS 4373									
PHYS 4399									