MEMO

FROM:	OHIO Transfer Credit and Articulation Management (contact: Jessica Holliday)
CC:	UCC General Education Committee (contact: Todd Eisworth)
SUBJECT:	**Ohio Transfer 36 (OT36) Submission Process**
DATE:	November 23, 2021

The purpose of this document is to provide step-by-step instructions[1] for processing courses for Ohio Transfer 36 (OT36, formerly known as Ohio Transfer Module OTM) approval. Details about the OT36 are available through the Ohio Department of Higher Education (ODHE) at https://www.ohiohighered.org/Ohio-Transfer-36.

Step 1: Identify an OHIO BRICKS component for the course

This memo is most relevant to BRICKS components that are currently restricted to courses with OT36 approval (listed below). Further details about the structure of BRICKS are available online from the UCC General Education Committee.

Category	Component	Min. Hrs	OT36 Area of Distribution
Foundations	Written Communication	3	OT36 First Writing
Foundations	Quantitative Reasoning	3	OT36 Mathematics, Statistics, and Logic[2]
Pillars	Humanities: Texts and Contexts	3	OT36 Arts and Humanities
Pillars	Humanities: Arts	3	OT36 Arts and Humanities
Pillars	Natural Sciences	3	OT36 Natural Sciences
Pillars	Social or Behavioral Sciences	3	OT36 Social and Behavioral Sciences
Arches	Constructed World	3	OT36 Arts and Humanities -OR- OT36 Mathematics, Statistics, and Logic[2]
Arches	Connected World	3	OT36 Social and Behavioral Sciences
Arches	Natural World	3	OT36 Natural Sciences

Step 2: Match course learning outcomes to the OHIO BRICKS component learning outcomes.

Learning outcomes for breadth of knowledge and common goals for OHIO BRICKS are available online from the University Curriculum Council's General Education Committee.

Please consider the extent to which the course achieves learning outcomes for the intended OHIO BRICKS component and the extent to which any course adjustments will need to be made. If the course is already approved as a general education course under Tiers or OHIO BRICKS and minor course adjustments are needed, the process for UCC approval may occur concurrently with the process for OT36 approval. If the course is not currently approved as a general education course or the course needs significant updates to meet the learning outcomes, the course will need to be submitted and conditionally approved through UCC general education course approvals before submitting to OT36.

Please contact Todd Eisworth (eisworth) or Beth Quitslund (quitslun) with questions about the OHIO BRICKS and/or UCC general education course approvals.

[1] Please contact the Associate Director for Transfer Credit and Articulation Management, Jessica Holliday (email: hollidaj)with questions or for additional details.

[2] ODHE has recently changed the way in which this category is administered, and they no longer have a generic category for quantitative courses. For more information, please contact Todd Eisworth (email: eisworth@ohio.edu) .

Step 3: Identify an appropriate area of distribution of the Ohio Transfer 36 (OT36).

State-specified guidelines and learning outcomes for the OT36 areas of distribution are available online through the OT36 Guidelines and Learning Outcomes website. Generally, all guidelines require that courses are not remedial, special topics, upper-division (3000 or 4000), or narrowly defined / technical. Areas of distribution also have area-specific guidelines and limitations.

Step 4: Complete the OT36 CEMS Submission Preparation Template.

For each area of distribution, the state provides an OT36 Course Equivalency Management System (CEMS) Submission Preparation Template online (OT36 Guidelines and Learning Outcomes). Each template lists the broad OT36 learning outcomes and area of distribution guidelines. Each template requires descriptions of learning and assessment activities that meet outcomes and areas of distribution guidelines.

ODHE provides helpful hints and sample syllabi by area of distribution online. Examples of completed templates are provided in *Appendix B* at the end of this document.

Step 5: Complete the OT36 CEMS Course Inventory Form.

To submit courses for OT36 approval, course data must be submitted to ODHE's Course Equivalency Management System (CEMS). Required course data includes course title, transcript ID, start term / year, credithours (including lecture / lab hours per week), the catalog description, instruction goals or objectives, and description of assessment. Required attachments include a working syllabus and pre-/co-requisite syllabi.

This information should be reported through the Course Inventory form provided in *Appendix A* at the end of this document.

Step 6: Submit the completed template, inventory form, current syllabus, and supplemental materials ***(if necessary)*****.**

OHIO's Associate Director for Transfer Credit and Articulation Management (or designee) submits all applications for OT36-approval. Materials must be submitted to the Associate Director no later than two weeks prior to the ODHE's OT36 submission deadline. For 2021-221, deadlines to submit completed materials to the Associate Director are **September 17, 2021,** and **February 18, 2022**.

Step 8: Receive feedback and/or confirmation of submission.

The Associate Director for Transfer Credit and Articulation Management (or designee) will review all materials, ask for clarifications or revisions (if necessary), and submit documentation for review. Applicants will receive confirmation of submission before the ODHE OT36 submission deadlines (October 1, 2010, or March 4, 2022).

Step 9: Receive feedback and/or confirmation of approval.

Faculty review panels for ODHE's Ohio Articulation and Transfer Network review submissions twice per year. The review cycle timeline for 2021-22 is October 15 – November 12, 2021, and March 18 – April 15, 2022.

After each review period, the Associate Director for Transfer Credit and Articulation Management (or designee) will be notified of decisions and provided feedback (if needed). The Associate Director for Transfer Credit and Articulation Management (or designee) will share this information with faculty via email.

Appendix A: Course Inventory Form

Course #	
Course Title	
Campuses (Main, Regional)	
Beginning Term (when is (was) it offered for the first time?)	
Total Credit Hours (including the entire course, lecture/lab)	
Contact Hours	Lecture: Lab:
Co-/Pre-requisite	
Catalog Description	
Textbook/Lab Manual	ISBN: Title: Publisher: Author: Edition: Copyright Year: Additional Notes:
Outside Readings/Ancillary Materials/ Instructional Resources	Note: If you are using open-source materials, please provide a complete list and web URL for all open source materials being used/considered for the course.
Instructional Goals or Objectives	
Description of Assessment and/or Evaluation of Student Learning	(Graded Assignments Including Points and Grading Scale (e.g., A = 90-100, B = 89-80, etc.))
Additional Information	

Required attachments: Course syllabus and pre-/co-requisite syllabi

Appendix B: Sample Preparation Templates

Arts and Humanities Submission Preparation Template
Include **s**ample assessments (for example, writing prompts) through which students demonstrate achievement of OT36 learning outcomes.

The learning outcome related to textual analysis requires that students "analyze, interpret, and/or evaluate primary works that are products of human imagination and critical thought." Be sure that course submission documents clearly identify primary works from arts and humanities disciplines (for example, works of art, music, literature, philosophy, etc.) with which students interact.

Ohio Transfer 36 Learning Outcomes	Your Students' Learning Experiences (all fields required)
1. **Basic Knowledge:** employ principles, terminology, and methods from disciplines in the arts and humanities.	By the end of this course, students should be able to: 1) define key concepts and terms relating to imperial Roman culture; 2) identify and define major developments in imperial Roman history. These outcomes are achieved by completion of class reading assignments and attendance at class lectures, where readings are discussed and new material is presented. Assessment of these outcomes is conducted by student class presentations (10% of grade), regular quizzes on reading assignments (60%), and two papers (30%). These assessments are described on pp. 1-2 of the course syllabus.
2. **Textual Analysis:** analyze, interpret, and/or evaluate primary works that are products of the human imagination and critical thought.	By the end of this course, students should be able to: 1) analyze and evaluate literary texts for reliability and utility in studying imperial Roman society's ideas and values; 2) recognize bias or predisposition in accounts given by primary literary sources. Class activities and guided discussions will model the process of analysis by asking students to identify the (hidden or overt) perspectives, biases, and views of

	the text's author, to explain what ideas (hidden and overt) the author is attempting to convey to the reader, and to evaluate its utility for understanding the development of human thinking about war in the ancient world. Students demonstrate this learning through performance in class presentations (10% of grade), quizzes (60% of grade), and writing assignments (30% of grade). The paper assignment is described in the attachment to the syllabus, and a grading rubric is provided to students (attached). In the assignment, students analyze several imperial Roman texts, interpret them as works of human thought, and present this assessment in an analytical argument.
3. **Contextual Examination:** reflect on the creative process of products of the human imagination and critical thought.	By the end of this course, students will be able to: 1) explain how and why developments in Roman imperial society occurred; 2) describe the effects of imperial intervention on contemporary Roman society. Class activities and guided discussions will model the process of examination by asking students to explain how various imperial Roman cultural products fit within their historical, literary, and/or artistic context, to identify the factors that influenced the formation of their authors' ideas, and to explain how developments in imperial Roman society led to changes in Roman thinking about their culture. This is assessed through student performance in class presentations (10% of grade), quizzes (60% of grade), and writing assignments (30% of grade). For example, on the midterm writing assignment,

	students are asked (among other things) to describe how Roman emperors presented their families and their regimes through official messaging on coins.
4. **Breadth:** explain relationships among cultural and/or historical contexts.	By the end of this course, students will be able to: 1) explain how and why developments in Roman imperial society occurred; 2) describe the effects of imperial intervention on contemporary Roman society. Class activities and guided discussions will model the process of examination by asking students to explain how changes in the imperial program reflected or caused changes in contemporary society, and to identify how particular aspects of an imperial dynasty influenced Roman thinking and values. For example, on the final writing assignment, students are asked to discuss in detail how Roman thought regarding the role of the emperor changed during the two centuries covered in the course, supporting their claims with specific evidence from the materials studied during the semester.
5. **Communication:** convey concepts and evidence related to humanistic endeavors clearly and effectively.	By the end of this course, students should be able to develop an effective argument both orally and in writing. Oral communication skills are emphasized in student presentations (10% of grade), when students are asked to explain their analysis and interpretation of texts, and argue how and why specific elements of the imperial program transformed imperial Roman society. Writing skills are assessed in the paper assignments (30% of grade), where students are given a rubric that sets out the

	expectations of an effective written argument.
Acknowledgement	**Please acknowledge that you have read the guidelines for types of courses approved for and excluded from the Arts and Humanities category of Ohio Transfer 36.**
The Ohio Transfer 36 requires at least 6 semester hours of course credit in Arts and Humanities. • Students completing courses in the Arts and Humanities category should achieve the learning outcomes above through the study of humanities disciplines such as the arts, music, theatre, film, literature, philosophy, and history. Students must select courses from at least two different disciplines to fulfill Ohio Transfer 36 minimum requirements. • Ohio Transfer 36 Arts and Humanities courses should be introductory-level courses that focus on the study of human endeavors spanning historical periods, regions, and/or cultures. • Course materials should clearly articulate how students interact with primary sources, which may include (but are not limited to) works of art, music, theatre, film, literature, or philosophy. **<u>Excluded courses:</u>** • Remedial or developmental courses, special topics courses, narrowly focused courses, and technical or pre-technical courses. • Courses that focus exclusively on content coverage without addressing the learning outcomes for the Ohio Transfer 36. • Career preparation courses, non-credit continuing education courses, and life experience courses (unless life experience credit, such as military training or other prior learning experience, becomes approved in the future for an Ohio Transfer 36 credit by the statewide faculty review panel). • Courses that are primarily designed for skill development (e.g., applied music lessons, studio art, symbolic or formal logic, theatre skills, creative writing, and foreign language). To be approved, foreign language courses must devote a majority of the course content to literature and not be grammar and/or skills-based. Skills-based activities, whether graded or not, may support the learning process in an Ohio Transfer 36 Arts and Humanities course, as long as the primary focus or goal of the course is not skill development.	Yes, I have read these guidelines. • This is a Classics course, which has been a core interdisciplinary discipline in American higher education from the beginning. This course primarily falls within the disciplines of literature and history, although art, theatre, religion, and philosophy are also prominent. • This is an introductory course at the 2000-level focuses broadly on the study of human endeavor and experience in the ancient world, spanning nearly three centuries of human history in ancient Italy and the broader Mediterranean world. • The course materials heavily emphasize primary sources, particularly ancient historical and literary texts. Most in-class discussions focus on discussing primary texts. • This course is not remedial, developmental, special topics, technical or

	pre-technical, and is not narrowly focused. • This course emphasizes the learning outcomes for the Ohio Transfer 36. • This is not a career preparation course, non-credit course, or life experience course. • This course is not designated primarily as skill development.

Social and Behavioral Sciences Submission Preparation Template

Ohio Transfer 36 Learning Outcomes (All of the fields are required)	**Your Students' Learning Experiences and Evidence to Meet the Ohio Transfer 36 Learning Outcomes**
1. **Core Knowledge**: Students will be able to explain the primary terminology, concepts, and findings of the specific social and behavioral science discipline.	In analyzing the historical development of technology, students employ the terminology of primary concepts from history including "context" (including political, social, cultural, and environmental context), "contingency," "determinism," "presentism," "primary sources," "secondary sources," and others in students' reading responses, in-class writing assignments, and exam and essay assignments. These are terms in concepts that are explained in detail in the lectures. Students regularly summarize core findings about key historical events in the history of technology (as described in assigned readings and in lectures) in the same assignments as well as answer fact-based quizzes. In formative assignments, especially discussion classes, students practice explaining the primary terminology, concepts, and findings. Students are assessed on their success in doing so in summative assignments, especially exams and essays.
2. **Theory**: Students will be able explain the primary theoretical approaches used in the specific social and behavioral science discipline.	Students summarize and evaluate different and competing theoretical explanations for historical change in the realm of technology in the in-class writing assignments (formative), reading responses (summative), and exam and essay assignments (summative). Just a few of these theoretical approaches include:

	structural "normal accidents" (Perrow) versus isolated causes of disaster; whether innovation (e.g. interpretations from archaeology & anthropology on technology as a form of hominid adaptation) or maintenance (e.g. Hanley, Smith) is dominant in technological development; whether automation enhances (Babbage) or degrades (Marx) the role of skill in human work; how social networks and cultural contexts play a role in technology transfer (e.g. Jannetta, Fitzgerald); whether or not gendered innovation can expand the inclusivity of technologies (e.g. Schiebinger); whether the development of technological systems is driven more by external societal politics and culture or internal momentum (Hughes); whether technologies tend merely to reflect and exaggerate existent social practices or to change them (e.g. Turkle, boyd).
3. **Methodology**: Students will be able to explain the primary quantitative and qualitative research methods used in the specific social and behavioral science discipline.	Students explain in reading responses (summative assessment) and in-class discussions and in-class written assignments (formative assignments) how different historians (see week-by-week readings on syllabus) have used close analysis of primary sources, detailed contextualization, and consideration of various theoretical approaches from secondary sources to answer questions about the historical development of technology. In this way, students regularly explain the qualitative research methods that are used in the discipline of history: how historians apply theoretical

	interpretation, empirical investigation, and in some cases comparative analysis to understanding past cultures and societies. Students are also assessed on their ability to articulate historical methodology in two essay assignments, which require students to cite and explain the significance of secondary sources.
4. **Values**: Students will be able to explain the primary ethical issues raised by the practice and findings of the specific social and behavioral science discipline.	Students describe, evaluate, and thus explain the practice and findings of historians regarding primary ethical issues involved in doing the history of technology. These are discussed as part of the course's main content. These primary ethical issues include: how historians assess ways in which technologies benefit some groups while disadvantaging others; how global narratives of technology that may variously reflect Orientalism, emphasize diffusion, or attempt to see a society on their own terms influence historians' approaches to evidence from the past, especially concerning foreign societies and cultures; how historians have addressed ways in which technological change impacts social inequalities of class, race, and gender; how historical analyses of technology have approached the ethics of whether high-risk technologies are worth developing and deploying. Students' ability to explain these issues is therefore assessed in every summative assignment in the course.
5. **Evidence**: Students will be able to explain the range of relevant information sources in the specific social and behavioral science discipline	In students' reading responses, in-class writing and speaking assignments, and exam and essay assignments, students engage with primary and secondary

	sources and draw conclusions about technological development using different types of primary and secondary sources, including material evidence (artifacts), visual evidence, and written evidence. Students select and cite relevant information from primary and secondary sources in order to draw explanatory conclusions about the historical development of specific technologies in regular reading responses, two extended essay assignments, as well as in an exam.
Acknowledgement	**Please acknowledge that you have read the guidelines for types of courses approved for and excluded from the Social and Behavioral Sciences category of Ohio Transfer 36.**
The Ohio Transfer 36 requires at least 6 semester hours of course credit in the Social and Behavioral Sciences. Ohio Transfer 36 Social and Behavioral Sciences courses should be introductory-level courses that explain the behavior of individuals and/or various groups in societies, economies, governments, and subcultures through empirical investigation and theoretical interpretation. ***Excluded courses*:** • Remedial or developmental courses, special topics courses, narrowly focused courses, technical or pre-technical courses and skills-based courses. • Courses that focus exclusively on content coverage without addressing the learning outcomes for the Ohio Transfer 36. • Career preparation courses, non-credit continuing education courses, life experience courses (unless life experience credit, such as military training or other prior learning experience, is approved in the future for an Ohio Transfer 36 credit by the statewide faculty review panel). Students completing courses in the Social and Behavioral Sciences category should achieve the following learning outcomes through the study of social and behavioral sciences disciplines such as anthropology, economics, geography, history, political science, psychology and sociology. Students must select courses from at least two disciplines.	I acknowledge that I have read the guidelines for types of courses approved for and excluded from the Social and Behavioral Sciences category of Ohio Transfer 36.

Mathematics, Statistics, and Logic Submission Preparation Template[2]
Attach 5-6, if not all, sample assessment materials for the course. The panel reviews assessments to determine the rigor of the course per the definition of a college-level mathematics course and the depth of student learning outcome per Ohio Transfer 36 criteria.

TMM021 Mathematics in Elementary Education I Learning Outcomes (All of the fields are required)	Your Students' Learning Experiences and Evidence to Meet the TMM021 Learning Outcomes
	Please provide in details the learning and assessment activities and exercises that students undergo in order to meet all of the learning outcomes.
All learning outcomes are required and must be met.	Please provide as part of the submission in the Course Equivalency Management System (CEMS) 1) a working syllabus, 2) sample assessments (e.g., quizzes, exams, assignments, etc.), and 3) a syllabus for pre-req and/or co-req course if the course is required.
1. Numbers The successful Mathematics in Elementary Education student can: **1a.** Discuss the intricacies of learning to count, including the distinction between counting as a list of numbers in order and counting to determine a number of objects, and use pairings between elements of two sets to establish equality or inequalities of cardinalities. *	• Evaluate videos of children counting to identify common errors made by children and how to respond to those errors • Identify examples of one-to-one correspondence that would be meaningful to children (e.g., does everyone have one crayon) and use these example to make claims about less than/more than • Analyze and describe struggles children may have with "teen" numbers as compared to how teen number are presented (e.g. inconsistent naming convention, not named with a meaning connection to place value twelve vs twenty-two. For example, 17 is read as seventeen while 27 is read as twenty-seven. This is difficult for children who are just beginning to read and learning to always read left to right. Textbook sections 1.1 focus on counting and 1.3 focus on comparing numbers.

1b. Attend closely to units (e.g., apples, cups, inches, etc.) while solving problems and explaining solutions. *	Units are address in all problem solving throughout the course. Additionally, units are specifically addressed in working with place value manipulatives and fractions. • Students are asked to determine the value of base ten blocks if a “super cube” (10cm x10cmx10cm cube) represents 1 or if a “flat” (1cm x10cmx10cm cube) represents 1. Similarly, if 100 paperclips/toothpicks represents 1, what is the value of 1 paperclip/toothpick? • Problem such as the Cookie Jar Problem: “There was a jar of cookies on the table. AJ was hungry because he hadn’t had breakfast, so he ate half the cookies. Then Abby came along and noticed the cookies. She thought they looked good, so she ate a third of what was left in the jar. Matt came by and decided to take a fourth of the remaining cookies with him to class. Then Liz came dashing up and took a cookie to munch on. When Logan got to the cookie jar, he saw that there were two cookies left. “How many cookies were in the jar to begin with?” he asked James.” Require student to carefully to attend to units as cookies eaten and cookies not eaten. • Carefully constructed images in which students count objects require them to attend to units in different ways (e.g., counting the dots displayed on an array of dice). Sections 1.1 address unit in place value, section 2.1 address units in problem solving, and all sections require some attention to units.
1c. Discuss how the base-ten place value system (including extending to decimals) relies on repeated bundling in groups of ten and how to	• Students organize sets of objects (toothpicks or paperclips) into

use objects, drawings, layered place value cards, base-ten blocks, and numerical expressions (including integer exponents) to help reveal base-ten structure. *	bundles of ten, then bundles of bundles of 10 (10 bundles of 10 each placed into a baggie) to show place values into hundreds. • Given a set of objects grouped in ways not consistent with our base ten system, regroup them to align with our base ten system. • Write numbers in expanded notation (312 = 30+10+2). • Use base ten blocks and layer place value cards to represent numbers • Use objects (money, paperclips and base ten blocks) to represent decimals. For paper clips define 1 paper clip as 0.1, or 0.01. For base ten blocks consider examples where the 10x10x10 cube is 1 or where the 10x10x1 flat is 1. • Given an arrangement of base ten blocks, students name multiple different numbers that could be represented by the arrangement (depending which block is taken to equal 1) • Explore multiple ways to represent a single number (37= 3 tens & 7 ones, 2 tens & 17 ones, etc) • Use ten frames to think about different ways of composing numbers (e.g., 7 is 5 and 2) and representing 10 (10 is 7 and 3) Section 1.1 addresses place value, 1.2 addresses represent places values to the right of the decimal and section 1.4 addresses round to particular place values.
1d. Use the CCSS (Common Core State Standards) development of fractions: * • Start with a whole. • Understand the fraction 1/b as one piece when the whole is divided into b equal pieces. • Understand the fraction a/b as a pieces of size 1/b and that the fraction a/b may be larger than one.	• Write an expression that shows how you would solve the following problem: Ms. Smith decided that 35 apples would be enough to feed one third of the class. How many apples will she need to buy to feed her whole class? Possible answers: 35 + 35 + 35, 3 x 35, 35 = (1/3)X

• Understand fractions as numbers that can be represented in a variety of ways, such as with lengths (esp. number lines), areas (esp. rectangles), and sets (such as a collection of marbles). • Use the meaning of fractions to explain when two fractions are equivalent.	• Show several representations (pattern block manipulative, area, length, number lines, name, picture (rectangles and circles) symbols 3/4, 6/8, and part of set 9 objects shaded of dozen) an for 3/4 and ask students which are really representations of ¾ to discuss many ways to present and model fractions. • Consider 3 identical rectangles, each divided into 4 equal parts where 2 full rectangles are shaded and 1/4 of the third rectangle is shaded. Explain why each student's answers could be considered correct: Marquez says that the shaded region is 9/12 and Carmina says the shaded region is 9/4. • Use drawings and reasoning to solve problems and explain solutions: For example: ○ If a 3/4 of snack food gives you your daily value of Calcium, then what fraction of your daily value of Calcium is in 1 cup of the snack food? ○ We have a cake. ⅓ of the cake is vanilla. Joe eats 2/5 of the vanilla part of the cake. What fraction of the cake did Joe eat? • Examine and critique reasoning, For example: The picture shows cakes of two different sizes. Each one is divided into 12 equal pieces. Marla ate 1 piece from each cake. What fraction of the total amount of cake (in the two cakes combined) did Marla eat? Ben says "Marla ate 2/24 of the cake because she ate 2 pieces out of 24." Is Ben correct? Why or why not? If the two cakes were the same size would Ben's reasoning be correct? Explain. • Imagine that this is a cookie. [bring a few circle cut-outs for the student to draw on or cut up] Could you show me how 2 people could share this so

	that each person gets the same amount? (Point to 1 piece and ask what you would call this.) Repeat for 3 people and 4 people. The try for 3 cookies shared to 2 people or 3 cookies share to 4 or 5 people. Ask students to develop multiple solutions and discuss which solutions would be mostly likely for children to develop. • Locate 7/5 on the number line. Conversely, here are the locations of 0 and 7/5 on the number line: find the location of 1. Locate 7/5 on the number line: This might be done by recognizing that 7/5 means “7 pieces of size 1one fifth” so there should be 7 equal intervals between 0 and 7/5 on the number • Give examples showing that a/ b and “a out of b” can mean different things. • For equivalent fractions, students can use paper folding to reason about why the “numerator and denominator are multiplied by the same number.” • Students can model equivalent fractions with pattern blocks to show that equivalent fractions cover the same area • Students have to justify why it is mathematical valid to multiply the numerator and denominator by the same number to create equivalent fractions • Students use pattern blocks to explain the process for converting between improper fractions and mixed numbers. This content is addressed throughout chapter 2.
1e. Model positive versus negative numbers on the number line and in real-world contexts. *	• Use local map with address, east/west union street to make connection to positive negative numbers on a number line. If our

	building is at 100 east and the diner is at 200 west, about where is 0? What address would bookstore have? • Use Bank statements, thermometers, video game with negative scores (-3 and +3 health), buildings with sub-basements (to represent negative numbers) to model real word uses of signed numbers Section 1.2 addressed representations of signed numbers.
1f. Reason about the comparison (=, <, >) of numbers across different representations (such as fractions, decimals, mixed numbers, ...). *	• Use of carefully chosen examples of numbers to compare that prompt the discussion of common errors children make and why they make them (e.g., 0.5 vs. 0.15) • Create number clothes line with one fixed number (say 1) and students have to add different types of numbers are added (1/2, 0, -2/5, 3/5, 1.2, 4/3, -0.3, -5, -4.5) such that they may need to refine the organization of the numbers as they go • Given any two numbers describe a way to find a number between them. Comparing whole numbers integers and decimals are addressed in sections 1.3 Comparing fractions is addressed in Section 2.3.
1g. Demonstrate the skill of calculating simple arithmetic problems WITHOUT the use of a calculator. *	• Students develop, explain, and justify 'short cuts' for calculations (e.g. 9 times and number is ten times the number minus one group of the number). • Use number talks to mental math (e.g., 37+38 can be thought of as 40+40-3-2) • Students explore children's invented algorithms for basic operations, explain the validity and efficiency of

	algorithms, determine which are generalizable, and discuss which are preferred for children use. See examples in the chapter 3 activities. • Students can calculate “easy” percent’s mentally (20% is divide by 5, 25% is divide by 4, etc) and use these in solving percent increase or decrease problems (e.g., 25% sale) • Students use percent tables to solve percent increase problems without the use of a calculator. For example: If a coat normally costs $40 but there is a 35% off sale, how much will the coat cost? (e.g., Student may argue using mental math that since 10% of 40 is 4, then 20% is 8, and 30% is 12 and 5% is 2, so 35% of 40 is 14. Since the coat is 35% off, the cost is $26. • Students should be able to explain general results such as: If the price of a radio is increased by p% and the new price is decreased by p%, what is the final price? This content is addressed in sections 3.2, 3.3 and 3.4 (for addition and subtraction), sections 4.2, 4.5, 4.6, 5.1, and 5.2 (for multiplication), section 2.5 (percent), sections 6.3, 6.4, 6.5, and 6.6.
2. Operations The successful Mathematics in Elementary Education student can: **2a.** Recognize addition, subtraction, multiplication, and division as descriptions of certain types of reasoning and correctly use the language and notation of these operations. *	• Students are introduced to start unknown, change unknown, and result unknown problem types for addition, subtraction, multiplication and division and they must be able to identify these problem types and what challenges children might experience with each. • Students identify and create examples of ○ part-part-whole and joining addition problems, and ○ take away and comparison subtraction problems

	○ sharing and measurement division problems • Students recognize that addition and subtraction are inverse operations and hence subtraction can be used to solve a start or change unknown joining problem. • Students can re-write multiplication problems as divisions to have fact families (e.g., 2x5=10 means 10/2=5 and 10/5=2) • Students can describe subtraction as take-away, comparison, or distance between points on a number line and distinguish between measurement and sharing division word problems. • Students can model multiplication in multiple ways: equal groups of objects, area, arrays, and cartesian product. This content is addressed in sections 3.1, 3.2 (for addition and subtraction), sections 4.1, 4.3, 4.4 (for multiplication), and sections 6.1 and 6.2 (for division).
2b. Illustrate how different problems are solved by addition, subtraction, multiplication and division and be able to explain how the operation used is connected to the solving of the problem. * **2c.** Recognize that addition, subtraction, multiplication, and division problem types and associated meanings for the operations (e.g., CCSS, pp. 88–89) extend from whole numbers to fractions and decimals. *	• Students can use count all, count on, count on from larger, count back, skip count, use of basic facts, and relationships between addition/subtraction, multiplication/division to solve problems • Students can create word problems using all four operations that involve integers, whole numbers, decimals, and fractions. • Students can map between the actions of a word a problem and the appropriate mathematical operation and recognize that yet other operations can be used to solve the problem (e.g., I have 18 candies to give to 3 trick-or-treaters, how many does each get is a sharing division

	problem but can be solved by knowing basic multiplication facts 3 x ? = 18 even if a child does not know division) • In extending to decimals and fractions, students must recognize actions in word problems still map to the same math operations even when decimals or fractions are used: in the case of fractions, replacing fractions with whole numbers can better help students recognize the correct operation to use (this is especially true with problems that involve multiplication and division with fractions which can be more difficult to identify). Similarly examining how physical models are similar or different for decimals and fractions as compared to whole numbers. For example with decimals, base ten blocks are still appropriate an students can investigate how a single collection of base blocks can represent multiple numbers depending on which block is defined as 1. Using base ten blocks to model addition and subtraction with decimals is still appropriate, but models need to be adjusted for multiplication and division. For example, area models of 2 x 3.2, 2.4 x3.2 will require students think carefully about what each partial product represents and how they connect to fractions. Pattern blocks and fraction strips are used to help students think about the differences in adding and subtraction fractions (as compared to whole numbers) and students must explain using manipulatives why common denominators are needed for combining fractions. This content is addressed in sections 3.1, 3.2 (for addition and subtraction), sections 4.1, 4.3, 4.4

	(for multiplication), and sections 6.1 and 6.2 (for division) sections 2.2 and 2.3 (for fractions).
2d. Employ teaching/learning paths for single-digit addition and associated subtraction and single-digit multiplication and associated division, including the use of properties of operations (i.e., the field axioms). *	• Students use specific single digit addition strategies: doubles (x+x), near doubles (x+(x+1) or x+(x – 1)), count on(+1, +2, +3), sums of 10 (1+9, 2+8, 3+7, etc.) and make 10s (9+8=9+1+7) and can recognize when the strategies are appropriate to use. • Doing number talk and videos of children's number talks are used to practice calculations, develop strategies for solving problems, and explore children's' common/atypical strategies (e.g., 7x8=7x5+7x3=8x8-7=7x7+7) • Students can state and use the commutative property to simplify calculations and describe how the commutative property simplifies learning basic facts (only half of the addition and multiplication charts need be memorized (e.g., when students know that 7 + 4 = 11, they also know that 4 + 7 = 11). • Students explore patterns in multiplication and addition charts (e.g., where are the doubles facts, where is a fact and its 'turn around" 5+3 and 3+5, where are near doubles, sums of 10) • We discuss that adding 0 while easy for adults is abstract for kids (e.g., word problems for +0 facts do not make sense: I had 3 cookie

	and I bought 0 more, now how many do I have?. Similarly x0 and x1 are easy for children to confuse if they have not developed an understanding of what multiplication means. Students have to notice and be able to describe relationships between additive and multiplicative identities and later addition and multiplicative inverses. This content is addressed in sections 3.1, 3.2 (for addition and subtraction), sections 4.1, 4.3, 4.4 (for multiplication), and sections 6.1 and 6.2 (for division).
2e. Compare and contrast standard algorithms for operations on multi-digit whole numbers that rely on the use of place-value units (e.g., ones, tens, hundreds, etc.) with mental math methods students generate. *	• Students explore children's invented algorithms for basic operations, explain the validity and efficiency of algorithms, determine which are generalizable, and discuss which are preferred for children use. See examples in chapter 3, 4 and 6 activities. This content is addressed in sections 3.2, 3.3, 3.5 (for addition and subtraction, sections 4.2, 4.5, 4.6 (for multiplication), sections 6.3 (for division).
2f. Use math drawings and manipulative materials to reveal, discuss, and explain the rationale behind computation methods. *	• Students model addition and subtraction using base blocks (or virtual versions) and describe how their actions with the blocks relate to the standard algorithm. Students have to unpack the mathematical meaning of terms carrying and borrowing and articulate why these terms are not helpful to use with students. • Students use area model and partial products strategies to model multiplication and have to articulate specifically how each strategy is

	connected to the standard algorithm. Students model division algorithm with base ten blocks, use the scaffold method, discuss how the base model can be generalized to decimals and make connections to the standard method for long division.
	• Students answer questions such as the following:
	  ○ Show an addition problem (57+29=86 written vertically) where 1 is ‘carried’ and a subtraction problem (547-85=462) written vertically) where 1 indicates “borrowing” occurred. What is the meaning of the 1 in each problem? What would be happening with the base ten blocks to demonstrate each 1? (the addition problem the ‘carried 1 actually represents a group of ten created by adding the ones place, and in the subtraction problem the 1 actually represents 10 groups of 10 regrouped from the 5 hundreds to create 4 hundreds and 14 tens)
	
	  ○ Given the problem of 351/3 =117 solved using the long division algorithm, what is the meaning of the 21 that would occur in the long division. What would be happening with the base ten blocks to demonstrate that 2? (the 3 hundreds are shared to each group of the 3 groups, one ten is given to each group, with 2 tens reaming that are traded in for 20- ones, the 20 ones are combined with 1 from 351 to give 21 to be shared to the 3 groups.

	• For fractions students use pattern blocks or fraction strips to justify the steps for converting between mixed numbers and improper fractions and to explain the rationale for needing common denominators in adding and subtracting fractions. • Students generalize a strategy for multiplying fractions by first multiplying a whole number times fraction, fraction times a whole number, and then a fraction times a fraction. Students have to explain why multiplying by a reciprocal is equivalent to division and explore alternate strategies for dividing fractions (e.g., is it legal to 'divide across" the same we "multiply across" for multiplying fractions? What if we gave fractions common denominators and divide?) This content is addressed in sections 3.2, 3.3, 3.5 (for addition and subtraction, sections 4.2, 4.5, 4.6 (for multiplication), sections 6.3 (for division).and sections 2.3, 3.4, 5.1,5.2, 6.4, 6.5 (for operations on fractions
○ **2g.** Extend algorithms and mental math methods to decimal arithmetic. *	• Examining how physical models are similar or different for decimals and fractions as compared to whole numbers is discussed. For example with decimals, base ten blocks are still appropriate an students can investigate how a single collection of base blocks can represent multiple numbers depending on which block is defined as 1. Using base ten blocks to model addition and subtraction with decimals is still appropriate, but models need to be adjusted for multiplication and division. For example, area models of 2 x 3.2, 2.4 x3.2 will require students think carefully about what each partial product represents and how they connect to fractions.

	Pattern blocks and fraction strips are used to help students think about the differences in adding and subtraction fractions (as compared to whole numbers) and students must explain using manipulatives why common denominators are needed for combining fractions. • Sample question: How the problems 81 – 12 related to 8.1 – 1.2? Given a strategy for the former how would you apply it to the latter? • When two decimals are multiplied, the rule of counting the total number of decimal places in the two factors to place the decimal point in the product can be justified by using the word form of the decimals to convert both factors to fractions, multiplying, and then reasoning about the placement of the decimal point based on the denominator (which should be a power of ten). • When a decimal number is divided by a decimal number, the convention of moving the decimal place in the divisor to create a whole number divisor and moving the decimal place in the dividend the same number of places is justified by converting the two decimal numbers to a fraction and considering an equivalent fraction. Operations on decimals are addressed in sections 3.3, 5.2, 6.6.
2h. Use different representations of the same fraction (e.g., area models, tape diagrams) to explain procedures for adding, subtracting, multiplying, and dividing fractions. (This includes connections to grades 6–8 mathematics.). *	• Examining how physical models are similar or different for decimals and fractions as compared to whole numbers is discussed. For example with decimals, base ten blocks are still appropriate an students can investigate how a single collection of base blocks can represent multiple numbers depending on which block is defined as 1. Using base ten blocks to model addition and

	subtraction with decimals is still appropriate, but models need to be adjusted for multiplication and division. For example, area models of 2 x 3.2, 2.4 x3.2 will require students think carefully about what each partial product represents and how they connect to fractions. Pattern blocks and fraction strips are used to help students think about the differences in adding and subtraction fractions (as compared to whole numbers) and students must explain using manipulatives why common denominators are needed for combining fractions. • Students generalize a strategy for multiplying fractions by first multiplying a whole number times fraction, fraction times a whole number, and then a fraction times a fraction. Students have to explain why multiplying by a reciprocal is equivalent to division and explore alternate strategies for dividing fractions (e.g., is it legal to 'divide across" the same we "multiply across" for multiplying fractions? What if we gave fractions common denominators and divide?) Defining and representing fractions are addressed in sections 2.2, and 2.3.
2i. Explain the connection between fractions and division, a/b = a ÷ b, and how fractions, ratios, and rates are connected via unit rates. (This includes connections to grades 6–8 mathematics. See the Ratios and Proportional Relationships Progression for a discussion of unit rate.). *	• A number line or string model can be used to illustrate the idea that $a \div b$=a/b. • For example, if a string of length 1 foot is divided into 3 equal parts, each part is one third of a foot i.e. 1÷3=1/3 . If a string of length 3 feet is divided into 4 equal parts, each part is ¾ of a foot, i.e. 3÷4=3/4 . • Students describe connections between fractions, ratios, and rates are using "unit rates." For example, if you can text 20 words in 30 seconds, the unit rate is either 2/3

	of a word per second or 40 words per minute. Defining and representing fractions are addressed in sections 2.2, and 2.3 and connections to decimals are made in 8.6.
2j. Explain why the extensions of the operations to signed numbers make sense. *	• Student use both number line and red/yellow chips to explain and derive rules for addition, subtraction, multiplication, and division with signed numbers. Operations with signed numbers are addressed in sections 3.5 and 5.3.
3. Algebraic Thinking The successful Mathematics in Elementary Education student can: **3a.** Model and communicate their reasoning about quantities and the relationships between quantities using a variety of representations. *	• Students can represent missing quantities and recognize equality among different representations: 347 = 3 hundreds + 4 tens + ___ ones = 2 hundreds + ____ tens + 7 ones = 2 hundreds + ____ tens + 17 ones, 5 + 2 = 3 + ___ • Students can give symbolic answers to problems like the ones above using their understanding of base 10 structure or basic facts, pictures to illustrate, or physical manipulatives (e.g., counters, base ten blocks) and explain the process they used and how they used their representation (e.g., picture, manipulative) to find the answer This is done through the throughout the course.
3b. Discuss the foundations of algebra in elementary mathematics, including understanding the equal sign as meaning "is the same [amount] as" rather than a "calculate the answer" symbol. *	• Students understand that an equation is a statement that two quantities have the same value (equivalent expressions have same value but can look different). Such a statement can be true or false. (e.g., 3 x 5 = 15 is a true, 3 x 5 = 10 + 10 is a false). • Students can find numbers that make an equation true or false "3 x

	__ = 15" and in the case of multiple possibilities explain a class of numbers for which statements are true or false (e.g., any number except 5 will make 3 x __ = 15 false) • Students generalize a particular solution or strategy to solving all problems of a similar type (e.g, the sum of any two numbers whose different is 1 can be thought of as a doubles plus 1 fact) and are able to describe difficulties children have with generalizing • Students can recognize equation with start and change unknowns and understand why those are more difficult that result unknown questions for children • Students can recognize types of equations that children might not interpret as such (e.g., 3 x 5 = __, vs. 3 x __ = 15) because children often interpret equal as "do the operation" or "find the result" • Students must be aware of (and avoid writing strings of equations that are in fact not representing equality (e.g., to solve 10x2+5 a student writes 10x2=20+5=25 to show their work but all of these expressions are not equal). When students are presented with such incorrect strings of equations they can correct them to represent a child's process that is both mathematically correct and faithful to the child's strategy. • For questions like this 5 + 2 = 3 + ___ student can find the correct answer and describe common mistakes children might make and why they would make them. This is addressed throughout chapter 3, 4, and 6.

3c. Look for regularity in repeated reasoning, describe the regularity in words, and represent it using diagrams and symbols and communicate the connections among these. *	• Students generalize a particular solution or strategy to solving all problems of a similar type (e.g, the sum of any two numbers whose different is 1 can be thought of as a doubles plus 1 fact) and are able to describe difficulties children have with generalizing • Students look at patterns for whole numbers and generalize to decimals or fractions. • Students examine children's invented strategies for calculations and determine if they are generalizable. • Students notice that patterns in numbers occur and try to extend those patterns or explain why they exist (every even number ends in 0, 2, 4, 6, 8, the sum of two odds is even) using pictures, words and symbols • Students can find many interesting patterns in hundreds charts and addition and multiplication tables. This is addressed throughout chapter 2, 3, 4, and 6.
3d. Articulate, justify, identify, and use properties of operations. *	Properties of Addition: 0 identity, commutative, associative. ● Properties of Multiplication: 1 identity, associative, commutative, distributive (multiplication over addition). ● Students should be able to state properties and what the property is called and what it means, give examples (additive & multiplicative identity & inverse, associative & commutative properties of multiplication and addition, distributive property), use it to simplify calculations, demonstrate it with physical manipulatives (snap cubes that are colored coded to show 2+3=3+2 or drawings or number

	lines), and explain why it always holds true. ● Number talks are a good way to use properties in simplifying calculations (17x3 can be thought of as 20x3 – 3x3). This addressed in sections 3.2, 4.3 and 4.4. Number talks are discussed with sections 3.2 and 4.6.
3e. Describe numerical and algebraic expressions in words, parsing them into their component parts, and interpreting the components in terms of a context. *	• Recognize 'short cuts' for that 367+98 such as 365+(98+2) or recognize that 3 (18,932 + 921) is three times as large as 18,932 + 921, without having to calculate the indicated sum or product. • Other sample problems that help students notice structure of expressions without calculating: 183+99, 268+52 600-199 • Students translate word problems into numeric expressions through this course. With the Cookie Jar Problem (cited in standard 1b) students have to carefully map parts of an equation to steps in the problem and clarify meanings of variables as cookies eaten or cookie remaining at each step. Other examples include Write a numerical expressions for word problems without performing any operations.
3f. Use a variety of methods (such as guess and check, pan balances, strip diagrams, and properties of operations) to solve equations that arise in "real-world" contexts. *	• Students solve basic fact word problem of various types (start unknown, and change unknown, compare, take-away, joining) with guess and check, strip diagram, derived facts 9Using known facts that relate to the problem , and pan balance as appropriate • Example problems: ○ Nadia has 3 more jelly beans than Brian. All together, Nadia and Brian have 15 jelly beans. How many jelly beans does

	Brian have? How many jelly beans does Nadia have? ○ Emma has some toys; after she gave away 5 toys, she had 9 toys left, how many did Emma have at first? Section 3.1, 3.2, 4.1, 4.5, and 2.2.
4. Number Theory The successful Mathematics in Elementary Education student can: **4a.** Demonstrate knowledge of prime and composite numbers, divisibility rules, least common multiple, greatest common factor, and the uniqueness (up to order) of prime factorization. *	• Define and compare definitions and examples of the words “factor, multiple, greatest common factor, least common multiple, prime, composite” and give examples of each. • Use Sieve of Eratosthenes to find prime numbers up to 120 and describe patterns in number chart as multiples are eliminated from chart. • Develop ‘ most efficient’ strategy for determining if number is prime and recognize that for extremely large numbers the ‘most efficient strategy’ is still not terribly efficient. • Use an area model to explain the difference between prime and composited (how many rectangles can I build of the given number of 1x1 squares?) • State and describe divisibility rules for 2, 3, 4, 5, 6 8, 9, and 10 • Explain divisibility rules (such as the divisibility rule for 2 and 3) using expanded notation, definition of division, the base 10 structure, and remainders. • Define even and odd numbers in multiple ways (e.g., even is set of pairs or 2 equal groups) and construct informal arguments with pictures and words for rules about operations on evenand odd numbers (e.g., the sum of two odds is even, the product of an even and odd is odd) • State and use uniqueness of prime factorization and explain why each number has unique prime factorization.

	• Compute LCM and GCF using a variety of methods, explain why those methods are valid, and explain connections among them. This is addressed in chapter 8 sections 8.1-8.5.
4b. Discuss decimal representation and recognize that there are numbers beyond integers and rational numbers. *	• Use a division algorithm to find decimal expansion of a rational number, both repeating non-terminating and terminating. For instance, 1/5 as 0.2, 2/3 as 0.66666 and 5/7 as 0.714285714285… • Look for patterns in types of rational numbers that do and not repeat • Develop and use a procedure for converting any repeating non-terminating and terminating decimal to a fraction • Argue informally that the decimal expansion of a rational number must repeat or terminate. • Explore examples of real numbers which are not rational (such as pi). Section 8.6 addressed decimal representation and connections to fractions.
Acknowledgement	**Please acknowledge that you have read the guidelines for types of courses approved for and excluded from Mathematics, Statistics, and Logic category of Ohio Transfer 36.**
The Ohio Transfer 36 requires at least 3 semester hours of course credit in Mathematics, Statistics, and Logic, Ohio Transfer 36 Mathematics, Statistics, and Logic courses should be: 1. A credit-bearing, college-level course in Mathematics must use the standards required for high school graduation by the State of Ohio as a basis and must do at least one of the following: 1) broaden, or 2) deepen, or 3) extend the student's learning. 2. The course does not cover variable learning outcomes from term to term. 3. The course is not an upper-division course. 4. The course is in the areas of mathematics, or statistics, or logic.	Yes, I have read and acknowledged this.

Excluded courses: • Remedial or developmental courses, special topics courses, narrowly focused courses, technical or pre-technical courses and skills-based courses. • Courses that focus exclusively on content coverage without addressing the learning outcomes for the Ohio Transfer 36. • Career preparation courses, non-credit continuing education courses, and life experience courses (unless life experience credit, such as military training or other prior learning experience, becomes approved in the future for an Ohio Transfer 36 credit by the statewide faculty review panel).	

[2] The Mathematics, Statistics, and Logic Submission Preparation Templates vary slightly from the example provided. Official templates can be found through the OT36 Guidelines and Learning Outcomes website.

Natural Sciences Submission Preparation Template

Attach a document to the course with a description of each lab activity. The Panel will need to be able to validate that two-thirds of the lab hours involve bona fide, experimental lab activities utilizing the scientific method (identifying/collecting data, manipulating data, evaluating and analyzing data). To that same document append at least one example of a laboratory exercise from the course.

Ohio Transfer 36 Learning Outcomes (All of the fields are required)	Your Students' Learning Experiences and Evidence to Meet the Ohio Transfer 36 Learning Outcomes
1. Understand the basic facts, principles, theories and methods of modern science.	Students apply Newton's Laws of motion in laboratory experiments (Experiment 5 Determination of Acceleration due to Gravity and Newton's Second Law, Experiment 6 Friction).
2. Explain how scientific principles are formulated, evaluated, and either modified or validated.	The background to Newton's Laws is presented and the hypotheses used to develop the laws are examined in the class (PHYS 2054) that is a corequisite of this lab (PHYS 2055). Newton's Second Law is validated through experiment. (Experiment 5 Determination of Acceleration due to Gravity and Newton's Second Law, Experiment 6 Friction). Validation of vector force predictions. (Experiment 4 Vector Treatment of Concurrent Forces, Experiment 13 Laws of Equilibrium for Non-concurrent Forces)
3. Use current models and theories to describe, explain, or predict natural phenomena.	In Experiment 11 Ballistic Pendulum the students use Conservation of Energy and Conservation of Momentum find the launch speed of a ball propelled by a spring.

	Ideal Gas Theory is validated by experiment in Experiment 20 The Ideal Gas Laws.
4. Apply scientific methods of inquiry appropriate to the discipline to gather data and draw evidence-based conclusions.	Validation of Newton's Second Law through experiment. (Experiment 5 Determination of Acceleration due to Gravity and Newton's Second Law, Experiment 6 Friction). Validation of vector force predictions. (Experiment 4 Vector Treatment of Concurrent Forces, Experiment 13 Laws of Equilibrium for Non-concurrent Forces)
5. Demonstrate an understanding that scientific data must be reproducible but that it shows intrinsic variation and can have limitations.	Experiment 1 Measurement and Error Laboratory in which students measure an object at multiple locations to get its area. They have to obtain an error estimate in the width and length and then propagate that error into the area given by the average of the width and length. In many labs students are expected to make multiple measurements and estimate uncertainties based on the standard deviations of the measurements.
6. Apply foundational knowledge and discipline-specific concepts to address issues or solve problems.	The purpose of most of the labs in this course is to apply foundational knowledge (Newton's Laws of Motion) and concepts (Conservation of Energy and Conservation of Momentum) to many different situations and test them. For example, in

	Experiment 11 Ballistic Pendulum both conservation laws are used in two methods for a comparison of the launch speed of a ball.
7. Explain how scientific principles are used in understanding the modern world, and understand the impact of science on the contemporary world.	In most of these experiments in this course the students explain their observations in the context of the scientific principles taught in the paired course PHYS 2054.
8. Gather, comprehend, apply and communicate credible information on scientific topics, evaluate evidence-based scientific arguments in a logical fashion, and distinguish between scientific and non-scientific evidence and explanations.	As part of the laboratory work for this course students write lab reports including one that has two drafts. The latter is referred to as a Technical Report in the Laboratory Manual. Each week students write in a lab notebook a laboratory report. The rubrics for grading these reports are in the Laboratory Manual. The feedback to the students by the TAs is based on the rubric.
Acknowledgement	**Please acknowledge that you have read the guidelines for types of courses approved for and excluded from the Natural Sciences category of Ohio Transfer 36.**
The Ohio Transfer 36 requires at least 6 semester hours of course credit in Natural Sciences, including at least one semester hour of course credit of Natural Sciences laboratory. Natural Sciences courses approved for inclusion within the Ohio Transfer 36 are introductory in nature, require college-level proficiencies appropriate to the course, and are taught at the lower division college level. Each course has a consistent content and a broad focus on one or more disciplines from within the physical and/or biological sciences, which include astronomy, biology, chemistry, environmental science, geology, physical geography and physics. Students completing courses in the Natural Science category should achieve the following learning outcomes through the study of natural sciences disciplines such	**I acknowledge reading the guidelines.** **David C Ingram**

as astronomy, biology, chemistry, environmental science, geology, physical geography, and physics. As appropriate to the discipline, the course highlights the nature of science, the importance of experimental inquiry in the Natural Sciences, and the way in which such inquiry into the natural world leads scientists to formulate principles that provide universal explanations of diverse phenomena. The course fosters an understanding and appreciation that all applicable evidence must be integrated into scientific models of the universe, and that scientific models must evolve. A course that focuses primarily on content coverage, without addressing each of the Student Learning Outcomes described herein, is not suitable as an Ohio Transfer 36 Natural Sciences course. In completing the Natural Sciences requirements within the Ohio Transfer 36, students will accurately understand and describe the scope of scientific study and core theories and practices, in either or both the physical and biological sciences, using appropriate discipline-related terminology. ***Excluded courses*:** • Remedial or developmental courses, special topics courses, narrowly focused courses, technical or pre-technical courses and skills-based courses. • Courses that focus exclusively on content coverage without addressing the learning outcomes for the Ohio Transfer 36. • Career preparation courses, non-credit continuing education courses, and life experience courses (unless life experience credit, such as military training or other prior learning experience, becomes approved in the future for an Ohio Transfer 36 credit by the statewide faculty review panel). **Natural Sciences Laboratory Requirement**: students will complete at least one course within the Natural Sciences Ohio Transfer 36 that includes a laboratory component. This laboratory component must carry at least one credit hour and involve at least 1,500 minutes of laboratory activities (an average of no less than two hours per week for a traditional 15-week semester). During the course, students will demonstrate the application of the methods and tools of scientific inquiry appropriate to the discipline, by actively and directly collecting, analyzing, and interpreting data, presenting findings, and using information to answer questions. In addition to achieving the Student Learning Outcomes 1-8 detailed above, Ohio Transfer 36 approved courses that include a laboratory component[1] will achieve all the following student learning objectives in the equivalent of at least 10 weeks (~2/3) of the course's "laboratory activities":	

• involves realistic measurements of physical quantities; • involves data analysis, using data that are unique and/or physically authentic and that include random and/or systematic (natural) variability; • includes realistic interactions with experimental apparatus, and realistic manipulation of tools/ instruments and/or observed objects in space and time; • involves synchronous feedback on safety (and consequences of unsafe actions), correctness of procedure, and progress toward experimental goals; and • involves effective interaction with the instructor at several points during each lab activity.	

If the course you are preparing for an Ohio Transfer 36 submission is a laboratory course or has a laboratory component, please also respond to the laboratory component. Please provide a separate cover memo for <u>each</u> mode of lab delivery to accompany the relevant version of the working syllabus (with each mode of delivery having its own unique working syllabus). In each version of the cover memo, the faculty should explain in detail specifically how the lab component of the course via that delivery mode meets laboratory requirements.

Natural Sciences Laboratory Requirement: students will complete at least one course within the Natural Sciences Ohio Transfer 36 that includes a laboratory component. This laboratory component must carry at least one credit hour and involve at least 1,500 minutes of laboratory activities (an average of no less than two hours per week for a traditional 15-week semester). During the course, students will demonstrate the application of the methods and tools of scientific inquiry appropriate to the discipline, by actively and directly collecting, analyzing, and interpreting data, presenting findings, and using information to answer questions.

In addition to achieving the Student Learning Outcomes 1-8 detailed above, Ohio Transfer 36 approved courses that include a laboratory component[1] will achieve <u>all</u> the following student learning objectives in the equivalent of at least 10 weeks (~2/3) of the course's "laboratory activities": ▪ involves realistic measurements of physical quantities; ▪ involves data analysis, using data that are unique and/or physically authentic and that include random and/or systematic (natural) variability; ▪ includes realistic interactions with experimental apparatus, and realistic manipulation of tools/ instruments and/or observed objects in space and time; ▪ involves synchronous feedback[2] on safety (and consequences of unsafe actions), correctness of procedure, and progress toward experimental goals; and ▪ involves effective interaction with the instructor at several points during each lab activity. *Footnotes:* 1. *Some disciplines, such as astronomy, meteorology, and ecology, are more amenable to achieving a quality virtual educational lab experience. By contrast, other disciplines, such as*	When entering in CEMS, please simply enter "See the attached memo." See the attached memo. I think we achieve all these out comes in our laboratory course.

chemistry, microbiology and physics, are much less likely to meet the expectations of an OTM science lab course if focused heavily on virtual lab experiences. [*The American Chemical Society has released a Position Statement on this issue: [https://www.acs.org/content/acs/en/policy/publicpolicies/invest/computersimulations.html.]](https://www.acs.org/content/acs/en/policy/publicpolicies/invest/computersimulations.html)* 2. *Synchronous feedback on safety could be achieved using sophisticated computational approaches or by actual instructor feedback.*	

Example Natural Science Lab Memo

PHYS 2055: General Physics I Lab
Credit hours: 1
Lecture contact hours:
Lab contact hours: 2.0
All labs will meet on-campus in 036 Clippinger

PHYS 2055 is the lab course that is matched to PHYS 2054 General Physics 1. This memo is to be attached to the CEMS submission.

This lab is an in-person, one-credit hour course that is scheduled to meet for two hours per week in a traditional 15-week semester. The course paired with this lab is the first semester of calculus physics for scientists and engineers, PHYS 2054, a three-credit hour course.

Students will be able to explain basic terminology, methods, and concepts used in modern science. The physics of this course, classical mechanics and thermodynamics, forms a base for all of science and engineering disciplines. Scientific models, such as Newton's Laws of Motion and the Kinetic Theory of Gases, are examined for their assumptions and how those limit the use of such a theory. In the laboratory component of this class, students will perform experiments to test hypotheses by collecting and analyzing data.

In the PHYS 2055 Lab:

- Students will have a broad understanding of basic 11th and 12th grade science and will be able to solve problems in the natural sciences.
- Students will be able to explain basic terminology, concepts and methods of modern science.
- Students will be able to apply scientific methods of inquiry appropriate to a discipline to gather and analyze data and draw evidence-based conclusions.
- Students will be able to evaluate evidence-based scientific arguments in a logical fashion and distinguish between scientific and non-scientific evidence and explanations.
- Students will be able to communicate how scientific findings contribute to the modern world.
- Students will write a weekly lab report in a lab notebook with the exception of one report that will be the lab for the technical report. For the technical report the students submit two drafts for comments and corrections by the TAs before submitting a final version. The report is described in the lab manual.

Laboratory activities/experiments:

Experiment 4: Vector treatment of concurrent forces
In this lab students must calculate the resultant vector from two and three vectors in order to provide stability to weights hanging from strings attached to a ring that is centered on ring. They must estimate the uncertainty or error in the angles and masses applied.

Experiment 1: Measurement and Error
The purpose of this lab to introduce students to making multiple measurements of something, in this case the width and length of a square of metal not cut perfectly square. They have to calculate the standard deviation in the average for these quantities and then propagate the error in the area.

Experiment 5: Determination of acceleration due to gravity and Newton's 2nd Law
There are two objectives in this laboratory exercise. The first objective, (A), is the study of the behavior of a body in the gravitational field. Do objects follow the equations of motion the students have studied in class? Can the

students verify the relationship between position of a falling object and time, also verify the relationship between velocity of a falling object and time? The second objective, (B), is to verify Newton's second law, F = ma. Is there is a linear relationship between force applied to an object and the net acceleration of that object.

Experiment 6: Friction
In this lab students make measurements that lead them to the calculation of static and kinetic coefficients of friction.

Experiment 7: Centripetal Force (Technical Report Lab.)
The objective of this experiment is to verify the expression for the force that must be provided for a mass to execute circular motion. Students do this by two separate measurements. The first is the centripetal force on a simple pendulum at the bottom of its swing. The second method measure the force on a mass to keep it moving in a horizontal circle.

Experiment 9: Impulse and Momentum
The purpose of this experiment is to investigate the relationship between the change in the momentum of a body as a result of a force acting on it over time.

Experiment 11: Ballistic Pendulum
The objective of this experiment is to determine the initial velocity of a projectile fired from a gun by two methods. In the first the projectile undergoes an inelastic collision embedding itself in the pendulum bob after which the projectile and body together rise to a measured height. The laws of conservation of momentum and energy are used to work backward from the height data to the initial velocity of the projectile. The second method is to determine the initial velocity determined from the horizontal range of the projectile when it is fired from the same gun. The two initial velocities and their respective standard deviations are compared.

Experiment 12: Experimental Determination of the Moments of Inertia of Solid Bodies
The purpose of this experiment is to measure the moments of inertia of objects for which the symmetry of the object means that the moment of inertia can be reliably calculated for comparison with the experimentally determined values

Experiment 15: Simple Harmonic Motion
In this experiment students measure the spring constant of a spring by two methods, Hooke’s Law and observation of Simple Harmonic Motion.

Experiment 18: Standing Waves on a String
The purpose of this laboratory session is to verify the law governing the behavior of transverse standing waves in an elastic medium. Students observe resonance on a string under tension.

Experiment 20: The Ideal Gas Laws
The purpose of this set of experiments is to verify the Ideal Gas Laws. The first experiment involves measured the variation of pressure and volume at constant temperature. A second experiment involves measuring the change in pressure as a function of temperature while keeping volume constant.