WESTERN GOVERNORS UNIVERSITY
ONLINE. ACCELERATED. AFFORDABLE. ACCREDITED.

# *Master of Arts in*
# Science Education for Physics Teachers Grade 5–12

*The Master of Arts in Science Education (5–12, Physics) is a competency-based degree program that prepares already licensed teachers both to be licensed to teach physics in grades 5–12 and to develop significant skills in science curriculum development, design, and evaluation. All work in this degree program is online and includes Natural Science, Mathematics, General Chemistry, Physics, and Science Education. All students complete a capstone project.*

## Understanding the Competency-Based Approach

Practically speaking, what does it mean when we say that WGU programs are competency-based? Unlike traditional universities, WGU does not award degrees based on credit hours or on a certain set of required courses. Instead, students earn their degrees by demonstrating their skills, knowledge, and understanding of important concepts through a series of carefully designed assessments.

Progress through your degree program is governed, not by classes, but by satisfactory completion of the required assessments that demonstrate your mastery of the competencies. Of course, you will need to engage in learning experiences as you brush up on competencies or develop knowledge and skills in areas in which you may be weak. For this learning and development, WGU has a rich array of learning resources in which you may engage under the direction of your mentor. You will work closely with your mentor to schedule your program for completing the assessments. (We discuss assessments in much more detail later in this guide.) You will work closely with additional faculty members as you proceed through courses of study that are designed to lead you through the content you must master in order to pass individual assessments.

The benefit of this competency-based system is that it makes it possible for people who are knowledgeable about a particular subject to make accelerated progress toward completing a WGU degree even if they lack college experience. You may have gained your skills and knowledge of a subject on the job, accumulated wisdom through years of life experience, or, indeed, took a course on a particular subject. WGU awards a degree to you based on the skills and knowledge that you possess and can demonstrate, not the number of credits you have on your transcript.

## Accreditation

Western Governors University is the only university in the history of American higher education to have earned accreditation from four regional accrediting commissions. WGU's accreditation was awarded by (1) the Northwest Commission on Colleges and Universities, (2) the Higher Learning Commission of the North Central Association of Colleges and Schools, (3) the Accrediting Commission for Community and Junior Colleges of the Western Association of Schools and Colleges, and (4) the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges. The university’s accreditation status is now managed by the Northwest Commission on Colleges and Universities (NWCCU). The university is also accredited by the Distance Education and Training Council (DETC), and the WGU Teachers College is accredited by the National Council for Accreditation of Teacher Education (NCATE). The nursing programs are accredited by the Commission on Collegiate Nursing Education (CCNE).

## The Academic Action Plan (AAP)

The focus of your program is your Academic Action Plan (AAP). The AAP is a detailed blueprint of the learning resources and assessments that comprise your program. The length of your program depends on both the amount of new information you need to learn and the amount of time you plan to devote each week to study.

Students will vary widely in the specific skills and information they need to learn. For example, some may be highly knowledgeable in a subject matter and would not need to engage in new

learning opportunities. Others may find that portions of the program require completely new learning and that they may need to take an online class or participate in a study module to acquire the knowledge and skills needed to pass the program competencies in that area. Some individuals may be able to devote as little as 15–20 hours per week to the program, while others may have more time. For this reason, you will complete pre-assessments to help your mentor form a profile of your prior knowledge and experience for use in creating your AAP.

## WGU's Mentoring Approach

Our mentoring approach is a powerful component of the WGU educational experience. When you enroll at WGU, you will begin interacting with your personal mentor, course mentors, and support staff. Your mentor takes an active role and a personal interest in your success. Whether by e-mail or phone, your mentor will be your "point person" of communication throughout your program. Your mentor will help motivate you to work hard to complete your program. When you have questions or concerns, your mentor team will help you resolve them.

You and your mentor will work together to evaluate your educational background, strengths, and weaknesses. With this analysis, your mentors will help determine in which areas you are already competent (and can move quickly to assessment) and areas you need to work on; this will become your personalized AAP. Your mentor will direct you to the Courses of Study that contain the best learning resources for you (courses, texts, independent study modules, etc.) and are supported by course mentors that serve as your content experts for each area of study. As you proceed through your academic program, you and your mentor will determine when you are ready for the required assessments. If you are ready, your assessment will be scheduled. You will follow this same process as you proceed through each domain.

## Connecting with Other Mentors and Fellow Students

As you proceed through your AAP, you may also have direct contact with other faculty members. These communications can take a variety of forms, including participation in learning communities, office hours via the courses of study, and webinars. As a WGU student, you will have access to your own personal MyWGU Student Portal that will provide a gateway to courses of study, learning communities, and program communities where you will have interactions with faculty and other students. Courses of study and communities are specifically designed to support you as you develop competencies in preparation for your assessments through the utilization of threaded discussions, blogs, and chats that are guided by content experts. You will access your program community during the Education Without Boundaries introductory course to network with peers who are enrolled in your program and to receive continued support through professional enrichment and program-specific chats, blogs, and discussions. WGU also provides a Student Services Associate to help you and your mentor solve any special problems that may arise.

## Education Without Boundaries

Education Without Boundaries (EWB) is a required introductory course that focuses on acquainting the student with WGU's competency-based model, distance education, technology, and other resources and tools available for students. You will also utilize tutorials, message boards, online chats, and other activities to connect with other students in your program. During the EWB course you will be introduced to your mentor and you will develop your Academic Action Plan (AAP).

# Transferability of Prior College Coursework

Because WGU is a competency-based institution, it does not award degrees based on credits but on demonstration of competency. However, if you have completed college coursework at another accredited institution, you may have your transcripts evaluated and may be able to have some lower-division or co-requisite assessments cleared. The guidelines for determining what will “clear” through transfer vary based on the degree program.

The following transfer guidelines generally apply to graduate programs: Graduate domains (i.e., subject areas) cannot be cleared through transfer. Requirements in the domains that can be considered the degree major cannot be cleared through transfer. Furthermore, WGU does not clear any requirements based on the student's professional experience and does not perform a "resume review" or "portfolio review" that will automatically clear any degree requirements. Degree requirements and transferability rules are subject to change in order to keep the degree content relevant and current.

Remember, WGU's competency-based approach lets you take advantage of your knowledge and skills, regardless of how you obtained them. Even when you do not directly receive credit, the knowledge you possess may help you accelerate the time it takes to complete your degree program.

# Assessments

Your AAP will include the assessments needed to complete your program. To obtain your degree you will be required to demonstrate your skills and knowledge by completing the following assessments:

**Performance Assessments** contain, in most cases, multiple scored tasks such as projects, essays, and research papers. Performance assessments contain detailed instructions and rubrics for completing each task and are submitted in TaskStream, an online project management and grading tool. Performance assessments also include observations and reflections of videotaped and real classroom situations. These pre-clinical experience performance assessments provide reflection instruction and enable students to analyze teaching and learning in real classroom situations and to apply pedagogical knowledge.

**Objective Assessments** are designed to evaluate your knowledge and skills in a domain of knowledge. Most objective assessments include multiple-choice items, multiple-selection items, matching, short answer, drag-and-drop, and point-and-click item types, as well as case study and video-based items.

**Essay Assessments** are used to measure your ability to integrate and apply concepts. Your writing will be scored against competency-based rubrics established by the faculty.

**Capstone Project:** Students must also complete a capstone project. For this project students will design, develop, and evaluate an instructional product for which there is an identified need. If carefully planned in advance, individual domain projects may serve as components of the capstone. The capstone project consists of two parts: the instructional package and the written capstone report. The instructional package should include the instructional materials, activities, and assessments. The capstone report describes in detail the development of the instructional product. It must be in APA format.

**Oral Defense:** The final Master's exam will be a comprehensive oral defense. This exam may be face to face when possible but will most likely be done through a telephone conference. Questions related to your work in the program will test your preparation and ability to synthesize and practically apply information obtained from your courses, self-directed study, and project experiences. The purpose of the exam is a checkpoint to assure that you have acquired the critically required skills and knowledge specified in the program competencies.

As mentioned earlier, we have assigned competency units (CUs) to each assessment in order to measure your academic progress. As a graduate student, you will be expected to enroll in a minimum of eight competency units each term. A standard plan, at eight units per term, would look similar to the one that follows.

Your personal progress can be faster, but your pace will be determined by the extent of your transfer units, your time commitment, and your determination to proceed at a faster rate.

## STANDARD PATH FOR MASTER OF ARTS, SCIENCE EDUCATION (5-12, PHYSICS)

| CODE | ASSESSMENTS | CU | TERM |
|---|---|---|---|
| **EWOB** | Education Without Boundaries | 1 | 1 |
| **GNC2** | Integrated Natural Sciences | 3 | 1 |
| **INT2** | Integrated Natural Science Applications | 3 | 1 |
| **BOC2** | Precalculus and Calculus | 1 | 1 |
| **BOT2** | Problems in Precalculus and Calculus | 1 | 2 |
| **BQC2** | Chemistry Theories and Concepts | 3 | 2 |
| **BQT2** | Chemistry Lab | 3 | 2 |
| **BYT2** | Physics: Mechanics | 2 | 2 |
| **BZT2** | Physics: Waves and Optics | 2 | 3 |
| **DPT2** | Physics: Electicity and Magnetism | 2 | 3 |
| **PHT2** | Modern Physics | 3 | 3 |
| **PNC2** | Integrated Physics | 4 | 3 |
| **DEC2** | Specific Teaching Practices: Science Pedagogy | 1 | 4 |
| **HMT2** | Specific Teaching Practices: Science | 3 | 4 |
| **IKT2** | MA, Science Education (5-12, Physics) Teacher Work Sample Written Project | 3 | 4 |
| **ILT2** | MA, Science Education (5-12, Physics) Teacher Work Sample Oral Defense | 3 | 4 |

In this example, the program will take four terms for the student to complete. The standard path shown above lists the courses of study (assessments) and the associated competency units by term. The AAP will include greater detail about the courses of study, including the assessments and their associated standard learning resources.

## Learning Resources

You will work with your mentor to select the various learning resources needed to prepare for the required assessments. In most cases, the learning materials you will use are independent learning resources (ILRs) such as textbooks, e-learning modules, study guides, simulations, virtual labs, and tutorials. WGU works with dozens of educational providers, including enterprises, publishers, training companies, and higher educational institutions to give you high quality and effective instruction that matches the competencies that you are developing. The cost of many learning resources is included in your tuition, and you can enroll directly in those through your AAP as your mentor has scheduled them. Some resources (e.g., many textbooks) are not covered by your tuition, and you will need to cover those costs separately. WGU has excellent bookstore and library arrangements to help you obtain the needed learning resources.

# *Areas of Study Within the Bachelor of Arts in Science (5–12, Physics)*

The WGU Master of Arts in Science Education (5–12, Physics) program content is based on research on effective instruction as well as national and state standards. It provides the knowledge and skills that enable teachers to teach effectively in diverse classrooms. The M.A. in Science Education (5–12, Physics) program content and training processes are consistent

with the accountability intent of the No Child Left Behind Act of 2001. The degree program is focused on the preparation of highly qualified teachers. As described in the federal legislation, a highly qualified teacher is one who not only possesses full state certification, but also has solid content knowledge of the subject(s) he or she teaches. The hallmarks of our program include: (a) appropriate and rigorous subject-matter preparation, (b) research-based pedagogical course preparation, and (c) clinical field experiences in which teacher candidates are supervised by trained coaches.

The following section includes the larger domains of knowledge, which are then followed by the subject-specific subdomains of knowledge, their associated assessments (including the four-character code that is used to identify the assessment), and the sample learning resources that have recently been used to help students gain the competencies needed to pass the assessments. Your specific learning resources and level of instructional support will vary based on the individual competencies you bring to the program and your confidence in developing the knowledge, skills, and abilities required in each area of the degree. Please note that the learning resources included in the following sections are *sample resources* that will vary based on your own academic action plan (AAP) and the resources current at the time you enroll in the program. The AAP and learning resources are dynamic, so you need to review your AAP and seek the advice of your mentor regarding the resources before you purchase them.

# General Science Content Domain

Below are all of the subdomains that make up this content domain. Each subdomain is made up of specific competencies, or performance descriptions, that correspond to the specific skills or knowledge areas you must master.

## Natural Science

*Content focuses on scientific concepts and inquiry as well as key concepts across and within the scientific disciplines.*

**Integrated Natural Sciences (GNC2)**
Proctored, computer-based objective exam

**Integrated Natural Sciences Applications (INT2)**
Performance assessment that utilizes scientific inquiry and analysis of evidence

**Sample Learning Resources:**

Integrated Natural Science. An online resource includes an e-text version of the following text:

Hewitt, P. G., Lyons, S., Suchocki, J., & Yeh, J. (2007). *Conceptual integrated science*. (1st ed.). San Francisco: Addison-Wesley. ISBN 0805390383.

Thinkwell's Scientific Inquiry. An online text that communicates the fundamentals of science to students using interactive media.

## Precalculus and Calculus

*In this subdomain, students will concentrate on the trigonometric, logarithmic, exponential, polynomial, and rational functions. There will also be a study of limits, continuous functions, differentiation, and integration.*

**Precalculus and Calculus (BOC2)**
Proctored, computer-based objective exam

**Problems in Precalculus and Calculus (BOT2)**
Performance assessment

**Sample Learning Resources:**

Safier, F. (1998). *Schaum's outline for precalculus* (4th ed.). New York: McGraw-Hill Companies. ISBN-13: 9780070572614.

Ayres, F., & Mendelson, E. (1999). *Schaum's outline of calculus* (4th ed.). New York: McGraw-Hill Companies. ISBN-13: 9780070419735

Thinkwell Precalculus CD and Workbook. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

Thinkwell Calculus for Science. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

## Chemistry

*The focus in this subdomain is on chemical structure, chemical reactions, stoichiometry, solutions, rates, and energy changes.*

**Chemistry Theories and Concepts (BQC2)**
Proctored, computer-based assessment

**Chemistry Lab (BQT2)**
Performance assessment

**Sample Learning Resources:**

Zumdahl, S. & Zumdahl, S. (2007). *Chemistry* (7th ed.). Boston: Houghton Mifflin Company. ISBN-13: 9780618528448.

Chemistry Lab provided by Latenitelabs. Chemistry Lab is a simulation program that encourages learning by allowing you to model and experiment with virtual chemicals.

Labpaq: Science Methods. These self-contained laboratory kits include the lab manual, science equipment, specimens, supplies, and chemicals necessary to complete college laboratory experiments at home. The experiments reinforce science content and teach laboratory techniques.

Thinkwell Chemistry. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

# Physics Content Domain

This domain covers mechanics, waves and optics, electricity and magnetism, and modern physics.

## Mechanics

*This subdomain covers the following topics: describing motion; Newton's laws of motion; gravitation and Newton's synthesis; work and energy; momentum and collisions; rotational motion; static equilibrium; fluids; and oscillations.*

**Physics: Mechanics (BYT2)**
Performance assessment

**Sample Learning Resources:**

Hewitt, P. (2006). *Conceptual physics (with practicing physics workbook)* (10th ed.). San Francisco: Addison Wesley. ISBN-13: 9780805393750.

Touger, J. (2006). *Introductory physics: Building understanding*. Hoboken, NJ: Wiley. ISBN-13: 9780471940005.

Bloomfield, L. A. (2006). *How things work: The physics of everyday life* (3rd ed.). Hoboken, NJ: Wiley. ISBN-13: 9780471468868.

Labpaq: Physics. This self-contained laboratory kit includes the lab manual, science equipment, and supplies necessary to complete college-level laboratory experiments at home. The experiments reinforce science content and teach laboratory techniques.

Thinkwell Physics I. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

American Museum of Natural History: Space Time and Motion. This online resource uses multimedia and discussions to connect teachers and future teachers from around the world to cutting-edge research, classroom resources, and each other.

## Waves and Optics

*This subdomain covers the following topics: wave motion, sound, temperature, thermal expansion, and the ideal gas law; kinetic theory and gases; laws of thermodynamics; light; lenses and optical instruments; the wave nature of light; and diffraction and polarization.*

**Physics Part: Waves and Optics (BZT2)**
Performance assessment

**Sample Learning Resources:**

Hewitt, P. (2006). *Conceptual physics (with practicing physics workbook)* (10th ed.). San Francisco: Addison Wesley. ISBN-13: 9780805393750.

Touger, J. (2006). *Introductory physics: Building understanding*. Hoboken, NJ: Wiley. ISBN-13: 9780471940005.

Bloomfield, L. A. (2006). *How things work: The physics of everyday life* (3rd ed.). Hoboken, NJ: Wiley. ISBN-13: 9780471468868.

Labpaq: Physics. This self-contained laboratory kit includes the lab manual, science equipment, and supplies necessary to complete college-level laboratory

experiments at home. The experiments reinforce science content and teach laboratory techniques.

Thinkwell Physics I. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

## Electricity and Magnetism

*This subdomain covers the following topics: electric charge and electric field; electric currents and resistance; magnetism; electromagnetic induction and faraday's law; and Maxwell's equation and electromagnetic waves.*

**Physics: Electricity and Magnetism (DPT2)**
Performance assessment

**Sample Learning Resources:**

Hewitt, P. (2006). *Conceptual physics (with practicing physics workbook)* (10th ed.). San Francisco: Addison Wesley. ISBN-13: 9780805393750.

Touger, J. (2006). *Introductory physics: Building understanding*. Hoboken, NJ: Wiley. ISBN-13: 9780471940005.

Bloomfield, L. A. (2006). *How things work: The physics of everyday life* (3rd ed.). Hoboken, NJ: Wiley. ISBN-13: 9780471468868.

Labpaq: Physics. This self-contained laboratory kit includes the lab manual, science equipment, and supplies necessary to complete college-level laboratory experiments at home. The experiments reinforce science content and teach laboratory techniques.

## Modern Physics

*This subdomain covers the following topics: birth of modern physics; Quantum Theory and models of the atom; Special Theory of Rrelativity and quantum mechanics; molecules and solids; nuclear physics and radioactivity; elementary particles; astrophysics; cosmology; and general relativity.*

**Modern Physics (FWT2)**
Performance assessment

**Sample Learning Resources:**

Krane, K. (1996). *Modern physics* (2nd ed.). Hoboken, NJ: Wiley. ISBN-13: 9780471828723.

Hewitt, P. (2006). *Conceptual physics (with practicing physics workbook)* (10th ed.). San Francisco: Addison Wesley. ISBN-13: 9780805393750.

Touger, J. (2006). *Introductory physics: Building understanding*. Hoboken, NJ: Wiley. ISBN-13: 9780471940005.

Bloomfield, L. A. (2006). *How things work: The physics of everyday life* (3rd ed.). Hoboken, NJ: Wiley. ISBN-13: 9780471468868.

Labpaq: Physics. This self-contained laboratory kit includes the lab manual, science equipment, and supplies necessary to complete college-level laboratory

experiments at home. The experiments reinforce science content and teach laboratory techniques.

Thinkwell Physics I. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

American Museum of Natural History: Space Time and Motion. This online resource uses multimedia and discussions to connect teachers and future teachers from around the world to cutting-edge research, classroom resources, and each other.

### Comprehensive Objective Assessment

*This assessment measures student knowledge for the entire domain. This includes topics covered in the following subdomains: mechanics; waves and optics; electricity and magnetism; and modern physics.*

**Integrated Physics (PNC2)**

Proctored, computer-based comprehensive objective assessment

## Subject-Specific Teaching Methods (Secondary Science) Domain

This domain builds the competence necessary for graduates to understand and provide safe, effective, research-based instruction in science. You may not transfer credits or prior years of teaching experience from other institutions to meet requirements of this domain.

### Specific Teaching Practices (Science)

*Content focuses on the knowledge and skills necessary to provide safe, effective, research-based instruction in science.*

**Specific Teaching Practices: Science (HMT2)**

Performance assessment

**Specific Teaching Practices: Science Pedagogy (DEC2)**

Proctored, computer-based objective exam

**Sample Learning Resources:**

CourseCompass: MyLabSchool. This learning resource includes video clips used for Pre-Clinical Experiences. Students view the video clips as directed and submit reflections.

Gallagher, J. J. (2007). *Teaching science for understanding: A practical guide for middle and high school teachers*. Columbus, Ohio: Pearson. ISBN-13: 9780131144255.

King, K. P. (2007). *Integrating the national science education standards into classroom practice*. Columbus, Ohio: Pearson. ISBN-13: 9780131173453.

Moyer, R. H., Hackett, J. K., & Everett, S. A. (2007). *Teaching science as investigations: Modeling inquiry through learning cycle lessons*. Columbus, Ohio: Pearson. ISBN-13: 9780132186278.

Pearson: Teaching Science Grades 5–12. This resource includes a CD that is shipped via UPS and includes the following online text:

Chaippetta, E., Koballa, & Thomas, R. (2002). *Science instruction in the middle and secondary schools* (5th ed.).

## Teacher Work Sample Written Project

The Teacher Work Sample Written Project is the culmination of the student's WGU degree program. It requires the demonstration of competencies through a deliverable of significant scope that includes both a written project and an oral defense.

**MA, Science Education (5-12, Physics) Teacher Work Sample (IKT2)**

The Teacher Work Sample is a written project containing a comprehensive, original, research based curriculum unit designed to meet an identified educational need. It provides direct evidence of the candidate's ability to design and implement a multi-week, standards-based unit of instruction, assess student learning, and then reflect on the learning process. The WGU Teacher Work Sample requires students to plan and teach a multi-week standards-based instructional unit consisting of seven components: 1) Contextual factors, 2) learning goals, 3) assessment, 4) design for instruction, 5) instructional decision making, 6) analysis of student learning, and 7) self-evaluation and reflection.

**MA, Science Education (5-12, Physics) Teacher Work Sample Oral Defense (ILT2)**

The final master's exam will be a comprehensive oral defense. This exam may be face-to-face when possible but will most likely be by telephone conference. The oral defense will include a presentation (typically PowerPoint) and defense of the Teacher Work Sample (TWS). Candidates will be asked to reflect upon the TWS, note its strengths and weaknesses, discuss its impact on student learning, and suggest future improvements. Questions related to a candidate's work in the program will test their preparation and ability to synthesize and practically apply information obtained from courses, self-directed study, and project experiences. The purpose of the exam is a checkpoint to ensure that students have acquired the critically required skills and knowledge specified in the program competencies.

## Need More Information? WGU Student Services

You may also contact the Student Services office by e-mail at **studentservices@wgu.edu** or by phone at 1-866-903-0110, **Monday through Friday from 6:00am to 8:00pm, MT, and Saturday from 9:00am to 1:00pm, MT**, for general student questions or concerns. Contact the service desk for technical support issues by accessing the "HELP" tab at **http://my.wgu.edu** or by phone at 1-877-HELP-WGU (801-435-7948). **The WGU IT Service Desk is open Monday through Friday from 6:00am to midnight, MT, and Saturday and Sunday from 10:00am to 7:00pm, MT.** You can visit the student portal at **http://my.wgu.edu** for the most current information regarding WGU support services and contact information for individual WGU staff.