The Well-Trained Mind Academy
Anatomy & Physiology

Course Blackboard site: www.wtma.blackboard.com

Required Text
Shier, D., Butler, J., & Lewis, R. *Hole's Essentials of Human Anatomy & Physiology. 10th edition*. New York, NY: McGraw-Hill, 2009.
Text ISBN: 9780072965636

Course Description:
This course will provide a thorough survey of the parts & functions of the human body. Course content includes but is not limited to the cellular basis of life, tissue structure & function, the human life cycle, and the inner workings of the following body systems: integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic & immune, digestive, respiratory, urinary, and reproductive systems.

Course Goals:
Upon completion of Anatomy & Physiology, successful students will have a solid foundation in all the major physiological systems of the body as well as all major anatomical structures. Students will be adept at making predictions and applying their knowledge to real-world situations.

Grading:

Homework	15%	**Quizzes**	15%
Team Project	10%	**Unit Tests**	20%
Research Paper	10%	**Midterm Exam**	10%
		Final Exam	20%

Example Schedule:

Week	**Lecture 1**	**Lecture 2**
FALL SEMESTER		
1	Intro/Course Expectations	Organization & Maintenance of Life
2	Organization of Human Body	Structure of Matter
3	Chemical Components of Cells	Parts & Functions of Cells
4	Cell Membranes: Structure & Function	Cell Cycle & Cell Division
5	Cellular Energetics & Enzymes	Review
6	Cellular Respiration	DNA/Protein Synthesis
7	Tissues I	Tissues II
8	Integumentary System I	Integumentary System II
9	Bone Growth & Function I	Bone Growth & Function II
10	Skeletal System I	Skeletal System II

11	Muscle Structures & Functions I	Muscle Structures & Functions II
12	Major Muscles I	Major Muscles II
13	Nervous System Function I	Nervous System Function II
14	Team Project Presentations	Team Project Presentations
15	Nervous System Anatomy I	Nervous System Anatomy II
16	Midterm Review	Midterm Review
SPRING SEMESTER		
17	Sensation I	Sensation II
18	Sensation III	Endocrine System I
19	Endocrine System II	Endocrine System III
20	Blood I	Blood II
21	Cardiovascular System I	Cardiovascular System II
22	Cardiovascular System III	Lymphatic & Immune Systems I
23	Lymphatic & Immune Systems II	Lymphatic & Immune Systems III
24	Digestive System & Nutrition I	Digestive System & Nutrition II
25	Digestive System & Nutrition III	Review
26	Respiratory System I	Respiratory System II
27	Respiratory System III	Urinary System I
28	Urinary System II	Water & Electrolyte Balance
29	Reproductive Systems I	Review
30	Reproductive Systems II	Pregnancy, Growth, & Development I
31	Pregnancy, Growth, & Development II	Pregnancy, Growth, & Development III
32	Cumulative Review	Cumulative Review

Homework:
The homework grade is divided into the following types of assignments:

1. **Chapter Review Questions**: students will complete & post their responses to the assigned chapter review questions from their textbook each week.
2. **Discussion Board Posts:** when assigned, students will provide an original response to a prompt located in the Discussion Board section of the course website. Students will also be required to read & respond to their peers' posts throughout the course.

Team Project:
Students will work in small groups to research and present an integrated topic of their choice based on what we have covered in class during the fall semester. Presentations will occur during the last week of class before winter break.

Research Paper:
Students are required to research & write a 4-6 page paper that traces the historical development of the diagnosis & treatment of a specific disorder of the human body. Students will choose their topic in January then work throughout the second semester to locate sources, create an outline, write a rough draft, edit/revise their draft, and finally submit a final paper in May. More information regarding expectations will be provided to the students near the end of the first semester.

The Well-Trained Mind Academy
Anatomy & Physiology Lab

Course Blackboard site: www.wtma.blackboard.com

Please note: The fall and spring semesters of this lab cover different material. We recommend that students interested in science take both semesters. However, students may choose to register for the fall or spring semester only, depending on transcript needs.

Required Materials:

- Students must obtain lab materials in advance in order to successfully conduct lab investigations by the scheduled due date. Access the full materials list for both semesters here.
- A high school anatomy & physiology textbook is highly recommended for reference. We recommend Shier, D., Butler, J., & Lewis, R. *Hole's Essentials of Human Anatomy & Physiology. 10th edition*. New York, NY: McGraw-Hill, 2009. *Text ISBN: 9780072965636*

Course Description:
This course will provide an in-depth exploration of human anatomy and physiology through laboratory investigation. Students will conduct investigations related to the topics of cell structure and function, skeletal system structure and function, muscle physiology, and nervous system physiology. Course content includes but is not limited to study and application of the experimental method, composition of lab reports, peer review, and presentation of lab results.

Course Goals:
Upon completion of Anatomy & Physiology Lab, successful students will master application of the experimental method in such fields as cell structure and function, skeletal system structure and function, muscle physiology, and nervous system physiology. Students will learn to think scientifically: becoming adept at developing hypotheses, designing controlled experiments, collecting and interpreting data, conducting scientific investigations, and thoughtfully engaging in scientific discourse.

Grading:

Lab Reports	50%
Additional Writing Assignments/Quizzes	10%
Participation	25%
Final Exam	15%

Lab Reports:
Composing lab reports is a major component of this course. A complete lab report includes a hypothesis (together with its underlying observations), a procedure to test the hypothesis, data collected during the experiment, and any analysis performed on and conclusions drawn from the

collected data. More details on the format and content will be provided during the first week of class.

It is *highly recommended*, but not required, that students keep a lab notebook containing all lab reports to date. Lab notebooks are not the same as archived work—they allow the scientist to make connections between the knowledge and conclusions from various labs, add notes on procedures, and use previous experience to improve future experiments.

Additional Writing Assignments/Quizzes:
To supplement the hands-on practice of scientific methods and procedures, quizzes and other brief
writing assignments may be assigned periodically. These non-lab assignments will test students' familiarity with completed labs and measure their growing mastery of the basic principles of scientific thought and investigation.

Participation:
Weekly class meetings will involve class discussion of previous and upcoming labs, including but not limited to the following activities:

- presenting and discussing lab results
- designing and critiquing original experiments for situations not covered in labs
- asking questions and discussing possible problems and techniques for upcoming lab procedures
- watching or participating in experimental procedures for labs

During meetings, students are expected to collaborate, ask questions, and otherwise participate in the scientific community. More details on the grading of this participation will be provided in class.

Final Exam:
Each semester will conclude with a lab exam, which will test students on the following topics:

- understanding of the basic anatomy principles learned during the semester
- knowledge of the associated lab procedures and conclusions
- basic principles of scientific thought and investigation
- sound experimental design and critique

Exams will combine multiple-choice and other short question formats with longer writing sections, possibly including drawings and other visual presentations.

Schedule

Note that each semester is self-contained and introduces principles of experimental method and design; for full-year lab students, the spring introductory lesson will build on the fall semester's work.

Fall

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Intro to Experimental Design
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: Cell Anatomy and Physiology
5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Memory Retention
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Interviewing a Medical Professional
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5
10	Experimental Method Practice	Lab 5: Bone Practical
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
Thanksgiving Break		
12	Experimental Method Practice	Lab 6: Muscle Practical
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Muscle Fatigue
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
Holiday Break		
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
Exam Week: No Class Meeting		**Final Exam**

Spring 2019

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Experimental Design Practice
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: Reaction Time
5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Cow Eye Dissection
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Microbiomes
Spring Break		
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5

10	Experimental Method Practice	Lab 5: Sheep Heart/Lung Dissection
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
12	Experimental Method Practice	Lab 6: Cardiovascular Health
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Reproduction
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
	Exam Week: No Class Meeting	**Final Exam**

The Well-Trained Mind Academy
Biology

Course Blackboard site: www.wtma.blackboard.com

Required Text:
McGraw-Hill Education *Glencoe Biology.* New York, NY: McGraw-Hill, 2017. *Text ISBN: 978-0076774289*

Course Description:
This course will provide a thorough survey of basic biological principles and topics including but not limited to biochemistry, cell structure and function, heredity, molecular genetics, evolutionary theory, organism diversity, and ecology. The class is structured in the manner of a "flipped" classroom, in which students will watch a video and read material from the textbook to prepare them for a class meeting focused on discussion and mastery of the material.

Upon completion of this course, successful students will have a mastery of introductory concepts and principles of biology as well as an ability to think scientifically. Students will become more adept at applying their knowledge of biology and the scientific method to real scenarios, interpreting data and the results of scientific investigations, and thoughtfully engaging in scientific discourse.

Course Goals:
Upon completion of introductory biology, successful students will have a mastery of introductory concepts & principles of biology as well as an ability to think scientifically. Students will become more adept at interpreting data, discussing scientific investigations, and thoughtfully engaging in scientific discourse.

Grading:

Homework	10%	**Quizzes**	10%
Discussion Boards	10%	**Unit Tests**	20%
***Research Paper**	10%	**Midterm Exam**	10%
***Living Book Analysis**	10%	**Final Exam**	20%

**See below for more a detailed explanation*

Schedule:
The schedule is subject to frequent updates from me. Please see Blackboard/email for changes.

Week	**Lecture 1**	**Lecture 2**
1	Intro/Course Expectations	Characteristics of Life
2	Scientific Method	Applying the Scientific Method
3	Intro to Biochemistry	Water Chemistry
4	Organic Molecules	Enzymes
5	Review	Intro to Cells

6	Parts of the Cell I	Parts of the Cell II
7	Passive Transport	Active Transport
8	Review	Photosynthesis I
9	Photosynthesis II	Cellular Respiration I
10	Cellular Respiration II	Application Problems
11	Intro to Heredity/Cell Cycle	Cancer/Review
12	Mitosis I	Mitosis II
13	Meiosis I	Meiosis II & Modes of Reproduction
14	Review	Intro to Mendelian Genetics
15	Genetic Crosses I	Genetic Crosses II
16	Midterm Review	Midterm Review
17	Pedigree Analysis & Recap Genetic Crosses	Complex Patterns of Heredity I
18	Complex Heredity II	Intro to Genetic Material
19	DNA Replication	Transcription
20	Translation	Gene Regulation
21	Genetic Engineering I	Genetic Engineering II/Review
22	Darwinian Evolution	Evidence of Evolution
23	Evolution in Action I	Evolution in Action II
24	Classification of Organisms	Review
25	Viruses & Bacteria	Protists
26	Fungi	Plants I
27	Plants II	Animals I
28	Animals II	Animals III
29	Intro to Ecology	Population Ecology
30	Community Interactions	Biomes
31	Nutrient Cycling	Environmental Science
32	Comprehensive Review	Comprehensive Review

Research Paper:
Students are required to research & write a 4-6 page paper that traces the historical development of either a discovery or technology that impacted the field of biology. Students will choose their topic in January then work throughout the second semester to locate sources, create an outline, write a rough draft, edit/revise their draft, and finally submit a final paper in May. More information regarding expectations will be provided to the students near the end of the first semester.

Living Book Analysis:
Students are required to read an approved text and write a summary/analysis response during their first semester in biology. More information regarding expectations will be provided to students during the first month of class.

The Well-Trained Mind Academy
Biology Lab

Course Blackboard site: www.wtma.blackboard.com

Please note: The fall and spring semesters of this lab cover different material. We recommend that students interested in science take both semesters. However, students may choose to register for the fall or spring semester only, depending on transcript needs.

Required Materials:
Students must obtain lab materials in advance in order to successfully conduct lab investigations by the scheduled due date. All materials other than the microscope should cost no more than $40 per semester.

Microscope:

My First Lab Duo-Scope Microscope *or*
AmScope Optical Glass Lens All-Metal LED Compound Microscope *or*
Levenhuk 2L Plus Colored Microscopes *or*
Home Science Tools Home Microscope *or*
DIY home microscope—I recommend using two lenses as outlined in the guide to achieve maximum possible magnification!

Suggested Text:

- Students must obtain lab materials in advance in order to successfully conduct lab investigations by the scheduled due date.
- A high school biology textbook is highly recommended for reference. We recommend McGraw-Hill Education *Glencoe Biology.* New York, NY: McGraw-Hill, 2017. ISBN 9780076774289

Course Description
This course will provide an in-depth exploration of biology phenomena through laboratory investigation. Students will conduct experiments related to basic biology topics, including plant photosynthesis and transpiration, cellular respiration, mitosis, heredity, natural selection, and animal behavior. Course content includes, but is not limited to, studying and applying the experimental method, composing lab reports, engaging in peer review with classmates, and presenting lab results.

Course Goals
This course will provide an in-depth exploration of biological phenomena through laboratory investigation. In the fall, students will investigate topics including ecology, biochemistry, cell structure and function, and bioenergetics. In the spring, students will investigate topics including heredity, natural selection, and special topics relating to specific organisms including plants and animals. Class meetings and assignments will require students to study and apply the experimental method, compose lab reports, engage in peer review with classmates, present lab

results, and discuss special topics, including scientific ethics and historic experiments in the field of biology.

Upon completion of the Biology Lab course, successful students will have become adept at applying their knowledge of biology and the scientific method by designing and carrying out experiments, interpreting data and the results of scientific investigations, presenting their results for peer comment and review, and thoughtfully engaging in scientific discourse.

Grading
Students' grades in this course are determined by weighted categories, divided as shown in this chart:

Lab Reports	50%
Additional Writing Assignments/Quizzes	10%
Participation	25%
Final Exam	15%

Lab Reports
Composing lab reports is a major component of this course. A complete lab report includes a hypothesis (together with its underlying observations), a procedure to test the hypothesis, data collected during the experiment, and any analysis performed on and conclusions drawn from the collected data. More details on the format and content will be provided during the first week of class.

It is *highly recommended*, but not required, that students keep a lab notebook containing all lab reports to date. Lab notebooks are not the same as archived work—they allow the scientist to make connections between the knowledge and conclusions from various labs, add notes on procedures, and use previous experience to improve future experiments.

Quizzes/Writing Assignments
To supplement the hands-on practice of scientific methods and procedures, quizzes and other brief writing assignments may be assigned periodically. These non-lab assignments will test students' familiarity with completed labs and measure their growing mastery of the basic principles of scientific thought and investigation.

Participation
Weekly class meetings will involve class discussion of previous and upcoming labs, including but not limited to the following activities:

- presenting and discussing lab results
- designing and critiquing original experiments for situations not covered in labs
- asking questions and discussing possible problems and techniques for upcoming lab procedures
- watching or participating in experimental procedures for labs

During meetings, students are expected to collaborate, ask questions, and otherwise participate in the scientific community. More details on the grading of this participation will be provided in class.

Final Exam

Each semester will conclude with a lab exam, which will test students on the following topics:

- understanding of the basic biology principles learned during the semester
- knowledge of the associated lab procedures and conclusions
- basic principles of scientific thought and investigation
- sound experimental design and critique

Exams will combine multiple-choice and other short question formats with longer writing sections, possibly including drawings and other visual presentations.

Example Schedule - *Note that each semester is self-contained and introduces principles of experimental method and design; for full-year lab students, the spring introductory lesson will build on the fall semester's work.*

Fall

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Live Organism Observation
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: Ecosystems
5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Population Ecology
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Biochemistry and Enzymes
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5
10	Experimental Method Practice	Lab 5: Mitosis
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
12	Experimental Method Practice	Lab 6: Photosynthesis in Leaf Disks
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Cellular Respiration in Yeast
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
Exam Week: No Class Meeting		**Final Exam**

Spring

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Heredity
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: Natural Selection

5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Evolution
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Organism Diversity
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5
10	Experimental Method Practice	Lab 5: Bacteria
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
12	Experimental Method Practice	Lab 6: Plants
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Animal Behavior and Choice
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
	Exam Week: No Class Meeting	**Final Exam**

The Well-Trained Mind Academy
Chemistry

Course Blackboard site: www.wtma.blackboard.com

Required Materials

- Suchoki, John. *Conceptual Chemistry,* 5th ed. Upper Saddle River, NJ: Prentice Hall, 2013. 9780321804419
- We will be using mostly HTML-based simulations. Occasionally Java simulations may be used. If you are unable to run Java, I will provide a work around.

Calculator

A scientific calculator (such as Texas Instruments TI-30X IIS) is required for this course. Online scientific calculators can also be used, but they are discouraged because they tie the student to the computer/internet for homework.

Course Description

This course will provide a survey of basic principles in chemistry. Course content includes but is not limited to the fundamental principles of subatomic, atomic, and molecular structure and bonds; properties of different phases of matter; types of chemical reactions; acids and bases; organic and biochemistry; and other special topics in chemistry.

Course Goals

Upon completion of Chemistry, successful students will have a mastery of introductory concepts and principles of chemistry as well as an ability to think scientifically. Students will become more adept at applying chemistry principles to real scenarios, interpreting data and the results of scientific investigations, and thoughtfully engaging in scientific discourse.

Course Principles

1. **Science is a learned skill.** No scientist is ever perfect, but we get better with practice! Doing anything for the first time takes some getting used to in any field, of course. That means:
2. **Mistakes are welcomed, not punished.** In-class problem solving will be graded based on effort, not on correct answers. This makes classwork the perfect time to work out mistakes and misunderstandings, so even if you're not 100% sure of your answers, you might as well dive in and take your best shot at tackling questions! Speaking of:
3. **Questions are key to science.** Whether you'd like something explained a different way, think you spot a mistake, or are just curious about a topic, asking questions is a great use of class time! Of course, to make that work:
4. **You are responsible for preparing for class.** Whether it's reading a section in the text or watching a brief video, pre-class prep will help you show up ready to ask new questions and practice new skills.

Grading:

Assignments	45%	**Quizzes and Exams**	20%
Semester 1 Paper	5%	**Midterm and Final**	20%
Semester 2 Paper	5%	**Attendance and Participation**	5%

Assignments
Assignments will vary throughout the year. Each week different assignments will be given for you to complete. These assignments may consist of problem solving sheets, activity worksheet, a questions based on simulations, problems from the book, discussion board posts, written critiques, short essays or projects. All weekly assignments will be due on Sunday at midnight EST. This will allow me time to grade and comment on assignments, getting them back to you by the next class period. Some assignments that are bigger (projects, papers) may take more time to grade. However, I will try to have all assignments returned within one week of the due date.

Research Papers
Each semester, you will write a paper that focuses on science as a human endeavor. The first semester you will choose a scientist and use a primary work by them. The second semester will focus on a technological innovation, scientific discovery, or natural phenomenon and the human response. Specific guidelines will be given when the assignment is announced.

Quizzes and Exams
Students will be assessed periodically on their comprehension of course material through quizzes and tests. These will always be announced at least one class period prior to the exam. Generally speaking quizzes may be given more often than exams with 4-6 quizzes given per semester and 2-3 exams.

Midterm & Final Exams
The Midterm Exam will be a Blackboard based test on material covered from the beginning of the course through the end of the fall semester. The Final Exam will be a Blackboard based test on material covered during the entire year. More detail will be provided on these assessments during the fall and spring semesters.

Google Docs and Group Work
Science is a collaborative process. As such, we will be utilizing Google Docs both inside and outside of class. Here your students can collaborate and work together in real time to create lab experiments, charts, tables, procedures, etc.

Example schedule:

Week	Lecture 1	Lecture 2
Week 1	Scientific Method	Measurement, Scientific Notation, and Dimensional Analysis
Week 2	States of Matter	Density

Week 3	Energy and Temperature vs. Heat	Phase Changes
Week 4	No Class - Fall Break	Review
Week 5	Gas Laws	Gas Laws
Week 6	Gas Laws and KMT	Gas Laws and KMT
Week 7	Atoms, Elements, Molecules and Compounds	Intro to the Periodic Table
Week 8	Physical and Chemical Changes, Separation Techniques	Conservation of Mass and Laws of Definite and Multiple Proportions
Week 9	Periodic Table and Atomic Structure	Periodic Table and Atomic Structure
Week 10	Atomic Theory Project	Atomic Theory Project
End of First Quarter		
Week 11	Light and the Bohr Model	Electrons and Electron Dot
Week 12	Electron Configuration	Periodic Trends
Week 13	Radioactivity and Half-life	Radioactivity and Half-life
Week 14	Radiometric Dating	Nuclear Fission and Fusion
Week 15	Review	Break
Thanksgiving Break		
Week 16	Real Life Chemistry: Water	Real-Life Chemistry: Water
Week 17	Water's Specific Heat	Water's Specific Heat
Week 18	Exam Week	
End of Second Quarter/Fall Semester		
Winter Break		

Semester II

Week 19	Review	Electron Dot Structures
Week 20	Forming Ions	Ion Nomenclature
Week 21	Covalent Bonding	Covalent Nomenclature
Week 22	Metallic Bonding	Metallic Bonding
Week 23	Molecular Shape and Polarity	Molecular Shape and Polarity
Week 24	Dipole Attractions	Concentration
Week 25	Solubility	Solubility
Week 26	How soap works	Purifying the water we drink
End of Third Quarter		
Spring Break		
Week 27	Chemical Reactions	Chemical Reactions
Week 28	The Mole	The Mole
Week 29	Empirical and Molecular Formulas	Empirical and Molecular Formulas
Week 30	Stoichiometry	Stoichiometry
Week 31	Thermochemical Equations	Equilibrium
Week 32	Acids and Bases	Redox Reactions
Week 33	Electrochemistry	The Chemistry of Life
Week 34	Medicinal Chemistry	Medicinal Chemistry
Week 35	Review and Exam Week	

The Well-Trained Mind Academy
Chemistry Lab
2020-2021

Course Blackboard site: www.wtma.blackboard.com

Required Kit:

Thames and Kosmos C2000 Lab Kit:
https://www.thamesandkosmos.com/index.php/product/category/science-kits/chem-c3000

Other Required Materials:

- None required. A high school chemistry textbook is highly recommended for reference. We recommend Suchoki, John. *Conceptual Chemistry,* 5th ed. Upper Saddle River, NJ: Prentice Hall, 2013.
- We will be using mostly HTML-based simulations. Occasionally Java simulations may be used. If you are unable to run Java, I will provide a work around.

Course Description

This course will provide an in-depth exploration of chemistry phenomena through laboratory investigation. Students will conduct experiments related to basic chemistry topics, including ideal gas properties, principles and properties of chemical reactions, solubility and pH, and thermochemistry. Course content includes, but is not limited to, studying and applying the experimental method, composing lab reports, engaging in peer review with classmates, and presenting lab results.

Course Goals

Upon completion of the Chemistry Lab, successful students will have practiced applying the experimental method to explore and test basic principles of chemistry. Students will learn to think scientifically, which entails becoming adept at developing hypotheses, designing controlled experiments, collecting and interpreting data, conducting scientific investigations, presenting results, and thoughtfully engaging in scientific discourse.

Course Flow

Most labs will follow a 2 week work cycle. The first week will be the pre-lab week where you should come to class having read the lab and any assigned background reading. In class we will discuss the upcoming lab and attend to any special topics that need consideration. During this class, we will work on the introduction to our lab reports, as well as the materials and methods section. We will leave the class with an understanding of the procedure that will take place as well as potential results.

After leaving class you will have one week to work on the lab. You will also prepare the data you get for presentation. When you arrive in class on the following week, we will present our results, discuss and critique our experiments and attend to any special interest topics. After class you will continue refining your lab report and get it ready for submission. The lab report will be

due the Saturday following the second lab period of that experiment. Once your lab report has been submitted you will want to prepare for the next class by reading the background information and procedures for the next lab.

Grading
Students' grades in this course are determined by weighted categories, divided as shown in this chart:

Lab Reports and Assignments	50%
Quizzes	20%
Presentation	15%
Independent Investigation/Lab Report	15%

Lab Reports
Composing lab reports is a major component of this course and an underlying theme in the course design. A complete lab report includes a hypothesis (together with its underlying observations), a procedure to test the hypothesis, data collected during the experiment, analysis and conclusions drawn from the collected data. Throughout the semester we will work on each part of the lab report and end with a final complete lab report.

It is *highly recommended*, but not required, that students keep a lab notebook containing all lab reports to date. Lab notebooks are not the same as archived work—they allow the scientist to make connections between the knowledge and conclusions from various labs, add notes on procedures, and use previous experience to improve future experiments.

Quizzes/Writing Assignments
To supplement the hands-on practice of science, quizzes and other brief assignments may be assigned periodically. These non-lab assignments will test students' familiarity with completed labs and measure their growing mastery of the basic principles of scientific thought and investigation.

Google Docs and Group Work
Science is a collaborative process. As such, we will be utilizing Google Docs both inside and outside of class. Here your students can collaborate and work together in real time to create lab experiments, charts, tables, procedures, etc.

Presentation
Weekly class meetings will involve class discussion of previous and upcoming labs, including but not limited to the following activities:

- presenting and discussing lab results
- designing and critiquing original experiments for situations not covered in labs
- asking questions and discussing possible problems and techniques for upcoming lab procedures
- watching or participating in experimental procedures for labs

During meetings, students are expected to collaborate, ask questions, and otherwise participate in the scientific community. More details on the grading of this participation will be provided in class.

Final Lab Report / Independent Investigation
Each student will carry out an independent investigation to be presented at the end of the semester. Benchmarks will be given throughout the semester and assessed. The final lab report will be written about this investigation. An option to connect with your local district/state science fair may be available.

Example schedule:

Week	Topic
Week 1	Aluminum Foil Lab
Week 2	Presentation
Week 3	Phase Changes Lab
Week 4	Presentation
Week 5	Boyle's Law
Week 6	Presentation
Week 7	Charles' Law
Week 8	Presentation
Week 9	Solutions, Suspensions, Colloids
Week 10	Presentations
End of First Quarter	
Week 11	Solubility and Temperature
Week 12	Presentation
Week 13	Chromatography
Week 14	Presentation
Thanksgiving Break	
Week 16	Recrystallization

Week 17	Presentation
Week 18: Dec 19	Final Lab Report
End of Second Quarter/Fall Semester	

Example Schedule for Spring Semester Lab

Week	**Topic**
Week 1	Conductance of Ionic and Molecular Solutes
Week 2	Presentation
Week 3	Heat of Solution
Week 4	Presentation
Week 5	Specific Heat
Week 6	Presentation
Week 7	Composition Reaction
Week 8	Presentation
End of Third Quarter	
Spring Break	
Week 9	Decomposition Reaction
Week 10	Presentation
Week 11	Double Replacement Reaction
Week 12	Presentation
Week 13	Oxidation of Iron
Week 14	Presentation
Week 16	Independent Investigations
Week 17	Independent Investigations
Week 18	Final Lab Report
End of Fourth Quarter/Spring Semester	

The Well-Trained Mind Academy
Physics

Course Blackboard site: www.wtma.blackboard.com

Required Text

Paul G. Hewitt, *Conceptual Physics,* 12th edition. Glenview, IL: Pearson, 2014. ISBN 978-0321909107

Calculator

A scientific calculator (such as Texas Instruments TI-30X IIS) is required for this course. Online scientific calculators can also be used, but they are discouraged because they tie the student to the computer/internet for homework.

Course Description

This course will provide a survey of basic principles in physics topics including but not limited to force and motion, properties of atoms and phases of matter, thermodynamics, sound and light waves, electricity and magnetism, optics, and modern physics topics including relativity and quantum mechanics. The class is structured in the manner of a "flipped" classroom, in which students will watch a video and read material from the textbook to prepare them for a class meeting focused on discussion and mastery of the material. Class assignments and assessments will focus on both conceptual topics and the use of relevant equations.

Upon completion of the Physics course, successful students will have a mastery of introductory concepts and principles of physics as well as an ability to think scientifically. Students will become more adept at applying their mathematical and conceptual knowledge of physics and the scientific method to real scenarios, interpreting data and the results of scientific investigations, and thoughtfully engaging in scientific discourse.

Prerequisite: Students should be comfortable with concepts covered in Algebra II, like solving systems of equations for unknowns. Pre-Calculus is helpful but not required; however, students will need to become familiar with the basic principles of adding vectors.

Course Goals

Upon completion of introductory physics, successful students will have a mastery of introductory concepts and principles of physics as well as an ability to think scientifically. Students will become more adept at applying physics principles to real scenarios, interpreting data and the results of scientific investigations, and thoughtfully engaging in scientific discourse.

Course Principles

1. **Practice makes physicists.** Never "perfect", but better every time! Doing anything for the first time takes some getting used to, in science or any other field. That means:
2. **Mistakes are welcomed, not punished.** In-class problem solving will be graded based on effort, not on correct answers. This makes classwork the perfect time to work out mistakes and misunderstandings, so even if you're not 100% sure of your answers, you might as well dive in and take your best shot at tackling questions! Speaking of:
3. **Questions are key to science.** Whether you'd like something explained a different way, think you spot a mistake, or are just curious about a topic, asking questions is a great use of class time! Of course, to make that work:
4. **You are responsible for preparing for class.** Whether it's reading a section in the text or watching a brief video, pre-class prep will help you show up ready to ask new questions and practice new skills.

Grading

Students' grades in this course are determined by weighted categories, divided as shown in this chart:

*Daily Work 20%	Quizzes 10%
*Scientific Analysis 10%	Unit Tests 20%
*Research Paper 10%	Midterm Exam 10%
*Primary Source Analysis 5%	Final Exam 15%

** See below for a more detailed explanation of these categories.*

Daily Work

Students will be graded on class-based work every week, including solving problems individually and in groups during class time. The Daily Work grade consists of the following components:

1. **In-Class Questions and Work:** Students will be asked to solve problems relating to the day's material, as well as getting to see and offer feedback on others' work. (50%)
2. **Discussion Board Posts and Replies:** Students will be required to post an original reflection to the discussion board each week a prompt is assigned, as well as replying to others' original posts. See Discussion Board Expectations document for more details. (25%)
3. **In-Class Mini-Presentations:** Students will sign up to give a number of informal 5-10 minute talks on advanced or specialized physics topics that are of particular interest. (15%)
4. **Response to Out-of-Class Readings/Video:** Students will be asked to watch short videos and/or read sections of the text before class meetings. This will allow in-class time to be concentrated on answering questions and solving problems. To ensure good

preparation for class, students may be tested on general knowledge from these videos and readings. (10%)

Scientific Analysis

Although lab work is not a part of the Physics course, understanding how to conduct scientific investigations is an integral part of the scientific process. Students will regularly be responsible for reading and analyzing descriptions of experiments, as well as discussing their thoughts on the experimental process, results, and conclusions. Students will also be provided with ideas for labs that illustrate principles taught in class, if they have an interest in experiments but are not enrolled in Physics Lab. Students that are interested in a full lab experience should also enroll in the Physics Lab course at WTMA.

Research Paper

Students are required to research and write a **4-6 page paper** that traces the historical development of either a discovery or technology that has impacted the field of physics. Students will choose their topic in January and work **throughout the second semester** to locate sources, create an outline, write a rough draft, edit/revise their draft, and finally **submit a final paper in May**. More information regarding expectations will be provided to the students near the end of the first semester.

Primary Source Analysis

Students are required to read an approved text and write a summary/analysis response **during their first semester** in Physics. More information regarding expectations will be provided to students during the first month of class.

Example Schedule:

Week	**Lecture 1**	**Lecture 2**
1	Intro/Course Expectations	History and Principles of Science/Physics
2	Newton's First Law	Linear Motion
3	Newton's Second Law	Newton's Third Law
4	Balancing Forces	Unit 1 Review
5	Momentum	Elastic and Inelastic Collisions
6	Energy	Circular Motion, Centripetal Force, & Torque
7	Center of Gravity & Mass/Ang. Momentum	Gravitational Force
8	Universal Gravitation & Black Holes	Projectile Motion
9	Projectile Motion	Unit 2 Review
10	Atomic Structure	Compounds and Molecules

11	Properties of Solids	Properties of Liquids
Thanksgiving Break		
12	Properties of Gases	Finish Solid/Liquid/Gas Properties; Plasma
13	Unit 3 Review	Heat
14	Phase Changes	1st Law of Thermodynamics
15	2nd Law of Thermodynamics	Entropy
Holiday Break		
16	Midterm Review	Midterm Review
Midterms Week		
17	Wave Properties	Doppler Effect
18	Sound Waves	Harmonics
19	Fourier Transforms	Unit 5 Review
20	Electric Charge/Coulomb's Law	Electric Fields and Potential
21	Electrical Current/Resistance/Voltage/Power	Kirchhoff's Law/Ohm's Law
22	Magnetic Poles and Fields	Electricity and Magnetism
23	Faraday's Law and Induction	Unit 6 Review
24	EM Waves	Seeing EM Waves
Spring Break		
25	Color	Reflection
26	Refraction	Lenses and Rays
27	Diffraction and Polarization	Excitation, Emission, and Absorption
28	Unit 7 Review	Light Quanta/Photoelectric Effect
29	Wave-Particle Duality	Electron Waves & Quantum Mechanics
30	Radioactivity	Nuclear Fission and Fusion
31	Special Relativity	General Relativity
32	Comprehensive Review	Comprehensive Review
Finals Week		

The Well-Trained Mind Academy

Physics Lab

Course Blackboard site: www.wtma.blackboard.com

Please note: The fall and spring semesters of this lab cover different material. We recommend that students interested in science take both semesters. However, students may choose to register for the fall or spring semester only, depending on transcript needs.

Required Materials:

- Students must obtain lab materials in advance in order to successfully conduct lab investigations by the scheduled due date.
- A high school physics textbook is highly recommended for reference. We recommend Paul G. Hewitt, *Conceptual Physics,* 12th edition. Glenview, IL: Pearson, 2014. ISBN 978-0321909107

Course Description

This course will provide an in-depth exploration of physical phenomena through laboratory investigation. In the fall, students will investigate topics including force and motion, energy and momentum, and thermodynamics. In the spring, students will investigate topics in electricity and magnetism and optics. Class meetings and assignments will require students to study and apply the experimental method (including use of relevant equations for data analysis), compose lab reports, engage in peer review with classmates, present lab results, and discuss special topics including scientific ethics and historic experiments in the field of physics.

Upon completion of the Physics Lab course, successful students will have become adept at applying their knowledge of physics and the scientific method by designing and carrying out experiments, interpreting data and the results of scientific investigations, presenting their results for peer comment and review, and thoughtfully engaging in scientific discourse.

Prerequisite: Students should be comfortable with concepts covered in Algebra II, like solving systems of equations for unknowns. Pre-Calculus is helpful but not required; however, students will need to become familiar with the basic principles of adding vectors.

Course Goals

Upon completion of Physics Lab, successful students will have practiced applying the experimental method to explore and test basic principles of physics. Students will learn to think scientifically, which entails becoming adept at developing hypotheses, designing controlled experiments, collecting and interpreting data, conducting scientific investigations, presenting results, and thoughtfully engaging in scientific discourse.

Grading

Students' grades in this course are determined by weighted categories, divided as shown in this chart:

Lab Reports	50%
Additional Writing Assignments/Quizzes	10%
Participation	25%
Final Exam	15%

Lab Reports

Composing lab reports is a major component of this course. A complete lab report includes a hypothesis (together with its underlying observations), a procedure to test the hypothesis, data collected during the experiment, and any analysis performed on and conclusions drawn from the collected data. More details on the format and content will be provided during the first week of class.

It is *highly recommended*, but not required, that students keep a lab notebook containing all lab reports to date. Lab notebooks are not the same as archived work—they allow the scientist to make connections between the knowledge and conclusions from various labs, add notes on procedures, and use previous experience to improve future experiments.

Quizzes/Writing Assignments

To supplement the hands-on practice of scientific methods and procedures, quizzes and other brief writing assignments may be assigned periodically. These non-lab assignments will test students' familiarity with completed labs and measure their growing mastery of the basic principles of scientific thought and investigation.

Participation

Weekly class meetings will involve class discussion of previous and upcoming labs, including but not limited to the following activities:

- presenting and discussing lab results
- designing and critiquing original experiments for situations not covered in labs
- asking questions and discussing possible problems and techniques for upcoming lab procedures
- watching or participating in experimental procedures for labs

During meetings, students are expected to collaborate, ask questions, and otherwise participate in the scientific community. More details on the grading of this participation will be provided in class.

Final Exam

Each semester will conclude with a lab exam, which will test students on the following topics:

- understanding of the basic chemistry principles learned during the semester
- knowledge of the associated lab procedures and conclusions
- basic principles of scientific thought and investigation
- sound experimental design and critique

Exams will combine multiple-choice and other short question formats with longer writing sections, possibly including drawings and other visual presentations.

Example schedule:

Note that each semester is self-contained and introduces principles of experimental method and design; for full-year lab students, the spring introductory lesson will build on the fall semester's work.

Fall

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Newton's Laws
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: 2D Kinematics
5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Friction
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Gravity
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5
10	Experimental Method Practice	Lab 5: Conservation of Energy & Momentum
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
12	Experimental Method Practice	Lab 6: Center of Mass
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Properties of Waves
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
	Exam Week: No Class Meeting	Final Exam

Spring

Week	Lecture Topic	What's Due?
1	Experimental Method/Pre-Lab 1 Discussion	Discussion Board 1
2	Writing the Lab Report	Lab 1: Laws of Thermodynamics
3	Lab 1 Analysis/Pre-Lab 2 Discussion	Discussion Board 2
4	Experimental Method Practice	Lab 2: Electric Charge
5	Lab 2 Analysis/Pre-Lab 3 Discussion	Discussion Board 3
6	Experimental Method Practice	Lab 3: Electric Fields and Potential
7	Lab 3 Analysis/Pre-Lab 4 Discussion	Discussion Board 4
8	Experimental Method Practice	Lab 4: Ohm's Law
9	Lab 4 Analysis/Pre-Lab 5 Discussion	Discussion Board 5
10	Experimental Method Practice	Lab 5: Magnetic Forces and Fields
11	Lab 5 Analysis/Pre-Lab 6 Discussion	Discussion Board 6
12	Experimental Method Practice	Lab 6: Snell's Law and Internal Reflection
13	Lab 6 Analysis/Pre-Lab 7 Discussion	Discussion Board 7
14	Experimental Method Practice	Lab 7: Optics and Ray Tracing
15	Lab 7 Analysis/Pre-Lab 8 Discussion	Discussion Board 8
16	Lab 8 Analysis/Final Exam Review	Lab 8: Student-Designed Lab
Exam Week: No Class Meeting		Final Exam

Physics Lab Supplies

Below are two tables containing the required lab supplies, one for each semester of the Physics Lab course. The lab supplies are arranged in order of use through the semester and include purchasing information and approximate estimated cost (based on supplier information at time of writing, where it can be found).

The cost of these materials will vary depending on what you have on hand, but shouldn't much exceed an average of $50/semester. Please contact the instructor if you're unsure you can obtain materials for some other reason. Also, science labs have a proud tradition of replacing expensive equipment with something cheaper or more convenient, as long as it gets the job done just as well—so if you want to try a substitution, ask the instructor!

Fall Physics Lab Supplies

Item	**Recommended Source**	**Estimated Cost**	**Labs Used**
basic supplies for any occasion: ● string ● masking tape ● pen/pencil ● permanent marker ● paper ● scissors ● tape measure/ruler ● protractor ● stopwatch (phone or computer usually works fine) ● aluminum foil ● cardboard	You probably have many of these around the house! For the tape measure and ruler, I HIGHLY recommend one with metric as well as English markings (otherwise you have to remember to convert all your measurements).	hopefully free!	useful for pretty much all labs...never bad to have around!
20N spring scale (10N is fine as well) OR food scale (must have a resolution of 1g)	spring scale: https://tinyurl.com/yxnq5t5h food scale: https://tinyurl.com/yyd257uf	$9-15	Fall: 1, 3

small pulley (1-2” is fine)	hardware store or Amazon: https://tinyurl.com/yyjzjsb9	$3-5	Fall: 1
20 small metal nuts, washers, or other similar holed object	around the house or hardware store	$0-5	Fall: 1, 2, 3, 4, 5
paper clips (optional)	around the house	$0	Fall: 1
carbon paper OR large towel (carbon paper is more precise)	10-sheet packs in stores, or around the house	$0-2	Fall: 2
marble (or similar small heavy sphere)	probably around the house	$0	Fall: 2
ramp (made of sturdy material and able to adjust angle)	cardboard, wood, books, or other household materials	$0	Fall: 2, 3
assorted small non-rolling solid objects	around the house	$0	Fall: 3
somewhat sturdy, thin tube (e.g. non-bendy straw)	around the house	$0	Fall: 4
1 dozen eggs (or a few plastic ones)	around the house or grocery store	$0-3	Fall: 5
cardboard, bubble wrap, plastic bags, and other assorted materials	around the house	$0	Fall: 5

microwave-safe dish (or paper plate)	around the house	$0	Fall: 6
mini marshmallows, chocolate chips, shredded cheese, or something else that melts well and in specific areas	around the house or grocery store	$0-2	Fall: 6
microwave with labeled frequency	probably around the house; contact Dr. B ASAP if this is a problem	$0 (do not buy a microwave just for this!)	Fall: 6
2 different-colored dice	around the house	$0	Fall: 7

Estimated total for Fall 2020: **$12-32**

Spring Physics Lab Supplies

Item	**Recommended Source**	**Estimated Cost**	**Labs Used**
basic supplies for any occasion: ● string ● masking tape ● pen/pencil ● permanent marker ● paper ● scissors ● tape measure/ruler ● protractor ● stopwatch (phone or computer usually works fine) ● aluminum foil	You probably have many of these around the house! For the tape measure and ruler, I HIGHLY recommend one with metric as well as English markings (otherwise you have to remember to convert all your measurements).	hopefully free!	useful for pretty much all labs...never bad to have around!

● cardboard			
at least 4 AA batteries	probably around the house	$0-5	Spring: 2, 3, 4
AA battery holder (or connect your battery terminals together in some other way)	Example: https://tinyurl.com/y3mgydhy	$2-5	Spring: 2, 3, 4
at least 5 alligator clips	Amazon: https://tinyurl.com/yy5duwxo	$6	Spring: 2, 3, 4
digital multimeter	Amazon: https://tinyurl.com/y53897kl	$10	Spring: 2, 3, 4
shallow glass dish (can hold layer of water)	around the house	$0	Spring: 2
Play-doh (or homemade alternative)	around the house or in stores	$0-1	Spring: 2, 3
at least 4 resistors	Example: https://tinyurl.com/y4xqctfj	$1-8	Spring: 4
silicone-coated copper wire	Amazon: https://tinyurl.com/y6jgkj8h	$5-10	Spring: 5
large steel or iron nail (~3” long)	around the house or hardware store	$0-1	Spring: 5
magnetic compass	use if you already have one--do not buy one just for	$0	Spring: 5

	this lab!		
iron filings	Example: https://tinyurl.com/y4xsqmbe	$2-5	Spring: 5
refraction cell	Amazon: https://tinyurl.com/yynlywp2	$8	Spring: 6
laser pointer	Amazon: https://tinyurl.com/y5xl3pyz	$5	Spring: 6
convex and concave lenses	Amazon: https://tinyurl.com/y4nq66og	$10	Spring: 7

Estimated total for Spring 2021: **$49-74**

Estimated total for both semesters: **$61-106**