LIFE AND PHYSICAL SCIENCES
Student Learning Outcome Alignment Form

Course Prefix/Number: BIOL 1307

Course Title: Biology for Science Majors II

Core Objective	Course SLO	General Learning Activities	Assessment
Critical Thinking Skills	(SLO #1) Describe modern evolutionary synthesis, natural selection, population genetics, micro and macroevolution, and speciation.	Lab activity from Howard Hughes Medical Center using stickle back fish to determine why fresh water populations lose spines and marine populations retain them. See attached activity.	Grade and see attached rubric
Communication Skills	(SLO #6) Identify the major phyla of life with an emphasis on plants and animals, including the basis for classification, structural and physiological adaptations, evolutionary history, and ecological significance.	Students work in groups of three or four with a lab packet. Information provided includes animations of life cycles, slides, models, and live or preserved materials. See attached activity.	Practical examination and included rubric
Empirical & Quantitative Skills	(SLO #1) Describe modern evolutionary synthesis, natural selection, population genetics, micro and macroevolution, and speciation.	Chi Square activity is part of the evolution unit. The student teams score the spines in stickleback fish and try to determine whether or not natural selection is acting on the species or not and if there is a statistically significant difference or not. See attached activity	Grade and attached rubric

Teamwork	(SLO #6) Illustrate the relationship between major geologic change, extinctions, and evolutionary trends.	Watched a short film about an asteroid impact, discussed questions in groups. See attached activity	Grade and attached rubric

CRITICAL THINKING VALUE RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

Critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Explanation of Issues	Did not state issue.	Issue is stated without clarification or description.	Issue is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined and/or backgrounds unknown.	Issue is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.
Evidence	Does not identify the basic components of an issue	Information is taken from sources without any interpretation. Viewpoints of experts are taken as fact, without question	Information is taken from sources with some interpretation but not enough to develop a coherent analysis or synthesis.	Information is taken from sources with enough interpretation to develop a coherent analysis or synthesis.	Information is taken from sources with enough interpretation to develop a comprehensive analysis or synthesis.
Influence of Context and Assumptions	Did not show awareness of the issue.	Show an emerging awareness of present assumptions.	Questions some assumptions. Identifies relevant information when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Thoroughly analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.
Student's Position	Takes no position on issue	Specific position is stated but is simplistic and obvious.	Specific position acknowledges different sides of an issue.	Specific position takes into account the complexities of an issue. Others' points of view are acknowledged within position.	Specific position is imaginative. Limits of position acknowledged. Other points of view are synthesized.

Conclusions and Related Outcomes	Does not use previously learned information in new situations.	Conclusion is inconsistently tied to some of the information discussed; related outcomes are oversimplified.	Conclusion is logically tied to information; some related outcomes are identified.	Conclusion is logically tied to a rage of information, including opposing viewpoints; related outcomes are identified clearly	Conclusions and related outcomes are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order

Communication RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric and Making Learning Real

Definition

Written communication is the development and expression of ideas in writing.
Oral Communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors.
Visual Communication is the use of images to persuade, entertain, inform, and enlighten an observing audience of products, ideas, and messages.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Quality of Information and Organization	Presentation lacks main points and related details. Information lacks connection to the presentation topic. Information is not organized.	Main points are not clear and lack significant detail. Some information is linked to the presentation topic. Information is loosely organized.	Main points are somewhat clear but could use more detail. Most information is linked to the presentation topic. Information is organized.	Main points are clear and detailed. Information is linked to presentation topic. Information is well organized.	Main points are very clear and very detailed. Information is directly linked to presentation topic. Information is very organized.
Nonverbal Communication	Speaker appears very uneasy and insecure. Speaker faces away from the audience or makes no eye contact. Speaker appears disengaged from the audience. Speaker uses few body motions or gestures or has gestures or movements that distract the audience.	Speaker appears uneasy and somewhat insecure. Speaker rarely faces the audience or makes eye contact. Speaker rarely appears to be engaging with the audience. Speaker uses few body motions or has gestures or movements that distract the audience..	Speaker appears generally at ease and confident. Speaker sometimes faces the audience and maintains eye contact. Speaker sometimes appears to be engaging with the audience. Speaker's body motions and gestures neither support nor detract from presentation.	Speaker appears fairly comfortable and confident. Speaker generally faces the audience and maintains good eye contact. Speaker generally appears to be engaging with the audience. Speaker uses body motions and gestures well.	Speaker appears very comfortable and confident. Speaker consistently faces the audience and maintains good eye contact. Speaker consistently appears to be engaging with the audience. Speaker uses body motions and gestures very effectively.
Quality of Verbal Communication	Speaker's voice is consistently too weak or too strong. Speaker fails to use inflections to emphasize key points and create interest or often uses inflections	Speaker's voice is frequently too weak or too strong. Speaker rarely uses inflections to emphasize key points and create interest or speaker sometimes uses	Speaker's voice is generally steady strong and clear. Speaker sometimes uses inflections to emphasize key points and create interest.	Speaker's voice is steady, strong, and clear. Speaker often uses inflections to emphasize key points and create interest. Speaker's	Speaker's voice is very confident, steady, strong, and clear. Speaker consistently uses inflections to emphasize key points or to create interest. Speaker's

	inappropriately. Speaker's talking paces is consistently too slow or too fast.	inflections inappropriately. Speaker's talking pace is often too slow or too fast.	Speaker's talking pace is appropriate.	talking pace is mostly appropriate.	talking pace is consistently appropriate.
Visual Tools	Visual aids demonstrate no creativity or clarity and are often difficult to read. Presentation is weakened by the visual tools.	Visual aids have limited creativity or clarity or are sometimes difficult to read. Presentation is not enhanced by the visual tools.	Visual aids are reasonably creative, clear, and easy to read. Presentation is sometimes enhanced by the visual tools.	Visual aids are usually creative, clear, and easy to read. Presentation is often enhanced by the visual tools.	Visual aids are very creative, clear, and easy to read. Presentation is consistently enhanced by the visual tools.
Appropriate Use of Vocabulary	Few or no terms are included in the presentation. May or may not be used appropriately. Lacks context.	Several terms are included in the presentation. May or may not be used appropriately. May lack context.	Most terms are included in the presentation. Generally used appropriately. Generally used in appropriate context.	All terms are included in the presentation. Used effectively. Used in context.	All terms are included in the presentation. Used in unique and creative ways. Used in context
Precision and Detail in Documents Produced	Written documents have numerous errors and lack detail. Little carte taken in the production.	Documents may have some errors and show some detail. Some care has been taken in production.	Evident that written documents are correct and show a general attention to detail and accuracy. General care has been taken in production.	Clearly evident that written documents are correct, detailed and accurate. Care has been taken in production.	Documents are clear, well-constructed, accurate, and show attention to detail. Extra care has been taken in the production of written documents.
Overall Presentational Effectiveness	The presentation was weak and not effective.	The presentation was average and somewhat effective.	The presentation was good and effective.	The presentation was very good and effective.	The presentation was exceptional and extremely effective.

Empirical and Quantitative Skills RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

The ability to formulate an inquiry that is scientific or mathematical in nature, and then manipulate and analyze numerical data and/or follow an investigative process using empirical and/or quantitative reasoning to satisfy the inquiry and create informed conclusions.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Identification	The purpose, components, and variables of the investigation/project are not identified.	The purpose, components, and variables of the investigation/project are somewhat identified.	The purpose, components, and variables of the investigation/project are mostly identified	The purpose, components, and variables of the investigation/project are clearly identified..	The purpose, components, and variables of the investigation/project are clearly identified.
Assimilation	The information that is required for an analysis of all investigative components is not evident. If applicable, values are incorrectly translated into variables and no necessary formulas are present.	The information that is required for an analysis of all investigative components is somewhat evident. If applicable, values are incorrectly translated into variables and some necessary formulas are present.	The information that is required for an analysis of all investigative components is mostly evident. If applicable, some values are correctly translated into variables and most necessary formulas are present.	The information that is required for an analysis of all investigative components is evident. If applicable, most values are correctly translated into variables and all necessary formulas are present.	The information that is required for an analysis of all investigative components is clearly evident. If applicable, values are correctly translated into variables and all necessary formulas are present.
Analysis	Most investigative or quantitative components are not scrutinized. The steps followed are illogical and/or irrelevant to the desired result. The proper tools/ technology were not used and/or integrated	Some investigative or quantitative components are scrutinized. Some steps followed are somewhat logical and relevant to the desired result. The proper tools/ technology were	All investigative or quantitative components are somewhat scrutinized. The steps followed are mostly logical and relevant to the desired result. The proper tools/ technology were mostly	All investigative or quantitative components are scrutinized. The steps followed are logical and relevant to the desired result. The proper tools/ technology were used and mostly integrated into the	All investigative or quantitative components are methodically scrutinized. The steps followed are logical and relevant to the desired result. The proper tools/ technology were used and

	into the final product. Any notation is not consistent and not defined.	somewhat used and not integrated into the final product. Any notation is somewhat consistent but not defined.	used and somewhat integrated into the final product. Any notation is mostly consistent and defined.	final product. Any notation is consistent and well defined.	well integrated into the final product. Any notation is consistent and well defined.
Presentation	A summary of the analysis is either inadequately presented or not presented at all. The presented information is mostly incorrect, and/or of poor quality, and/or the terminology/figures are inaccurate and/or hard to understand. Few or no visual representations of evidence are acceptably scaled/ represent the analysis findings.	A partial summary of the analysis is presented. The presented information is somewhat correct, of adequate quality, and the terminology/figures are somewhat accurate and relatively easy to understand. Some visual representations of evidence are acceptably scaled and represent the analysis findings.	A summary of the analysis is presented. The presented information is mostly correct, of good quality, and the terminology/figures are mostly accurate and easy to understand. Most visual representations of evidence are acceptably scaled and represent the analysis findings.	A good summary of the analysis is presented. The presented information is correct, of good quality, and the terminology/figures are accurate and easy to understand. Most visual representations of evidence are well-scaled and/or well represent the analysis findings..	A concise summary of the analysis is presented. The presented information is correct, of high quality, and the terminology/figures are accurate and easy to understand. All visual representations of evidence are well-scaled and well represent the analysis findings.
Application	The integration does not include all steps of the investigation and does not lead to an accurate, nor complete conclusion that relates to the initial investigative argument.	The integration of most steps of the investigation lead to a somewhat accurate, partially complete conclusion that is relative to the initial investigative statement.	The coherent integration of most steps of the investigation lead to an accurate, mostly complete, acceptable conclusion that is relative to the initial investigative statement.	The coherent integration of all steps of the investigation lead to an accurate, mostly complete, relevant conclusion that is relative to the initial investigative statement.	The coherent integration of all steps of the investigation lead to an accurate, complete, relevant conclusion that is relative to the initial investigative statement.

Teamwork Skills RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

Teamwork is behaviors under the control of individual team members, their manner of interacting with others on team, and the quantity and quality of contributions they make to team discussions.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Contributes to Team Meetings	Does not collect any relevant information; no useful suggestions to address team's needs;	Shares ideas but does not advance the work of the group.	Offers new suggestions to advance the work of the group	Offers alternative solutions or courses of action that build on the ideas of others.	Helps the group move forward by articulating the merits of alternative ideas or proposals
Facilitates the Contributions of Team Members	Often argues with team mates; doesn't let anyone else talk; occasional personal attacks and "put-downs"; wants to have things done his way and does not listen to alternate approaches;	Engages group by taking turns and listening to others without interrupting.	Engages group by restating the views of other members and/or asking questions for clarification.	Engages group by constructively building upon or synthesizing the contributions of others..	Engages group by both constructively building upon and synthesizing the contributions of others as well as noticing when someone is not participating and inviting him/her to engage.
Individual Contributions Outside of Team Meetings	Completes no assigned tasks outside of team meetings.	Completes some assigned tasks by deadline.	Completes all assigned tasks by deadline; work accomplished advances the project.	Completes all assigned tasks by deadline; work accomplished and is thorough, comprehensive, and advances the project.	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Proactively helps other team members complete their assigned tasks to a similar level of excellence.

Fosters Constructive Team Climate	Is argumentative and does not work with the team.	Supports a constructive group climate by treating other members respectfully.	Supports a constructive group climate by treating other members respectfully and conveying a positive attitude about the group and its work.	Supports a constructive group climate by treating other members respectfully, conveying a positive attitude about the group and its work, and motivating other group members.	Supports a constructive group climate by treating other members respectfully, conveying a positive attitude about the group and its work, motivating other group members, and providing assistance to group members.
Responds to Conflict	Is not present enough to engage in conflict.	Passively accepts alternate viewpoints/ideas/opinions.	Redirects focus toward common ground, toward task at hand (away from conflict)..	Identifies and acknowledges conflict and stays engaged with it.	Addresses conflict directly and helps to manage/resolve it in a way that strengthens overall group cohesiveness.

Syllabus: Principles of Biology II for Science Majors
Course Number: BIOL 1307
Semester & Year: Spring 2013

Instructor Information

Name: Mark Storey
Office: Chemistry Building Rm. 202
Telephone: 903-823-3298
E-mail: Mark.Storey@texarkanacollege.edu
Office Hours: M - TR – 12:00PM- 12:30PM , W 3-5PM, Fri 10AM -12PM

Textbook Information

- **Principles of Life**. Hillis, Sadava, Heller and Price 1st ed.(2012) Sinauer Assoc Inc and W.H. Freeman and Co. **ISBN 978-1-4292-5721-3** (required)
- Free textbook website: http://www.whfreeman.com/hillis1e
- Lab Packet – Handouts provided in class and on TC Online - LMS Moodle Course Page
- Protective clothing - Safety glasses will be required for certain lab activities, lab coat or apron (old work shirt) is encouraged.
- Optional Website: (yourBioPortal.com) http://courses.bfwpub.com/hillis1e.php

Student Learning Outcomes for the Course

*At the conclusion of the **lecture portion** of this course students should be able to:*

1. Demonstrate an understanding of genomic organization and molecular genetics including recombinant DNA biotechnology, differential gene expression and development.
2. Describe modern evolutionary synthesis, natural selection, Mendelian inheritance, micro and macroevolution, and speciation.
3. Describe phylogenetic relationships and classification schemes.
4. Identify the major phyla of life with an emphasis on plants and animals, including the basis for classification, structural and physiological adaptations, evolutionary history, and ecological significance.
5. Describe basic animal physiology and homeostasis as maintained by organ systems.
6. Compare different sexual and asexual life cycles noting their adaptive advantages.
7. Illustrate the relationship between major geologic change, extinctions, and evolutionary trends.

*At the conclusion of the **laboratory portion** of this course students should be able to:*

1. Be able to apply scientific reasoning to investigate questions, and utilize scientific tools such as microscopes and laboratory equipment to collect and analyze data.
2. Use critical thinking and scientific problem-solving to make informed decisions in the laboratory.
3. Communicate effectively the results of investigations.
4. Demonstrate knowledge of modern evolutionary synthesis, natural selection, Mendelian inheritance, micro and macroevolution, and speciation.

5. Distinguish between phylogenetic relationships and classification schemes.
6. Identify the major phyla of life with an emphasis on plants and animals, including the basis for classification, structural and physiological adaptations, evolutionary history, and ecological significance.
7. Describe basic animal physiology and homeostasis as maintained by organ systems.
8. Compare different sexual and asexual life cycles noting their adaptive advantages.
9. Illustrate the relationship between major geologic change, extinctions, and evolutionary trends.

Student Requirements for Completion of the Course

Lecture Topics/ Exams - Biology 1407 Spring 2013

EXAM I

Chapter 12: Genomes pg 226
Chapter 13: Biotechnology pg 244
Chapter 14: Genes Development and Evolution pg 263

Chapter 15: Mechanisms of Evolution pg 288

EXAM II

Chapter 18: The History of Life on Earth pg 347
Chapter 24: The Plant Body pg 506
Chapter 27: Reproduction of Flowering Plants pg 556

Chapter 29: Physiology, Homeostasis and Temperature Regulation pg 588

EXAM III

Chapter 30: Animal Hormones pg 603
Chapter 31: Immunology: Animal Defense Systems pg 620
Chapter 34: Neurons and Nervous Systems pg 672

Chapter 42: Organisms and their Environment pg 822

FINAL EXAM (Comprehensive) Emphasis on Student Learning Guide Questions Chapters 12-15, 18, 24, 29, 29 and 30, 31, 34, and 42(all chapters covered during the course) and selected essay questions from Exams I, II, and III.

Student Assessment (EXAMS)

Three (3) lecture exams will be given over thee units and a comprehensive final exam, for a total of four exams valued at 55% of the course grade. The examination format will include multiple choice, short answer and essay items. Exams will be administered a minimum of one (1) week after being announced. Please inform the instructor ASAP if you know you will miss a lecture exam on the scheduled date and make arrangements to take the exam in advance. Portions of the lecture unit exams will be conducted in the TC testing center.

The course grade will be calculated from the following schedule:

Lecture Exams (3) & Final Exam (1)	**55%**
Online Weekly Quizzes	**10%**
Lab Exams + Participation Lecture & Lab	**20%**
Lab Reports	**15%**
Total	**100%**

Grading Scale

Semester Grade	Course Average
A	90-100
B	80-89
C	70-79
D	60-69
F	59-below

Class Schedule See *Lecture Topics/ Exams - Biology 1407 Spring 2013*

EXAM I (5th week of semester)

EXAM II (10th week of semester)

EXAM III (15th week semester)

Absentee Policy *(TC Official Policy)*

Texarkana College's absentee policy allows instructors to withdraw a student from a course due to excessive absences. If a student leaves and returns during class or leaves the class before the class is over, he/she may be considered absent. Three tardies constitute one absence. Check the syllabus for each class to see how much time you are allowed to be late before the tardy is counted as an absence. **(10 minutes after class has begun)**

Do no stop attending a class without formally withdrawing from the course by the institution's published Last Day to Drop. If a student does not attend class and does not withdraw from the class, the student will receive a grade of F in the class. The published Last Day to Drop applies to students; an instructor may withdraw a student for excessive absences at any time during the semester.

Withdrawal from a course(s) may affect a student's current or future financial aid eligibility. Students should consult the Financial Aid Office to learn both short and long term consequences of a withdrawal.

As an adult learner, you must assume responsibility for attending lecture classes and laboratories. It is to your benefit to be present at each class session.
You should make every effort to be present in each class because: the laboratory class is designed to provide hands-on learning experiences. Students will learn basic laboratory skills while reinforcing concepts learned in lecture. To a large extent, grades in the laboratory will reflect participation and laboratory skills acquired, so it is important that students do not miss laboratory exercises.

The maximum number of absences in a MW or T-TR class is four (4) per semester (the equivalent of two (2) weeks of instruction). The only excused absences are for officially recognized TC student club activities or for Texarkana College official business. **Please Note: Illness and doctor appointments do not qualify as an excused absence.**

EXCUSED ABSENCES *(TC Official Policy)*

A student's absence due to school trips and/or school business will not be counted against a student's allowable number of absences. Military duty and absences for Holy Days (FBD LEGAL) are covered in a separate section of the catalog and the student handbook. These are the only types of absences that are considered excused by Texarkana College. Responsibility for work missed for any absence is placed on the student. Instructors are required to allow students to make up work missed if the absence is due to military duty or religious holy days when students follow the correct notification procedures. Instructors are not required to allow students to make up work for absences due to other reasons. Make-up policies are listed in each individual instructor's syllabus.

WARNING: If you exceed the maximum number of absences for this course (lecture and lab are counted together) you will be dropped (W) from the course. For example if you miss a lecture and attend the lab you will be counted absent for that class session (maximum of 4 sessions) (NO EXCEPTIONS).

Students are required to attend lecture and laboratory classes for the entire period. Students that arrive more than 10 minutes after class has begun or leave early, will be marked as absent. Students that arrive between 1 and 10 minutes after class has begun will be recorded as tardy. **Three tardies will be recorded as an absence**. Students that sleep during class, ignore this class because they are busy texting, chatting, checking social media sites or doing homework for other classes or do not participate in class activities for any other reason, **will be marked as absent!**

If situations make it necessary for missing class or lab you are still responsible for all the work you missed during class and lab. If you miss class, you should let me know ASAP (by TC student e-mail) and in advance if at all possible. I can give you the assignments to help you remain current in the course.

If circumstances develop (e.g. extended illness, moving from the city, etc.) which necessitates your withdrawal from this or any other course be sure to let me know AND officially withdraw in the Director of Admissions office located in the C. M. Nelson Administration building. The date each semester is posted on the inside page of the current Texarkana College Catalog / Website under "Academic Calendar". A grade of W is recorded on your permanent transcript *if you withdraw before the official deadline*.

Make-up Policy

Lecture Exams: All in class portions of lecture make-up exams (multiple choice objective portion) will be taken during the week of Final Exams. The Essay portion of the exam **cannot** be made up if it was originally administered in the TC Testing Center, as this portion of exam was made available for an extended period of time already.

IMPORTANT: No class curve (grade adjustment) is applied to make up exams.

Lab Exams: No makeup exams are available for Lab Exams !

Lab Reports and other written assignments in lecture and lab are due at the beginning of the class session (lecture) and will be penalized 10% for being late for the first 24 hours and 20% for the second 24 hours and will not be accepted after 48 hours . Late work can be turned in via e-mail to my e-mail address: *Mark.Storey@texarkanacollege.edu*

Class Conduct

Students are expected to conduct themselves as adults. Any student who acts in such a manner as to disturb the class and interfere with the learning process will be expelled from the course with a grade of "F". **No music players or cellular phones are permitted in my classroom**. **No texting or talking during class...TURN THEM OFF!** *See Absentee Policy*
If you bring a cell phone (electronic communication device) into my classroom, be sure that it is **turned off and not out on your desk.** If I notice you using your phone during lecture and ask you to turn it off on the first offense the second time **you will be asked to leave and you will be counted absent for that class period.** (You will be free to communicate electronically during breaks during each class session.)

Any student that has a cell phone or any electronic communications device in their possession during any quiz or examination will receive a zero (0) for the quiz or examination. NO EXEPTIONS! You will also be counted absent for that class session.

All electronic devices (e.g. audio recorders, laptop/tablet computers etc.) brought into class must be cleared by the instructor for use for **each** class session.

Academic Integrity Statement

Scholastic dishonesty, involving but not limited to cheating on a test, plagiarism, collusion, or falsification of records will make the student liable for disciplinary action after being investigated by the Dean of Students. Proven violations of this nature will result in the student being dropped from the class with an "F".

This policy applies campus wide, including TC Testing Center, as well as off-campus classroom or lab sites, including dual credit campuses. This information can be found in the Student Handbook at https://texarkanacollege.edu.

Disability Act Statement:

Texarkana College complies with all provisions of the Americans with Disabilities Act and makes reasonable accommodations upon request. Please contact Larry Andrews at 903.823.3283, or go by the Recruitment, Advisement, and Retention Department located in the Administration building for personal assistance.

If you have an accommodation letter from their office indicating that you have a disability which requires academic accommodations, please present it to me so we can discuss the accommodations that you might need for this class. *It is best to request these changes at the beginning if not before the start of class* so there is ample time to make the accommodations..

Financial Aid: Attention! Dropping this class may affect your funding in a negative way! You could owe money to the college and/or federal government. Please check with the Financial Aid office before making a decision.

Course Continuity Plan

In the case that the college officially closes because of an emergency (inclement weather etc.) which causes a short term disruption of this course, we will use the TC Moodle CMS ("TC Online") and TC student e-mail to continue this course in the short term (1-3 weeks). All students need to use their campus e-mail to receive course related information.

I reserve the right to modify the syllabus at any time during the semester. The online version of this syllabus (*TC Online CMS*) is the official syllabus and supersedes all versions of this document in print.

By signing this statement, I agree that I have read and understand what is expected of me to perform satisfactorily in this course of study.

I also understand that any photographic and or audio recordings that are made of students including myself) during this class of are the property of Texarkana College and can be used to promote the educational mission of Texarkana College.

_____

Student Name (**PRINT** First & LAST NAME)

_____

Legal Signature

_____

TC Course Number / Section Number

_____

Date

Ciassr·oom Activities

Evolving Switches, Evolving Bodies

The following classroom-ready resources complement *Evolving Swit, Evolving Bodies*. This 15-minute film tells the story of the dramatic transformation of stickleback bodies as they adapted to living perman freshwater environments drastically different from the ocean. Scienti studied living stickleback populations and a remarkable fossil record, identified key gene and genetic switches involved in the evolution of forms.

At A Glance Film Guide (PDF)
Student Quiz (PDF)
In-Depth Film Guide for Teachers (PDF)

The Stickleback Evolution Virtual Lab
Student Handout-Advanced (PDF) Student Handout-Basic (J>DF)
Teacher Materials (PDF)

A worksheet that guides students through The Virtual Stickleback E Lab. The virtual lab lets students learn firsthand the methods for anal body structure in stickleback collected from lakes and fossils recoven quarry. Students measure, record, and graph their results to discover evolutionary patterns.

THE VIRTUAl STICKlEBACK EVOlUTION lAB

INTRODUCTION

As you complete each part of the virtual lab, as assigned by your teacher, answer the questions below in the space provided.

QUESTIONS

INTRODUCTION

1. Define **model organism.**

2. How do the spines protect ocean stickleback fish?

3. Why do researchers think that freshwater stickleback populations arose when ancestral ocean-dwelling stickleback became trapped in freshwater lakes?

4. *Watch the video about pelvic reduction in freshwater stickleback.* The loss of stickleback pelvic spines is similar to the loss of which body parts in some four-legged vertebrates?

5. From a researcher's perspective, what is the advantage of having access to hundreds of postglacial lakes?

6. *Watch the video with evolutionary biologist Dr.Michael Bell.*
   a. According to Dr. Bell, what insights can we gain from studying modern populations of organisms?

   b. What insights can we gain from studying the fossil remains of populations of organisms?

7. *Watch the video with Dr.David Kingsley explaining hind-limb reduction.* Name two other vertebrate animals whose evolutionary histories included the loss of hind limbs.

8. Provide two reasons why the threespine stickleback fish is a useful model organism for studies in evolution.

OVERVIEW

1. What is the difference between marine, sea-run, and freshwater stickleback fish? Be specific.

2. *Watch the stickleback fish anatomy video.*
   a. What are the two types of paired fins?

   b. How are stickleback pelvic fins different from those of other teleost fish species? (Teleosts are a large group of ray-finned fish, including, for example, minnows, tuna, and goldfish.)

   c. *Dichotomous (circle one choice per pair that best completes the following statements):*
      1. Anterior means toward the (head **/** tail) of the fish while posterior toward the (head **/** tail) of the fish.
      2. (Dorsal **/** Ventral) means the back side of the fish and (dorsal **/** ventral) is the belly side.

   d. What advantage does the ability to simultaneously lock in place the two pelvic spines with the dorsal spine directly above them provide to the stickleback?

TUTORIAL 1

1. Describe the following pelvic girdle scoring categories used in the virtual lab:
   a. Complete pelvis:

   b. Reduced pelvis:

   c. Absent pelvis:

2. *Scroll down the Overview page and watch the short video on pelvic scoring.*
   Does the pelvis of *every* fish with pelvic reduction look the same? What are the similarities and differences?

3. *Complete Tutoria/1.*

EXPERIMENT 1

1. What is the overall objective of Experiment 1?

2. *Click on the link to the map of Alaska, and then dick on the blue pin "A" on the larger map.*
   Which lake is located between Bear Paw Lake and Frog Lake just to the north?

3. In a population, what happens to organisms that are better adapted to the environment in which they live?

4. *Watch the short video on how postglacial lakes form.*
   What do researchers think is one of the selective pressures for the complete pelvis trait in ocean-dwelling threespine stickleback fish?

5. *Watch the short video on the Cook Islet scenery.*
   What features in the various habitats might be selecting for either a reduced or complete pelvic girdle?

6. *In the virtual lab window, complete Part 1: Staining the Fish.*
7. Why do you think it is important to empty the used stain, destaining solution, and water under a fume hood?

8. *In the virtual lab window, proceed to Part 2: Scoring the Fish.*
9. In the window on the right, click on the Random Sampling link. What is a **population?**

10. Why are random samples used to study populations?

11. What is one advantage of studying larger-sized samples?

12. Give an example of **sampling bias.**

13. *Watch the video of Dr. Bell explaining sampling in Bear Paw Lake.*
    a. Why is variation in a population critical to evolution?

    b. From his 20 years of studying Bear Paw Lake, is there evidence that stickleback pelvic structures have changed in this population within this time period?

    c. Is Bear Paw Lake similar to other lakes Dr. Bell has studied?

14. *Complete Part 1 of the lab in the window on the left.*
15. Why is it important that the labels included in the specimen jars be made of special paper that does not disintegrate in alcohol overtime?

16. Examine the pelvic score data you just collected. Does the pelvic phenotype differ between Bear Paw Lake and Frog Lake fish? Explain.

17. *Complete the graphing exercise as instructed by your teacher.*
18. *After graphing, verify your data.* How do your data compare to those obtained by Dr. Bell's lab?

19. *Complete Experiment 1 Quiz. Take time to read the explanation for each correct choice provided following each question.*
20. Explain why the stickleback fish in Frog Lake are more similar to ocean and sea-run stickleback than they are to the stickleback fish in Bear Paw Lake.

21. In addition to predators, can you think of other environmental factors that might be responsible for the differences between Bear Paw Lake and Frog Lake stickleback populations? How would you test your prediction?

22. *Proceed* to *Tutoria/2.*

TUTORIAL 2

1. What score would you assign to a fossil specimen that has only one pelvic spine visible?

2. Some stickleback fossils show no signs of pelvic structures. What are some **possible sources of error** associated with scoring a stickleback fossil "absent"?

3. *Watch the video about scoring stickleback fish fossils.*
4. *Complete Tutoria/2.*

EXPERIMENT 2

1. What is the overall objective of Experiment 2? Explain what the information collected in Experiment 2 will allow you to estimate.

2. *Watch the short video on the Truckee Formation in Nevada.*
   What does each sedimentary rock layer of the Truckee Formation represent?

3. What is one type of information that researchers can gain from fossils that they cannot get from living populations?

4. *Begin the Experiment in the window on the left. Watch the video showing Dr. Bell preparing a fossil.*
5. *In the virtual lab window, complete Part 1: Preparing Fossils.*
6. *Proceed to Part 2: Scoring Fossils.*
   In this virtual lab, you will graph fossil data from six rock layer (your data come from two of these layers). Approximately how many years apart are any two adjacent samples?

7. You collected data on pelvic structures using fossils from rock layers 2 and 5. Approximately how many years of deposition separate these two layers?

8. Which layer is older, 2 or 5? Explain your answer.

9. *Complete Part 2 of the lab in the window on the left.*
10. When you obtained your pelvic phenotype totals, do the fossils in layer 2 differ from those in layer 5? Explain how.

11. *Complete the graphing Experiment as instructed by your teacher.*
12. *After graphing, verify your data.* How do your data compare to those collected by Dr. Bell and colleagues?

13. *Complete Experiment 2 Quiz. Take time to read the explanations for each correct choice provided following each question.*
14. What can be inferred about the presence or absence of predatory fish when the Truckee Formation was a lake? Explain the evidence for your inference.

15. *After completing the quiz, click on Experiment 2 Analysis.*

16. Complete the tables below as you perform the rate calculations. *(The link to the instructions is very helpful.)*

Sample layer	Number of Fish with a Complete Pelvis	Total Number of Fish Sampled	Relative Frequency of Complete Pelvis Trait in Population Sampled
1			
2			
3			
4			
5			
6			

Time	Decrease in Percentage of Complete Pelvis Trait per Thousand Years (Rate of Change)
First 3,000 years (layer 1 to layer 2)	
Next 3,000 years (layer 2 to layer 3)	
Next 3,000 years (layer 3 to layer 4)	
Next 3,000 years (layer 4 to layer 5)	
Next 3,000 years (layer 5 to layer 6)	
Total15,000 years (layer 1 to layer 6)	

17. What does it mean when the rate of change is a negative number?

18. *Complete the Analysis Quiz. Take time to read the explanation for each correct choice provided following each question.*
19. Describe the trend in the data over time.

20. Why is it important to calculate the rate of change over time?

21. In what ways is the change in the complete pelvis phenotype in the fossils from the Nevada lakebed similar to what might have occurred in Bear Paw Lake from Experiment 1?

22. *Proceed to Experiment 3.*

EXPERIMENT 3

1. What is the overall objective of Experiment 3?

2. What is one function of the *Pitxl* gene?

3. *Watch the video segment from the HHMI short film,* "Evolving Switches, Evolving Bodies."
   a. What is the relationship between changes in body form, the process of development, and genes?

   b. Why did Dr. Kingsley do genetic crosses with stickleback fish?

4. *In the virtual lab window, click on the blue gloves and perform Part 1: Staining the Fish (you can skip the staining if you completed it in Experiment 1). Proceed to Part 2: Scoring Pelvic Asymmetry.*
5. Which one of the three pelvic phenotypes is analyzed in more detail in this Experiment?

6. What is the difference between *left-biased* and *right-biased* pelvic asymmetry?

7. *In the virtual lab window, complete Part 2: Scoring Pelvic Asymmetry.*
8. *Complete the graphing exercise as instructed by your teacher.*
9. *After graphing, verify your data.* How do your data compare to those collected by Dr. Bell and colleagues?

10. *Complete Experiment 3 Quiz. Take time to read the explanation for each correct choice provided following each question.*
11. The pelvic asymmetry observed in stickleback fish from Bear Paw Lake and in Coyote Lake is biased toward which side?

12. Based on previous research conducted mice, what do the findings on pelvic asymmetry from Bear Paw Lake and Coyote Lake stickleback suggest about the genetic mechanisms underlying pelvic reduction?

13. *When you are finished with question 5 of the quiz, watch the video of Dr. Bell explaining his findings. (If you have already clicked to the summary page, you can simply click the "back" arrow at the top of the computer window and see the link to this video.)*
14. Name two factors that could be contributing to the size of the reduced pelvis being larger on the left.

15. *Complete the Final Quiz.*
16. *Print the final Summary page if instructed to do so by your teacher.*
17. Listed below are the key concepts of this virtual lab. Write a short essay explaining how this virtual lab provides **evidence** for **EACH** of the key concepts.

    Natural selection can drive the evolution, not just of simple traits like coat color or body size, but also of complex traits like the size and shape of skeletons.

    Different environments with different predators, food sources, or resource limitations apply different selective pressures on the shape of animal bodies.

    Important evolutionary insights can be gained by making comparisons among fossils of different ages and locations and among living populations under different selective pressures, and by comparing fossils to living populations.

    Careful quantitative analysis of the traits of living populations can tell us about mechanisms of selection, including genetic mechanisms, whereas quantitative analysis of populations of fossilized specimens can provide a record of change over time and even the pace of specific adaptive changes.

    Statistical analysis is essential for gauging confidence in conclusions drawn from population data, which can include natural variation, populations in transition, and measurement error by the researcher.

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Student Group _____

Stickleback Evolution lab Quiz

Circle the best answer, or solve the problem.

Questions concerning the analysis of stickleback fish from freshwater lakes (Experiment 1):

1. Data collected from your scoring of pelvic spine expression indicated that:
   A. Bear Paw lake had more fish than Frog lake.
   B. The fish in Bear Paw Lake were larger than those in Frog lake.
   C. The data indicated a wide variation of expression of pelvic spines in fish in Frog lake.
   D. Fish in Frog lake have pelvic spines and fish from Bear Paw lake lack spines.

2. The data that your group scored was _____with Dr. Michael Bell's data collected in 1990.
   A. Consistent
   B. Inconsistent

3. Select the best descriptive statement:
   A. The stickleback population in Frog lake is more similar to marine, and sea run stickleback populations with regard to pelvic morphology in comparison to the Bear Paw population.
   B. The stickleback population in Bear Paw lake is more similar to marine and sea-run populations of stickleback populations with regard to pelvic morphology in comparison to the Frog lake population.
   C. There was no real substantial difference in the two freshwater lake populations populations with regard to pelvic morphology in comparison to the sea-run or marine population wild type.
   D. There is a very large range of morphology within freshwater populations with regard to pelvic morphology in comparison to the marine and sea run population wild type.

4. What was the environmental pressure in Bear Paw lake that was identified in the lab and the introductory movie that selected against prominent spines in the stickleback fish? (made spines a liability instead of a protection)

5. In Alaska, Kalmbach lake was described as historically not having any large predatory fish species present, however in the early 1980's rainbow trout were introduced. Approximately 30 generations (30 years) of sticklebacks have been raised. What type of pelvic morphology is probably present today in 2013?

6. In doing the Chi-Square analysis of your data from Experiment 1, you determined that you needed to use _____degrees of freedom.

   A. 1
   B. 2
   C. 3
   D. 4

7. In doing the Chi-Square analysis of your data from Experiment 1, you determined that you could reject the null hypothesis in :
   A. Bear Paw lake
   B. Frog lake
   C. Morvoro lake
   D. Both A&B
   E. All lakes (choices A, B & C)

8. In performing Chi-Square analysis of data, the expected number of fish to have spines (out of a total population of 20 fish) was ...
   A. 1
   B. 5
   C. 10
   D. 15
   E. 20

9. The p value of 0.01means that ...
   A. No meaningful data is derived from the p value.
   B. If the null hypothesis is true, there is a 1% chance that you would actually get a difference between the observed and the expected events as big or bigger than what was detected.
   C. If the null hypothesis is true, there is a 99% chance that you would actually get a difference between the observed and the expected events as big or bigger than what was detected.
   D. There is a 1% chance that an alternative (experimental hypothesis) can explain the results.

10. What does it mean when a null hypothesis is rejected?
    A. There is no statistically significant difference between the observed and the expected data.
    B. There is a difference between the observed and expected data and it is unlikely that the difference happened by chance.
    C. There is no statistically significant difference between the observed and the expected data, therefore the difference is due exclusively to chance.
    D. The alternative hypothesis has been effectively demonstrated.

The following questions concern information from Experiment# 2 Fossilized Fish

11. In viewing the layers in the quarry...
    A. The top sediment layer was the oldest.
    B. The middle layer strata was determined to be the oldest due to an uplift event approximately 10 million years ago.
    C. The lowest sediment layer was the oldest.
    D. The top layer is the only strata that could be positively dated, as all other layers that fossils were analyzed were indistinguishable.

12. The line graph was used to display the data from the fossilized fish specimens. Why was a line graph used instead of other types of graphs?

13. What was the general trend in the fossilized fish over the 15,000 year period that was analyzed?

14. How could you test the fossilized fish lake bed to determine if there were any large predatory fish present over the 15,000 year history?

15. In the introductory movie, we learned that the PitX1gene does not differ from the population of stickleback fish that have completely developed pelvic spines and those that lack spines completely. How then did the Stanford molecular geneticist explain what accounts for the difference between the two types of fish?

Student Learning Outcomes (SLO) **BIOL 1307**
1. To identify and discuss the fundamentals of biology by demonstrating a knowledge of basic concepts of and laboratory and field techniques concerned with the study of systematics, development, genetics, ecology, behavior, cell biology, bio-energetics, homeostatic mechanisms, and life processes in animals, plants, and microbes.
2. To demonstrate an understanding of genomic organization and molecular genetics including recombinant DNA biotechnology, diffential gene expression and development.
3. Recognize the identifying features and classification of viruses, bacteria, protistans and fungi.
4. Characterize the identifying features and classification of mosses, seedless vascular plants, gymnosperms and angiosperms.
5. Characterize the identifying features and classification of animals.
6. Recognize the parts of the life cycles of selected organisms.
7. To demonstrate an understanding of the components of biological evolution and population genetics, ecological systems, energy flow and biogeochemical cycles.
8. To understand the relationships between organisms in an ecosystem.