BIOL 3020 Molecular Genetics Laboratory

The University of Toledo
College Natural Science and Mathematics
BIOL 3020-001
2 Credit Hours

Instructor:	John Gray	**Term:**	Fall 2016
Teaching Assistant:	Tobias Clark	**TA Office Location**	WO3246 419 530 1546
Office Hours:	Tues 3 to 3.50pm	**Class Location/Times:**	Tues 2 to 2.50 WO3246A
Office Location:	WO 3232A	**Lab Location/Times:**	Thurs 2 to 4.50 WO1212
Office Phone:	419 530 1537	**Course Website:**	https://blackboard.utdl.edu
Email:	jgray5@utnet.utoledo.edu	**Instructor's Website:**	Use Blackboard for this class

COURSE/CATALOG DESCRIPTION
A laboratory course in experimental molecular biology involving gene cloning, analysis of cloned product and other techniques of modern molecular genetics. Corequisite: BIOL 3010

COURSE OVERVIEW This course aims to be a modern hands-on practical course that will …

1. Teach you the fundamental concepts and techniques for the use of recombinant DNA technology - a key tool in modern molecular genetic studies.
2. Teach you the fundamental technique of experimental investigation (Research).
3. Provide you with an introduction to the use of computer based manipulation and analysis of DNA sequence information as an essential tool in modern biology.
4. Provide you with new insights into the use of molecular genetics and it's impact on our daily lives and understanding of the world.

COURSE OBJECTIVES

1. Students will be expected to demonstrate effective skills in the use of enzymes to cut and join DNA molecules, the engineering of new DNA molecules and their propagation in bacteria, and the analysis and detection of DNA molecules using electrophoretic separation and hybridization techniques.
2. Students will be expected to utilize critical thinking in the design of experiments, the performing of experiments, the collection of data, the proper analysis of data and the correct way to report and present a scientific research study.
3. Students will be expected to demonstrate effective use of modern bioinformatics software tools to analyze gene and gene functions.
4. Students are expected to utilize critical thinking in a graded group exercise to design a genetic engineering project. Students will be expected to demonstrate effective teamwork and presentation skills in designing, reporting, and delivering and presenting a proposal about their genetic engineering project.

TEACHING STRATEGIES The pre-lab lecture will be taught by the instructor and is designed to prepare students to understand the theory and concepts underlying the experiments they will conduct in lab. Students are expected to have read materials online prior to the pre-lab lecture and clickers will be used to assess understanding during the pre-lab lecture (worth 5% of overall grade). In the lab students will learn hands-on to follow a scientific experimental protocol, record results and analyze them under the guidance of a teaching assistant. A major component of the course is to learn scientific writing. Students will learn how to write and report the findings of their lab activities and 60% of the overall grade will be assigned for this purpose. Students will be awarded 5% of their overall grade for punctual and professional behavior in the laboratory and following the TAs instructions. Homework assignments (worth 10% of the overall grade) will be given after every lab. and are designed to have students reflect on the experiments they just completed and explain theory or analyze results that come form such experiments. Lastly a group project worth 30% of the overall grade (See Biotech Sharktank) is designed to expand students understanding of the possibilities of modern molecular genetics beyond what is doable in the lab. This aspect of BIOL 3020 is aimed at fostering group interaction and presentation skills which are important for the modern workplace.

WORKWEEK

In this laboratory course, the week begins at 12:01 AM Monday morning at which time all materials for the week will be posted for the coming week if not earlier. The week ends at 11.5ppm the following Sunday night. Assigned work for any week is to be completed by dates detailed in the syllabus and schedule. Students should begin each week on Monday by checking the schedule and then viewing the content for the week in the folder of materials on Blackboard for that week.

PREREQUISITES

Students who take this course should have completed **BIOL - 2170 FUNDAMENTALS OF LIFE SCIENCE II: CELLS AND INHERITANCE AND DEVELOPMENT** A general introduction to cell structure and function, energy processing in plants and animals, basic genetics, molecular biology, and development. Prerequisite: CHEM 1210 or 1230
and
BIOL - 2180 FUNDAMENTALS OF LIFE SCIENCE LABORATORY II [1 hour] A series of laboratory exercises which supplement the material discussed in BIOL 2170. Corequisite: BIOL 2170".

COREQUISITES

BIOL - 3010 MOLECULAR GENETICS

[3 hours] The principles of heredity at the molecular level, covering gene and chromosome structure, replication and repair, recombination, control of gene expression, control of cell division. Prerequisite: BIOL 2170; CHEM 1220 or 1240.

TECHNICAL SKILLS

To succeed in this course, it will be important for learners to possess the following technical skills:

1. Read and understand the theory behind, and the protocol for a molecular genetics experiment
2. Conduct a hands-on molecular genetics experiment with care and accuracy.
3. Record and analyze the results of a molecular genetics experiment in a correct scientific fashion.
4. Write a report on the results of a molecular genetics experiment in a correct scientific fashion (See Guide to Writing Lab Reports in this syllabus).
5. Familiarity with word processing software such as Microsoft Word for writing a scientific report/proposal
6. Familiarity with presentation software such as Microsoft Powerpoint for public presentation of a genetic engineering proposal (Sharktank Project)
7. Utilize modern bioinformatics software to manipulate and analyze genetic information – in particular the use of the Lasergene® (DNASTAR) package of software as well as online database/resources such as GenBank and DNA Subway.
8. Exhibit good teamwork, interpersonal, and presentation, skills in the development of a proposal for a genetic engineering project.

REQUIRED TEXTS AND MATERIALS

It is not required to purchase a textbook for class – notes will be provided Blackboard or as photocopied handouts. A binder is recommended to keep such notes together if you print them out but this is not necessary as you can access all materials online during the lab.

1. Students are required to provide a hardcovered ruled notebook (Composition book). This is to be used for class preparation, note taking and data collection.
2. A lab coat is required for use during the lab sessions but protective goggles are not. Lab coats may be purchased from medical supply stores in Toledo (e.g Univ. Bookstore or Superior Uniform 821 Philips Ave. (419 476 9616 (approx. $21)

TECHNOLOGY REQUIREMENTS

1. Students must purchase a Turning Point® Response Card (Clicker) which will be used in the pre-lab lecture (See section on clickers in syllabus).
2. For computer based learning you need to purchase your own flash drive to backup your work. Loss of work is not an acceptable excuse for late assignments.

Browser Check Page

Students need to have access to a properly functioning computer throughout the semester. The Browser Check

Page will enable you to perform a systems check on your browser, and to ensure that your browser settings are compatible with Blackboard, the course management system that hosts this course:
http://www.utdl.edu/utlv/Bb9BrowserCheck/innovation/blackboard/browsercheck.html

Software
Student computers need to be capable of running the latest versions of plug-ins, recent software and have the necessary tools to be kept free of viruses and spyware. The computer needs to run the following software, available in the Online Learning Download Center at http://www.utoledo.edu/dl/main/downloads.html:

- Word Processing Software
- Adobe Acrobat Reader
- Apple QuickTime Player
- Java Plugin Console
- Adobe Flash Player
- Adobe Shockwave Player
- Mozilla Firefox Browser – **Recommended**

Internet Service
High-speed Internet access is recommended as dial-up may be slow and limited in downloading information and completing online tests. This course does contain streaming audio and video content.

Use of Public Computers
If using a public library or other public access computer, please check to ensure that you will have access for the length of time required to complete tasks and tests. A list and schedule for on-campus computer labs is available at http://www.utoledo.edu/it/CS/Lab_hours.html.

UT Virtual Labs
Traditionally, on-campus labs have offered students the use of computer hardware and software they might not otherwise have access to. With UT's Virtual Lab, students can now access virtual machines loaded with all of the software they need to be successful using nothing more than a broadband Internet connection and a web browser. The virtual lab is open 24/7 and 365 days a year at http://www.utoledo.edu/it/VLab/Index.html.

DNA Analysis Software
Students will be provided access to professional DNA software (Lasergene® package from DNASTAR®) in the laboratory (WO1212) and the Biological Sci. Dept. Computer cluster in BO1099. Students are expected to complete tasks during laboratory sessions but may continue work in BO1099 outside of lab time. This software is not freely available to the public.

COURSE POLICIES

Note on Academic Dishonesty (Cheating/Plagiarism):
Academic dishonesty will not be tolerated. Please read The University's Policy Statement on Academic Dishonesty available at http://www.utoledo.edu/dl/students/dishonesty.html.
Bringing a clicker to class for someone else is considered academic dishonesty for both parties. I can count the number of students in class and the number of responses. If the 2 do not match up, I will stop class and determine who is missing. The penalty will be that both parties get an F in the entire course.
Very few students feel the need to cheat. You can get a very respectable grade of which you can be proud if you use the considerable talents and intellect that have propelled you this far in your studies. Students caught cheating however will be recorded a zero for that quiz or assignment. All available information on the cheating incident will be forwarded to the Dean of Student Affairs for investigation and appropriate action.
With the advent of the internet some students have copied the work of others directly into their writing assignments such as lab reports. The copying of entire articles and paragraphs or even entire sentences is considered plagiarism and will be treated the same as cheating. The work of others must be paraphrased using your own words/sentences even if you maintain that "it is written better than I could" or "I could not think of another way of saying that" – the usual exception being a direct quote of a speech or announcement. Even when work is paraphrased you must also cite a source/reference of where you found the information so that the reader can locate if for his/herself. Web sources must also be cited by providing a complete web address of the reference material in the bibliography section of your report.

Course Policy on Absences:

You are expected to participate in **all** lab. sessions**.** ***In the event of an unanticipated absence due to illness or emergency, evidence of the necessity of the absence must be provided in the form of a doctors letter or equivalent i.e. a contactable supervisory adult that will substantiate the necessity of your absence.*** You must inform us as early as possible of an anticipated absence and we will attempt to include you in one of the other lab. sessions. Anticipated absences must be due to extenuating circumstances, - vacations, weddings, and interviews are not excusable reasons for not attending the laboratory. *Any unaccounted for absence constitutes failure in the course*.

GRADING POLICIES

Student work will be assessed as follows. Specific guidelines, grading criteria, and a timeframe for grades and feedback will be provided as each assignment is announced:

Graded Activity	# of points	% of overall grade	Due Dates
Prelab "Clicker" Questions	**25**	**5**	**Prelab lectures Tues 2pm**
Lab. Report #1	**75**	**15**	**Due Feb 9th in lab**
Lab. Report #2	**100**	**20**	**Due Mar 16th in lab**
Biotech Sharktank	**100**	**20 (3,3,8, and 6%)**	**Various deadlines: 1st preproposal Feb 10th 2nd preproposal Mar 17th Full Proposal Apr 14th Presentation Apr 27th**
Homework Problems	**50**	**10**	**Due at start of each lab**
Lab. Report #3	**125**	**25**	**Fri Apr 28th 5pm to TA**
Participation in lab.	**25**	**5**	**Average of all labs**
Totals	**500**	**100%**	

Students are expected to complete and submit all assignments and tests by the due date listed in the Course Schedule. Late assignments and make-up tests will not be permitted unless arrangements are discussed and approved well before the required due date above. **If a student does hand in a report late then there will be a 10% deduction of grade per day or part of a day (*i.e.* after 3 days delay a *perfect* report could only earn 70%).**

Ask questions as soon as possible by email or by phone if you do not understand an assignment. This course does not have any Midterm or Final Exams.

The grading scale for this course is as follows:

% of available marks	Grade	Standard
90-100	A	Achievement of outstanding quality
88-89	A-	Achievement of slightly less than outstanding quality
85-87	B+	Achievement of slightly more than high quality
74-84	B	Achievement of high quality
71-73	B-	Achievement of slightly less than high quality
69-70	C+	Work of slightly more than acceptable quality
62-68	C	Work of acceptable quality
60-61	C-	Work of slightly less than acceptable quality
58-59	D+	Work slightly above the quality expected
52-57	D	Work below the quality expected
50-51	D-	Work slightly below the quality expected
< 50%	F	Work below quality and quantity expected

AMERICANS WITH DISABILITIES ACT

The Americans with Disabilities Act (ADA) requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. In accordance with the ADA and university policy, if you have a documented disability and require accommodations to obtain equal access in this course; please contact the instructor at the beginning of the semester to discuss any necessary accommodations.

Please contact the Office of Academic Access for verification of eligibility at 419-530-4981 (voice) or 419-530-2612 (TDD).

COMMUNICATION GUIDELINES

Email: Students are expected to check their UT email account frequently for important course information. This class is being taught for you, so if you are having trouble understanding any aspect of it, please let me know. I am here to help, and will do my best to respond to email within 24 to 48 hours.

Netiquette:

It is important to be courteous and civil when communicating with others. In this course you will be sharing a google drive account with others in your group – be sure to use clear and courteous communciations at all times in preparing your group work. To ensure your success when communicating online, take time to familiarize yourself with the "dos" and "don'ts" of Internet etiquette: http://www.albion.com/netiquette

TECHNICAL SUPPORT

If you encounter technical difficulties with Blackboard, please contact the UT Online Help Desk at (419) 530-8835 or utdl@utoledo.edu. The Help Desk offers extended hours in the evenings and on weekends to assist students with technical problems. When calling after hours, leave a detailed message, including your Rocket Number and phone number, and an Online Learning staff member will respond on the next business day. The UT Online Help Desk website is available at: http://www.utoledo.edu/dl/helpdesk/index.html

Technical questions related to on-campus Internet access, virtual labs, hardware, software, personal website hosting, and UTAD account management can be directed to UT's IT Help Desk at (419) 530-2400 or ithelpdesk@utoledo.edu. The IT Help Desk website is available at http://www.utoledo.edu/it/CS/HelpDesk.html.

LEARNER SUPPORT

The primary support that you will receive in this course is through your TA during the lab time and by the instructor during office hours.

In addition the University of Toledo offers a wide range of academic and student support services that can help you succeed:

eTutoring Services

The Ohio eTutoring Collaborative, in partnership with The University of Toledo, now provides online tutoring support for all UT students. eTutoring Services are offered in a wide array of subjects, including Writing, Math, Calculus, Statistics, Accounting, Biology, Chemistry, and Anatomy and Physiology.
Learn more at: https://www.etutoring.org/login.cfm?institutionid=232&returnPage

eLibrary Services Portal

The eLibrary is a customized gateway to UT Libraries for online students. It was designed to help you locate the best online library resources without leaving Blackboard.
Learn more at: http://www.utoledo.edu/dl/students/elibrary.html

Office of Academic Access

The Office of Academic Access provides accommodations and support services to students with disabilities.
Learn more at: http://www.utoledo.edu/utlc/academicaccess/index.html

Counseling Center

The Counseling Center is the university's primary facility for personal counseling, psychotherapy, and psychological outreach and consultation services. The Counseling Center staff provide counseling (individual and group), mental health and wellness programming, and crisis intervention services to help students cope with the demands of college and to facilitate the development of life adjustment strategies.
Learn more at: http://www.utoledo.edu/studentaffairs/counseling/

Services for Online Students

Knowing what to do, when to do it, and who to contact can often be overwhelming for students on campus - even

more so for distance learners. Visit the link below to learn more about the wide range of services for online students.
Learn more at: http://www.utoledo.edu/dl/students/student_serv.html

GETTING THE MOST OUT OF BIOL 3020:

In BIOL 3020 you will be exposed to some fascinating and powerful tools of modern genetics. About half of the experiments that you perform are related to an NSF funded research project so you will be performing new research. This provides a different perspective from other labs in which you may be repeating experiments already performed a million times. If you embrace this opportunity to explore modern biology using modern techniques, I expect that your educational experience will be richer.

Most of the procedures involve many steps and all experiments require careful attention to detail. Due to the limited time available there will not be possible to repeat an experiment if it should go wrong. Therefore you will maximize your experience by being very well prepared for each laboratory session. If you do this then you can concentrate on developing your skills "at the bench" and you will have time to dwell on and ask questions about the more advanced applications of the techniques you are learning. Your preparation will help make the lab a less hectic affair and a make it a more enjoyable learning environment.

You must attend each laboratory session and will have thoroughly read the manual material and background references for each exercise. Active participation is encouraged and the teaching assistants are there to help you develop your experimental and analytical skills. To encourage you to be prepared, 5% of your grade will be assigned for your timely presence and active participation in the lab. Persons always lagging behind others or who have not read the protocol will lose points.

The pre-lab lecture will be used to review and add to the material that will be encountered in the laboratory. In this period we will discuss any changes in the lab. session that deviate from the manual. Students should read notes posted on Blackboard before coming to the pre-lab session. Clicker points will be awarded during the pre-lab session.

Bring your notebook that contains your own abbreviation or flowchart of the protocols in the manual - by making these flowcharts you will have to have read the manual carefully and the nuances of the experiment will have become obvious. Use this notebook for recording data - prepare tables for recording the data beforehand if necessary. Use only ball-point pen in lab to record data and delete errors with a single slash, e.g., ~~0.002 gm~~ 0.05 gm. Scientists use notebooks that have carbon paper to create duplicate sheets to preserve data and although you are not required to purchase these more expensive notebooks you may prefer to do so.

During the lab session it will be important to move smoothly to complete all the objectives in a timely fashion. Some experimental steps involve times where you have to wait, use these lulls to prepare for the next steps or as an opportunity to discuss and learn about the broader aspects of the technique being utilized.

The homework questions are designed to make you reflect on what you have learned in class and help you begin to analyze the data that comes from the experiments.

Finally the teaching assistants will have office hours to help individuals with problems they are having with the material. It is best to identify your difficulties on a weekly basis and attend office hours as you need. Try to avoid leaving your request for assistance until just before quizzes as the T.A.s may be overwhelmed and they will have less time to give you individualized attention.

F.I.R.E. Fostering the Integration of Research with Education
CORN GENOMICS RESEARCH PROJECT:

A modern undergraduate education is enhanced significantly by involvement in a real research study. Some of the work in BIOL 3020 is directly linked to a new Genomics Project in Dr. Gray's laboratory and funded by the National Science Foundation (NSF). This project which started in Fall 2007) aims at cloning and characterizing a large set of transcription factor (TF) genes from the important crop and model genetic organism *Zea mays* –

otherwise known as Corn. The maize genome is now accessible at www.maizesequence.org. You will work in pairs to clone a set of TFs that have never been studied before. You will use up-to-date cloning and bioinformatics techniques to accomplish your objectives and write up your findings in your lab reports. The skills that you will learn can be applied to any organism that you may work with in the future. I expect that you will find this to be both challenging (hard work) and rewarding. There will be opportunities for a few students to continue this work as honors projects in the lab of Dr. John Gray (WO 3232 phone 419 530 1537).

COMPUTER BASED DNA MANIPULATION AND ANALYSIS:

Background:

A key element in the BIOL 3020 course is the use of computer software to aid in the manipulation of DNA molecules and the analysis of DNA sequence information. The acquisition of these skills is essential for modern biologists and a major learning objective for this course. Entire new fields of study and research named Genomics and Bioinformatics employ computers as an intrinsic component of operation. The computer software site licenses (which retail at about $4,000 per license) were originally purchased for this class using an award from the University of Toledo Program for Academic Excellence but are now licensed free for educational use. Last year a new mobile computer lab became available for use in the laboratory and assignments can be completed outside lab in the Biological Sciences Computer Cluster in BO 1099 (access limited to enrolled students in certain biology classes).

DNASTAR Lasergene DNA Analysis Software Package:

The software package that you will learn to use is the Lasergene package developed by DNASTAR Inc. (www.dnastar.com). This is a comprehensive suite of programs that allows you to perform virtual manipulations of DNA that will parallel those you will perform in the laboratory. The more advanced aspects of Lasergene allow you to optimize the design of new recombinant DNA molecules and devise an optimal strategy for their synthesis in the lab (genetic engineering). The MegAlign and Editseq programs will allow you to compare DNA sequences with each other and those available in public databases over the internet. This resource will actually allow you to make new discoveries if you begin to master the software and the biological theories underlying them.

Learning Lasergene:

You will be introduced to the software by in-class and in-lab demonstrations. Following these demonstrations you will be given assignments and questions to include in your lab reports. You will have access to the site-licensed Lasergene software on 12 computers in the New Biology Computer Cluster in BO 1099. This room will be by rocket card access only and is available most days during the semester (some times are reserved for use by other classes).

It will be necessary for you to arrange times where you can sit and perform the analysis either alone or preferably with your lab partner. Online manuals on how to use the software will be available. In addition each T.A. will be assigned an hour in which they will be present in the computer cluster to answer questions you may be having about the software or address any difficulties you may be encountering.

For all students and especially those who are not accustomed to using computer software there will be a sharp learning curve and you will need to apply yourself to learning the software early - it may be impossible to gain guaranteed access to computer terminals as the time for writing your reports nears. There are 40 students total enrolled in this course (20 pairs). With 12 terminals there is no bottleneck to getting your work done - but it is better to be early in getting your assignment done.

Remember you are encouraged to learn in pairs as that promotes scientific dialogue - so try to identify times when you and your lab partner can both work on a computer terminal to accomplish the assigned homework. Remember however that you MUST write your lab reports (other than the results section) independently of each other.

Saving your work:

All terminals are PC platforms and have USB ports for flash drives and CD writable drives. You must bring your own flash drives in order to save your work - there is a “Public folder” on the computer in which files can be temporarily stored but you should empty this when you leave the workstation. The computers are connected to a printer in the same room so you can print out your results for inclusion in your lab reports**. As always it is wise to backup your work in more than one place - do not learn the hard way!!**. The computer cluster is a resource that is expensive to maintain and you must leave each workstation in the state you found it. The computers are fixed so that you will not be able to make any changes to the hard drive.

In Class Questions (Clicker Questions) (These will be worth 5% of your overall grade)

To encourage active learning participation in the pre-lab lecture, a personal response system is employed during lectures. You are required to purchase a Turning Technology ResponseWare license (also known as a "clicker") for use in class (see purchase and registration information below). Your answers will be tracked and you will be awarded points. These points accumulatively will be worth 5% of your overall grade. Since the same clicker is used university wide, you may already have a clicker and that is sufficient for use in this and other classes. The clicker can be sold back to the bookstore later.
A variety of questions will be asked throughout each lecture aimed at testing your focus and understanding of the material. Most questions will be answered solo but in some instances you may be permitted to work in groups before selecting an answer. Obviously reading ahead will be a good step towards being ready for the lecture. Not all questions will be equally weighted but some will earn more points than others. Also there may be more than one correct answer to some questions.

Grading Clicker Questions:
In this course, in class answers using clickers account for a total 5% of your grade. You will accumulate clicker points each day until the last day of lecture. 15% of the cumulative total will then be dropped to account for absences, missed questions, or a defective clicker. I do not give excused absences unless a medical or other valid documented excuse (e.g. funeral attendance) for several days is presented. For example, if the available total points is 115, then 100 points out of 115 is a perfect score. Earning over 100 points does not add to your grade. If you earned 93 points that is 93/100 = 0.93 x 5 % = 4.7% for your In Class Questions part of the final grade.

The first week of the semester anyone with a transmitter will be encouraged to use it but the transmitter is not required. ***Use of the transmitter is required by the start of the 2nd week***. I will have around 3 to 5 questions per lecture (sometimes less or more) for each lecture. The maximum number of clicker points will be set 15% below the actual total points offered. This margin is built in to eliminate excused absences, forgot the clicker, broken, dead batteries, etc. It is your responsibility to check and make sure your transmitter (whether a clicker or your own device) is working.

RESPONSE CARDS or RESPONSEWARE (Clickers)

Each student is required to have a Turning Point License/Account which will be used for live in-classroom assessment. Note this account can now be set up with a range of mobile devices (see below) – it is no longer necessary to buy a response card (clicker) – but you still need to purchase a Turning point license!

Turning Technologies is the company UT uses for "clickers". "Clickers" are personal response devices used to send answers to questions during lecture. The "clickers" in use at UT have been small rectangular devices similar to a remote control. UT students have purchased thousands of units over the past decade. The "clickers" reward students for going to class, paying attention, and participating. The student responses allow professors to gauge student understanding in real time.
Turning Technologies newest solution introduces a new way of gathering responses. ResponseWare is a BYOD (Bring Your Own Device) program. A student can use any web enabled device (laptop, tablet, smart phone) to either log onto the internet (laptop) or use a free app (tablet or smart phone) to send responses during class. Note that a data plan or phone service is NOT required. Windows, Mac, Android, and iOS platforms are supported.

BOTH the traditional clicker and ResponseWare REQUIRE a license to use and upload data. For both, a student creates an account at https://account.turningtechnologies.com/account/ using their official UT student email address. In creating the account, the students is asked for a license code.

The student may either buy the code directly from ***TurningTechnologies*** or purchase a code from the Barnes and Noble Bookstore. Licenses are NOT available from Amazon or other sources. ResponseWare is a free app but requires the license code to interface. The clicker's data will be sent to the professor but the program prevents its upload without a license.

Both the traditional clicker and ResponseWare will be in use starting Fall 2016. In Molecular Genetics I will allow both types in the same class at the same time.

Students may purchase options from two sources:

• Turning Technologies online store. The license code is immediately activated. Shipping and sales tax are not included in the price. Shipping should take 2-3 days to Toledo.

• Purchase from Barnes and Noble on campus. Barnes and Noble Bookstore is a business. They add charges to cover their business expenses. Prices given below do not include sales tax.

There are four options available:

	Turning Technologies (with rebate)	Barnes and Noble (with rebate)	Recommended for
Four year license plus clicker	$54.99 -$20.99 rebate = $34.99*	$78.55 -$20.99 rebate = $57.56*	All new students. Many professors will use clickers in class and may or may not activate ResponseWare. This is your best option to cover all bases.
Four year license only	$37.00 -$37.00 rebate = FREE	$52.85 -$37.00 rebate = $15.85	All returning students who already have a clicker. You MUST have a license for your data to be used.
One year license plus clicker	$34.00 NO REBATE	$48.55 NO REBATE	Not recommended. A license will still be required for use in 2017/2018 and on.
One year license only	$20.99 -$20.99 rebate = FREE	$30.00 -$20.99 rebate = $9.01	Not recommended. A license will still be required for use in 2017/2018 and on. No rebates after August 2017.

*In 2015/2016, a new clicker cost $42.65 at the Barnes and Noble Bookstore.

Rebate

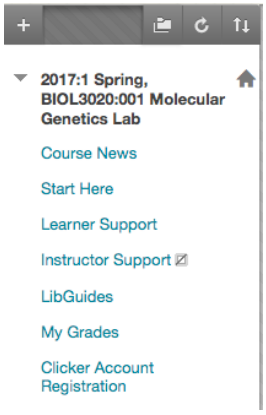
Turning Technologies is providing a rebate to soften our transition to their new system. This rebate is only available until August 2017. Purchases made either online or through Barnes and Noble use the same system. Turning Technologies is using another company to handle rebates. A students provides a copy of their receipt and the rebate coupon by mail to the rebate company. Rebates are received by mail 6-8 weeks later. Rebate forms are available online (https://rebates.turningtechnologies.com/) and from Barnes and Noble at purchase.

Used clickers Barnes and Noble will not be buying or selling used clickers. Students can use either the LCD or non-LCD clicker. Students can share clickers (but not in the same section of a course). Every student must have their own license.

Using Your Clicker (Response Card) in class

Your Response Card or mobile device is a radio Frequency (RF) transmitter. It sends a signal to the instructor's receiver. The signal contains your answer and the transmitter's ID code. This ID code must be matched to your name for you to receive credit. ***Clicker Buttons****:* The Response card can be used for either letter or number answers. Press the button that corresponds to your answer. The "GO" button is used for channel setting. The "?" button sends a signal to your instructor that you have a question. Alternative buttons are used on your mobile device.

Registering your Responseware-Getting a License : Your name must be associated with the Clicker ID code for you to get a grade. If you use another student's Response Card, you will not get credit. When you purchase a Responseware License you register or activate it on the Turning Point Website. You should also Register your clicker account on Blackboard so that the instructor knows what device you are using.



1. Log into BIOL 3020 on Blackboard
2. Select ***Clicker Account Registration*** from windowpane on the left of screen
3. Enter the required information when prompted
4. If anything is incorrect or needs updated, please e-mail me ASAP. jgray5@utnet.utoledo.edu

IMPORTANT Register your Clicker by Jan 13th 2017 at 5pm

After that I will need to make a participant list for use in class and you need to be on there.

Channel Setting: If using a a Clicker it must must be set to the same channel as your instructor's receiver (41) 1. When your instructor has set up the program, press the "go" button . 2. The light should alternate red and green. 3. Type in the 2 digit channel code for the class. (Channel 1= 01 or channel 41=41) 4. The light should change to a solid green. 5. After the second digit is entered, press and release the "go" button again. 6. Press and release the 1/A button.

Sending a Response : When polling is open on a question, send your answer by pressing the correct response once. The button will stay green for a few seconds to indicate your response has been received. If the light only lights briefly with a red/green light, polling is not open or you are not on the correct channel.
There are no excused absences for lecture.

GUIDE TO WRITING YOUR LAB REPORTS:

The major proportion of your grade will be evaluated by the three lab. reports that you will hand in after completing each of the three major sections of the course. The format for the lab. reports is the standard format for a scientific paper. The following general guidelines should be followed closely. Also, you should take the opportunity to either purchase the following book or read the copy in the Carlson Library:
"Successful Lab Reports - A Manual for Science Students" by C.S. Lobban and M. Schefter, Cambridge University Press (1992) 105 Pages.
This book provides an excellent guide to the content of lab. reports and is useful for any science lab. you are taking now or in the future. Other useful books are "**How to Write a Lab Report" by J.N. Borowick, Prentice Hall (1999) 144 pages,** and **"A Short Guide to Writing about Biology" by Jan A. Pechenik, Longman (2009) 304 pages**
For other more specific questions consult your T.A. during office hours. The T.A. will provide suggestions for improvement if you are having difficulties. The Writing Center can also be of invaluable assistance - many students make dramatic improvements in their writing skills after some timely and professional critical evaluation. The Writing Center is located in Carlson Library, Room 1005 Phone 530-4939. Fall 2012 Hours: Monday to Thursday 10 to 8 pm; Friday 10 to 5 pm. Note that the Writing Center is not just for those who have poor writing skills - some of the students that obtained the highest grades in this course have utilized this resource.

General: Lab-reports are due three times during the course on the days indicated on your course schedule. Reports should be typed with drawn figures or tables where appropriate. Use a font size of at least 10 and single spaced lines. Your reports must be prepared individually at all stages except for data collection where collaboration with your lab. partner is fine. There is no length restriction except for the one that science reports ought to be concise and to the point. Each report will be graded based upon its completeness, accuracy, organization and overall quality. The major portion of the points (about two thirds) will be awarded for the Results and Discussion sections of your report.

Report Format: The format will be typical of a scientific paper remembering however that the purpose here is to illustrate that you understood the experimental protocol, that you attempted to complete the experiment, that you gathered data which may or may not answer the proposed question, and that you correctly analyzed and interpreted your data.

Title (3%) and Abstract (6%):

Provide a brief title (not more than 100 characters) of the experiment that is inclusive of all that was achieved. The abstract should report in less than 200 words, all the results that were achieved and the conclusions (or lack thereof) that can be made.

Introduction (12%):

The introduction provides the context for the lab and most importantly poses the hypothesis that was tested in the study. The format should be background, question, hypothesis and prediction. e.g. Does the topology of a DNA molecule affect it's migration during electrophoresis ? - hypothesize that it does - Predict that the mobility of a supercoiled plasmid will be faster than that of a linear or open circular plasmid. You must cite any references that you use in the introduction including the manual of textbook chapter that are required for this class. The computer assignments are to be included as an individual objective/aim(s) within the introduction.

Materials and Methods (12%):

This is a summary of the methods and procedures used. In most instances this will consist of a brief statement verifying that the instructions in the lab. manual were followed - remember to cite the lab. manual.

This is also the place to mention any changes in the protocol. If you did not follow a particular step in the manual this **must** be mentioned and if so why was this modification made ?

For the computer assignments you must mention the name of the software and computer platform you used to perform your analysis.

Results (30%):

Report in a series of paragraphs the outcome of each major step in the previous weeks experiments. Think of yourself as a news reporter for this section – record what you see and present the material in such a way that people could make up their own minds about the data – they should understand clearly how the data was collected and be able to read it. Include a table, diagram, graph or figure where necessary and have them numbered sequentially and clearly labeled. Each should have a brief legend (i.e. title) that accurately describes the data contained therein. Describe in the text what you found and draw a brief but valid conclusion from the data. Correct and accurate reporting of the results in a neat fashion is an important part of your report and will constitute about one third of the available points.

Where you have been assigned tasks using the Vector NTI software the printouts should be included in this part of your report.

You may work with your lab partner for collecting results and working on computer assignments. However this is the only section where you should do this – the rest of the report must show your individual understanding and interpretation of the material.

Discussion (30%):

This is the second important section of your report where you can demonstrate your analytical skills and judgment and for which another third of the points will be awarded. Here the results that you obtained are interpreted and clearly explained to the best of your ability. The following steps may help you organize your discussion.

1: Restate your question, hypothesis and prediction or objectives.
2: What is your interpretation of your results in the light of your hypothesis and what is known about this topic from the literature? in some cases the experiment may have failed and not allowed you to answer the question posed and if so this must be stated
3: Write down the specific data that provided this answer and that allowed your hypothesis and prediction to be accepted or denied. Are your data reliable? Are there any problems with your data? Can you think of a better way to answer this question? are there additional experiments required to answer this question ? if so, what are they?
4: What is the relevance of your results to the broader literature? (keep very brief)

If you are reporting the results of several experiments you may organize the above information into several concise paragraphs. Do not ramble in your discussion and keep to the points of the experiments that you performed.

Interpret the results of your computer assignments in this section and if directly relevant compare with the results obtained in the lab. e.g. if you run a virtual gel electrophoresis then how does it compare with the actual gel result you obtained in the lab? what might be the reasons for any differences ? The best reports will show a very strong grasp of the material and a very good depth of understanding.
When you describing your analysis of a transcription factor from corn (Lab report 3)– write up your discussion as if you would be presenting a "finished product" to your boss if you were working in a company – provide a figure of the construct that you have made and a summary of the type of transcription factor it is – what TF family does it belong to? What are the characteristics of that TF family? What are the most closely related TFs from other species and is anything known about their role in metabolism?

Literature cited (3%) and Overall Coherence (4%):

Correctly cite any references you used throughout your report including the course textbook and manual. You are not required to do literature searches in this course and it is not expected that you will have more than 5 to 10 references in any of your reports. Use a reference format such as that found in a mainline scientific journal such as Cell. 4% of the grade will be awarded for overall connectivity of your report such as connecting aims or hypotheses in the introduction with interpretation of actual results in the discussion.

Final Advice:

It is wise to do a rough draft of your report that only you will read - then when your thoughts and data are organized go ahead and type up the final report. If you wish to show a draft of your report to your TA – bring it to them early – 10 days or a week before it is due – they cannot assess it carefully in a few minutes the day before it is due and you will be too stressed to make the changes they may request. **Back up your report** at a second location so that you don't lose your work and have to retype the whole manuscript - backing up your data always provides peace of mind and you will sleep easier! Also when you are formatting your thoughts some people find it helpful to imagine describing your experiments to a lab. partner that had missed the lab - you would have to provide a little background, describe what you did and how you did it, display the results and how you collected them, and finally interpret your results and provide some conclusions. Since the reports are required three times in the semester it is best to work on them each week - don't let them mount up - especially the last report which will be longer than the others - avoid getting stressed out towards the end of the semester!

This course ought to be an enjoyable learning experience for you if you approach it in the right fashion. The above guidelines are meant to ease the process of identifying what you need to do in order to achieve a good grade - so you can concentrate more on the process of doing and learning more about the fascinating field of modern molecular genetics.

PLANT-BIOTECH SHARKTANK

A Collaborative Assignment for Groups of 5-8 students
(worth 20% of overall Grade)

Overall Objective: Working in groups of 8, you will develop a proposal for a biotech product. The biotech product will involve "the genetic engineering of a plant **using CRISPR technology (editing of one or more genes *in vivo*)** that results in a useful phenotype or novel agriculture or horticulture. Traits can include things like plant height, number or shape of flowers or leaves, disease resistance, nutritional content, number or shape of fruits or seeds, plant stature, root system architecture, color, insect resistance, drought or cold tolerance, water requirements, to name a few. The final biotech proposal will have a written and live presentation format. The written proposal will involve 8 written pages of text (including 1 page of references) plus diagrams and figures to describe the product and its manufacture. The oral presentation will involve a 10 minute in-class powerpoint presentation and answering of questions.

Projects will be judged by instructors and points awarded for scientific content and creativity, coherence and organization, likelihood of success, utility of product, teamwork and team contributions, professionalism of written proposal, oral presentation, and ability to entertain questions about the product. All students in a group will earn the group grade for this part of the course. The goal is to make the course more interactive (and fun) and replaces individual midterm and final test taking.

Educational Aims:

1: To foster group collaborative skills amongst students
2: To foster integrative thinking between knowledge and skills learned in class and outside of class
3: To foster applied thinking – how knowledge and skills learned in class may be applied to develop a biotech product proposal.

Deliverables: 3%, 3%, 8% and 6% of overall grade.

1: Week 5(3%): A short outline of the proposed biotech product (1 page)
2: Week 10 (3%): A more detailed outline of the proposal product (3 pages) and who is researching/developing the different components of the product.
3: Week 15 (8%): Final product proposal (8 pages of written text plus diagrams –diagrams do not contribute to page length) with detailed rationale, diagrams and flowchart for development of the biotech product.
4: Week 16 (6%): Short 10 minute presentation of product proposal and answering of questions posed by instructors and other students.

Make a free Google Drive Account (www.drive.google.com)

To share thoughts and create documents as a group while outside the classroom make a free Google drive account using ***your rockets email account!*** I will then send an invite to a shared document where you can create your group pre-proposals and proposal. When you add to the document please add your initials at the end of the sentence (e.g. JG). – that way I can see who is contributing to the group project. Also choose one color text for each participant - but not red (that is for me).

First pre-proposal contents (1 page)
(3% of overall grade): Due in pre-lab Week 5

Five weeks are allowed for the development of a viable plan - you need to start early and actively think of new ideas. Each student must come up with at least one idea.

1: Title in 25 words or less.

2: 250 words description of overall biotech product proposal

3: List of participants and main contributions to proposal (Include brainstorming ideas that were given serious consideration by the group – one idea should be listed as a backup idea). Use initials throughout

Second pre-proposal contents (3 pages):
(3% of overall grade): Due in pre-lab Week 10

1: Title in 25 words or less (can change from first pre-proposal).

2: 250 words description of overall biotech product proposal

3: Background information: Describes the general area of biotech, agriculture or medicine that this biotech product will contribute to. What is the problem or need that this product will address

4: Outline of how product will be developed – ***must include the main choice of gene that will be modified and the organism in which this will be performed.*** You must identify the sequence of the gene or precisely where it is located in a genome.

5: List of participants and main contributions to proposal. Use initials and color text throughout

Final Biotech Project proposal contents (7 pages plus figures):
(8% of overall grade): Due Friday of Week 15

1: Title in 25 words or less (can change from second pre-proposal). .

2: Abstract (250 words or less) describing overall proposal and expected product

3: List of participants and main contributions to proposal. Use initials throughout the report to indicate who contributed to each paragraph in the report.

4: Background information: Describes the general area of biotech, agriculture or medicine that this biotech product will contribute to. What is the problem or need that this product will address.

5: Scientific Development of Product:

a: Describe the final product that will be made. The product should have a scientific as well as a commercial name.

b: What gene(s) will be modified by rDNA or CRISPR to generate the product

c: What part of the gene will be modified?

d: Will you need to isolate part of the gene to make a genetic construct (give cloning, PCR details)

e: What genetic constructs will need to be made ? this part must include descriptions of the CRISPR constructs that will be used. Precise plasmid maps must be constructed using the Seqbuilder software that you will learn about in class. Sequences can be obtained from Genbank but sources must be precisely quoted (Genbank numbers or genomic sequence co-ordinates)

f: What host will be modified – species and strain. Where will you obtain the host from? How will the genetic constructs be introduced into the organism that is to be modified? How will you verify that the modified organism has the construct and that it is stable from generation to generation of the host.

g: What is the expected phenotype of the modified organism? Will some product be produced? How will it be produced? in a constitutive or induced manner? How will the organism be grown, harvested, or used in the final application setting? (who will be the consumer?)

h: Possible pitfalls in the making of the product and plausible alternative solutions to overcome such pitfalls – list at least three.

i: Timeline of development and release of product.

j: possible ethical or environmental risks associated with product. How will the product be contained or safety concerns dealt with?
6: List of references for information gathered for the proposal.

Final Biotech Project (Sharktank) Presentation (In Powerpoint format):
(6% of overall grade): To be presented in lab Week 16

Your powerpoint presentation should have at least the following 9 slides which can be developed from your project proposal submitted in previous week.

1: Title slide with project in 25 words or less and list of participants
2: Slide with overall aim of project
3: Slide with brief background to biotech product – problem or need that the product will address
4: Choice of gene and source – how was it chosen and obtained
5: Summary of construction of genetic construct – image of plasmids that will be transformed into host cells to bring about genetic change.
6: How the gene will be introduced into the host and how you will check if desired phenotype is achieved and is stable.
7: If everything works – what will be the outcome?
8: Possible pitfalls and plausible solutions.
9: Summary slide and acknowledgments

Students should take turns to present at last one slide each.

After presentation, students will be asked questions about their product proposal from other students and the instructors (this is shark tank part!).

Some other presentation pointers:
1: Use black font on a white background - use large clear font. Be sure to include your group company name on the title slide as well as individual names. Company logo??.
2: Use more figures - let the "slides do the work" and you "bring them alive" - be sure to label figures clearly.
3: Figures can be on background (e,g, charts. Statistics of problem), flowchart of plasmid construction, plasmid map, biochemical pathway you are dealing with, cellular diagram if it is a signaling pathway etc. Do not miniaturize figures.
4: It is best if each slide has a title that says something important.
5: You can have 2 to 3 slides per speaker rather than 1 or 2 to make sure viewers can see the content. Each speaker should have something "solid" to say on which they can answer questions - e.g. solid intro, solid rationale, solid work plan to make construct, clear description of construct features, clear description of how the transgenic organism will be made, clear outline of how you will check that the transgenic organism has the desired phenotype, clear potential pitfalls and possible solutions.
6: Don't forget to present potential pitfalls and possible solutions. OK if there are pitfalls as long as you are not ignoring them.
7: Use color and small images to brighten slides that have only bullet points (but make sure that text is very clear)
Some useful weblinks to become oriented with recombinant DNA technologies:

Brief Weblinks to Recombinant DNA technologies:
What is a Vector
http://en.wikipedia.org/wiki/Vector_DNA

Technology for knocking out genes in animals and plants
http://www.sigmaaldrich.com/life-science/zinc-finger-nuclease-technology/learning-center/zfns-in-animals.html

Making Transgenic Organisms (Transgenesis)
http://en.wikipedia.org/wiki/Transgenesis

Retroviruses for gene therapy:

http://en.wikipedia.org/wiki/Retrovirus#Gene_therapy

Steps in making a Transgenic Plant using Agrobacterium:
http://en.wikipedia.org/wiki/Plant_transformation_vector

1992 paper on making Transgenic corn plant by electroporation
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC160236/pdf/041495.pdf

Transgenic Maize: Methods and Protocols
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3359929/

Types of Vaccines (including subunit vaccines):
http://www.vaccines.gov/more_info/types/
http://en.wikipedia.org/wiki/Protein_subunit

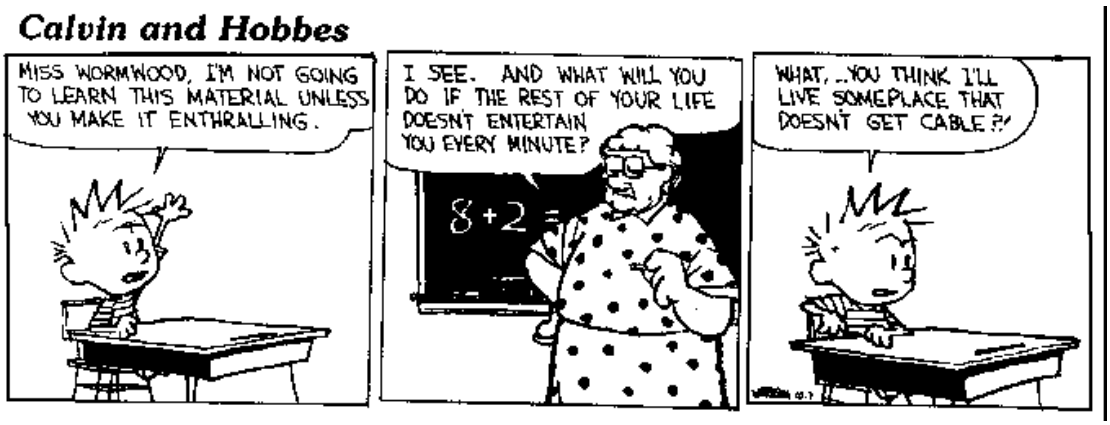
Information about CRISPR
http://www.crispr-cas.org/p/resources.html

CRISPR genome editing resource
http://www.genome-engineering.org/crispr/?page_id=41

CRISPR plasmid resources from Zhang lab
https://www.addgene.org/crispr/zhang/
Some major Biotech company logos (you may want to visit their websites)

Homework Problems (These will be worth 10% of your overall grade)

Problem solving and trouble shooting are key skills to learn as you consider a career in the life sciences. You will be provided with problem sets online that will be based on the previous weeks topics. You are free to work in pairs or small groups to solve these problems but they must be handed in at the ***beginning*** of the following lab – i.e. so the problem set based on lab 1 will be due at the beginning of lab 2.
The answers should be typed up neatly and make sure to put your name on the top so that a grade can be assigned. The problem sets will be graded by the TA and handed back the following week.



Take responsibility for your education! (its never too late)

Take responsibility for your own education. Here's the part where college distinguishes itself from high school. Students are in high school because they have to be. Students are in college because they want to be. You are paying dearly for your college education, so you should go out and get it. Don't wait for someone else to hand it to you; it won't come.

Taking responsibility for your own education means going to the dictionary when you run across a word you don't know. It also means asking your professor to read a draft of your essay, or raising your hand in class to ask for a difficult point to be repeated.

But taking responsibility for your education means more than this.

It means seeking out challenging courses and difficult professors, for only if you push yourself by taking hard courses will you improve your academic and intellectual skills.

It means engaging your friends in the dormitories and coffee shops about what you are learning in the classroom.

It means holding yourself to higher standards than you professors hold you. If you take only easy courses and sit passively through them, you will fail to gain the very education that you are paying so dearly for.

Taken from: College is more than job training (The Blade: Toledo, Ohio, Saturday Sept 30, 2000)

Week	Exercise	Dates
	Part 1 Lab 1 thru 4	**Bold** = prelab lec
1	Introduction to laboratories on DNA Analysis. Exercise in pipeting accuracy. Discovery of DNA structure movie.	Jan **10**/12
2	Determining the Length of DNA Molecules.	Jan **17/19**
3	Restriction Mapping of DNA.	Jan **24**/26
	Last Day to Drop via web or in person is Jan 23rd	
4	DNA Database Mining (BLAST search)	Jan **31**/ Feb 2
	Part 2 Lab 5 thru 8	
5	DNA Hybridization Lab 1 (Start Dotblot) Bacterial Transformation (pGLO)	Feb 7/9
	(1st Lab Report on Labs 1 to 4 Due in lab Feb 9th)	
	Sharktank 1 page pre-proposal due online by Feb 10th	
6	DNA Hybridization Lab 2 - development of DotBlot (Prehybridize day before lab), and Introduction to computer based homology searches and phylogenetics	Feb **14**/16
7	Isolation of Plasmid DNA, Quantitation of DNA by UV spectrophotometry	Feb **21**/23
8	Green Fluorescent Protein Purification	Feb **28**/ Mar 2
9	***No Lab the week of March 6th due to Spring Break***	
	Part 3 Lab 9 thru 13	
10	PV92 PCR Informatics Experiment Part 1	Mar **14**/16
	2nd Lab report on labs 5 to 8 due in lab Mar 16th	
	Sharktank 3-page pre-proposal due online by Mar 17th	
11	PV92 PCR Informatics Experiment Part 2, Species genotyping Part 1	Mar **21**/23
	Last Day to withdraw is March 24th	
12	Species Genotyping Part II (Preparation for Biotech Presentations)	Mar **28** / 30
13	Designing CRISPR constructs on the computer	Apr **4/6**
14	Video presentation (Preparation for Biotech Presentations)	Apr **11**/13
	(Sharktank full proposal due online Friday April 14th at 5pm	
15	Final Preparation for Biotech Presentations	Apr **18**/20
16	Prelab on Apr 25th is a help session in BO1099 Sharktank Oral Presentations and Questioning Thursday Apr 27th	Apr **25**/27 (27th in BO1099)
	3rd Lab Report on labs 9 to 14 due to TA by Friday April 28th at 5pm	
17	*There will not be any tests during finals week*	