Radford University Biome Integrative Exchange Sites (RUBIES)
Principle Investigator (PI): Anthony D. Curtis, Ph.D.
Amount of award: $9,912.00

Brief Overview of RUBIES

The funding obtained through Radford University's Audeamus program helped establish Radford University Biome Integrative Exchange Sites (RUBIES). These sites serve as conduits for broader exchanges, including scientific research, among higher education institutions located near these biomes to allow students to gain first-hand experience in these natural areas while they are still relatively intact. The selected biomes, and their descriptions, are modified from Norm Christensen's *The Environment and You*, and are given below:

- **Tropical Rain Forest Climate**

Although there is variation from month to month, rainfall is persistent and temperatures are continually warm throughout the year in tropical rain forests. These conditions support remarkably diverse forests of broad-leaved evergreen trees such as in the Amazon Basin near Iquitos, Peru, and the Madre de Dios region.

- **Tropical Seasonal Forest Climate**

A distinct dry season from December through March typifies the climate for the tropical seasonal forest in northern Venezuela (Caracas, Venezuela). Many of the broad-leaved trees lose their leaves during this dry season.

- **Tropical Savanna Climate**

An understory of grasses with scattered trees typifies the tropical savanna of northern Botswana (Maun, Botswana). In this biome, the dry season is longer, and less rain falls during the rainy season than falls in the tropical seasonal forest.

- **Temperate Deciduous Forest**

There is reliable rainfall year-round in the temperate deciduous forest biome, represented by Radford, Virginia. Most of the trees in this biome survive the cold winter by losing their leaves.

- **Temperate Evergreen Forest Climate**

This biome occurs in regions with cool, moist winters and comparatively dry summers, as is found in northwestern Oregon (Portland, Oregon). The old-growth evergreen forest has a complex structure with a variety of trees sizes and an understory with abundant shrubs, herbs, and ferns.

- **Chaparral**

This biome, found in places such as southern California (Santa Barbara, California) is dominated by shrubs and low trees that are tolerant of severe summer drought.

- **Temperate Grassland**

This biome has cold winters and hot summers and receives only modest rainfall. It is dominated by grasses and herbs whose roots form a dense sod. The Konza Prairie of eastern Kansas (Wichita, Kansas) is one of the very few temperate grasslands that remains undisturbed by human activities.

- **Boreal Forest Climate (Taiga)**

The Russian word for this biome is *taiga*, which translates loosely as "little sticks." This is an apt description of the northern portions of this biome, as in Canada's Northwest Territory (Fort Smith, Canada), where short growing seasons and boggy soils limit tree size.

- **Tundra Climate**

Although the growing season is less than 3 months and winters are harsh, tundra such as this in the Alaska Range (Pt. Barrow, Alaska) supports a diverse array of shrubs and herbs.

- **Desert Climate**

Desert is the driest biome on Earth and occurs in tropical, temperate, and polar zones. Deserts such as the dry valleys of Antarctica, the Asian Gobi, and the North American Sonoran support plant and animal species that are adapted to dry conditions and highly variable temperatures (Tucson, Arizona).

Results of the Project

Funds for the project were used primarily for travel, lodging, and meals to Lima, Peru where the Director of the Center of Innovative Teaching and Learning, Mr. Charles Cosmato, and the PI attended the 6th International Conference for the Humanities, Arts, Science, and Technology Alliance and Collaborator (HASTAC 2014, www.hastac2014.org). While in Lima, we met with Ms. Jennifer Cottle of Innova Schools. The conference and interaction with Innova Schools proved to be an invigorating venue to talk with interested faculty, discuss ideas about RUBIES, and to deliver an interactive lesson to the PI's students at Radford University in real time. Ms. Cottle and Innova Schools were most gracious hosts, and we will continue to develop the relationship where appropriate.

We aim to partner with a school near the Peruvian Amazon, perhaps in the city of Cusco, Peru, to begin dialog on developing a course focused on the issues of protecting water quality, among others, during development of natural areas. This work is dependent, in part, on the collaboration with RU's International Education Center to establish contact with such universities. The goal over the next academic year is to begin work establishing these relationships while building upon the results from the other main objective of the project, real-time measurement of student understanding using their wifi-capable device.

The other main objective of the project was to test the efficacy of delivering a lesson remotely from Lima, Peru to students at Radford University in real time to measure their understanding. Students enrolled in the PI's Biology for Health Sciences (BIOL 105) course experienced an exam review conducted in this fashion on Thursday April 24, 2014 beginning at 9:30 am. Seventy-one students attended the review session, student responses from selected questions and resulting student-response data are presented below:

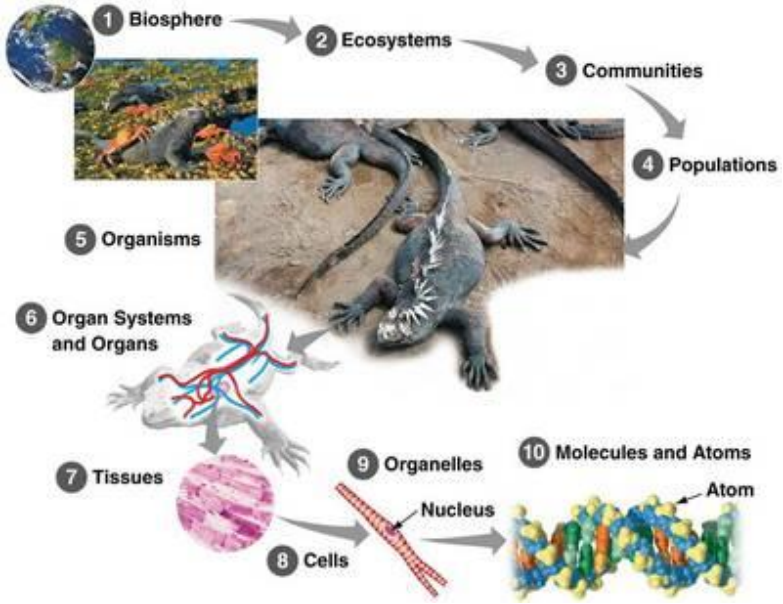
82. multiple choice
Over time,---------- evolve, not ----------.

1. individuals; populations
2. **populations; individuals**

63 responses, 76% correct
A. 24%
B. 76%

1. multiple choice

Which of the following levels of life's hierarchy is not appropriate when referring to two of life's domains, Archaea and Bacteria?



1. the population level
2. the organism level
3. **the organ level**
4. the molecular level

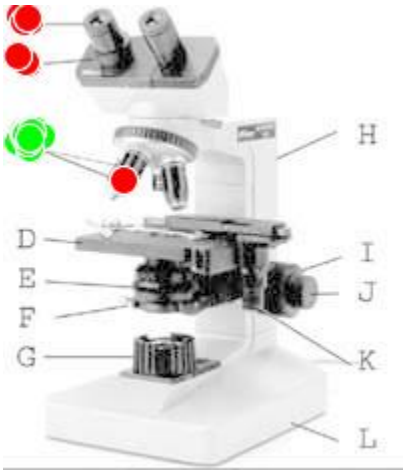
58 responses, 60% correct

A. **12%**
B. **7%**
C. **60%**
D. **21%**

3. region

Using the diagram below, please indicate which letter identifies the objective lens(es).

63 responses, 81% correct



5. region

Please indicate which cell on this ANOVA table will let you know whether there is a statistically significant difference.

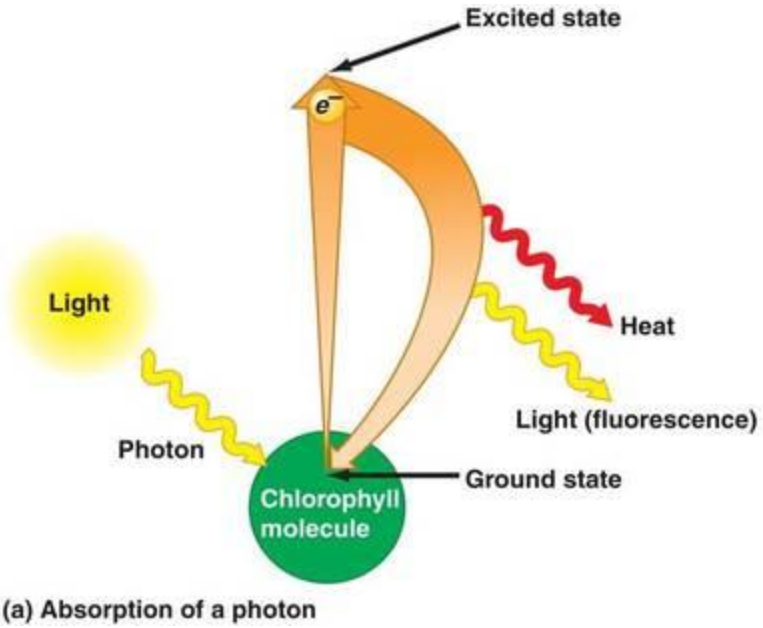
56 responses, 93% correct

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	940.9	1	940.9	12.46225	0.[illegible]	5.317655
Within Groups	604	8	75.5			
Total	1544.9	9				

47. multiple choice

When a photon of the correct energy is absorbed by a photosystem, an electron is energized and transferred to a primary electron acceptor. This creates an electron "hole." How is the missing electron replaced?



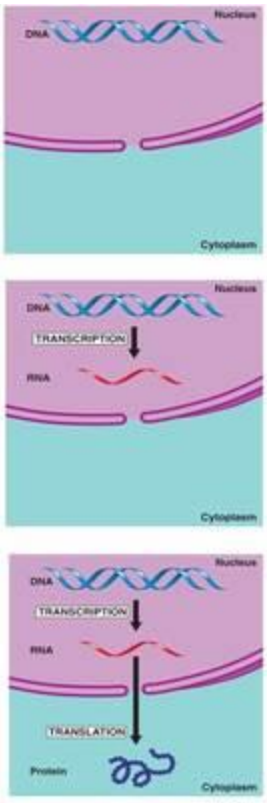
1. An electron removed from glucose replaces the missing electron.
2. **An electron from hydrogen made available by splitting water replaces the missing electron.**
3. The electron comes from ATP.
4. The replacement electron comes from NADPH.

66 responses, 85% correct

A. **2%**
B. **85%**
C. **0%**
D. **14%**

61. multiple choice

While studying Mendelian genetics, you learned the terms genotype and phenotype. The figure diagrams the flow of genetic information in a eukaryote. Which of the following are the molecular-level equivalents of genotype and phenotype?



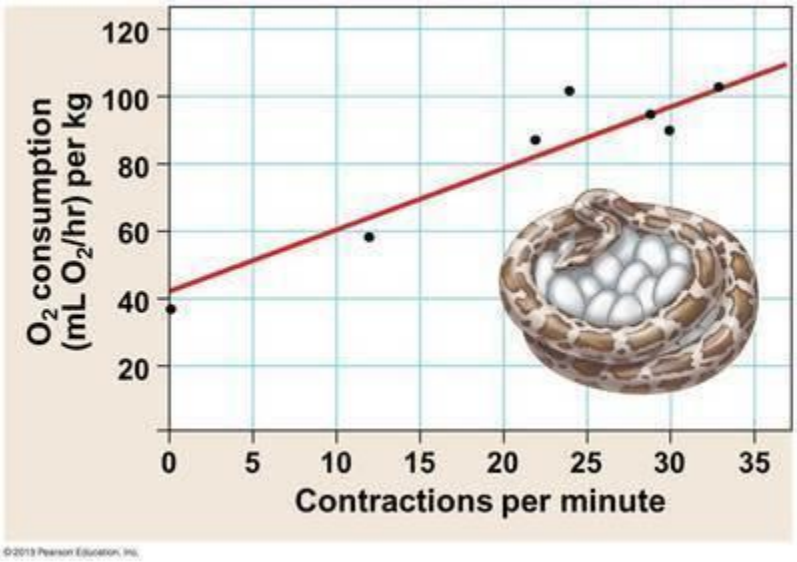
1. transcription (genotype) translation (phenotype)
2. DNA (genotype) RNA (phenotype)
3. **DNA (genotype) protein (phenotype)**
4. RNA (genotype) protein (phenotype)

63 responses, 40% correct

A. **32%**
B. **24%**
C. **40%**
D. **5%**

95. multiple choice

According to this graph, if the Burmese python were contracting 20 times per minute, then what would be the amount of oxygen consumed (mL O2/hr per kg)?



1. 5
2. 10
3. 15
4. 20
5. 25
6. 40
7. 60
8. **80**

57 responses, 96% correct

A. **0%**

B. **0%**

C. **2%**

D. **2%**

E. **0%**

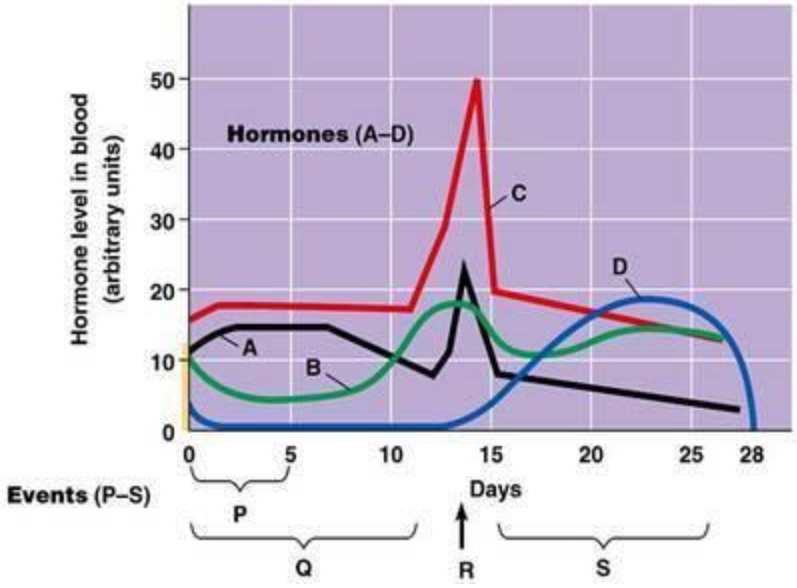
F. **0%**

G. **0%**

H. 96%

157. multiple choice

Which of the lines on the graph represents the levels of progesterone during the menstrual cycle?



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

50 responses, 60% correct

A. **2%**
B. **8%**
C. **30%**
D. **60%**

Student Performance vs. Learning Catalytics Points Earned in Lecture

There was significant regression on overall student performance and the points earned from the Learning Catalytics sessions at midterm for the PI's Biology for Health Sciences (BIOL 105) class ($F = 17.4$; $df = 1, 120$; $p < 0.01$) (Figure 1). Since Learning Catalytics is a web-based program, and there is significant regression between student performance and the points students earned during those sessions, there is great potential for monitoring and improving students' understanding while they participate in these student-centered, active-learning sessions in courses designed for distance and global education.

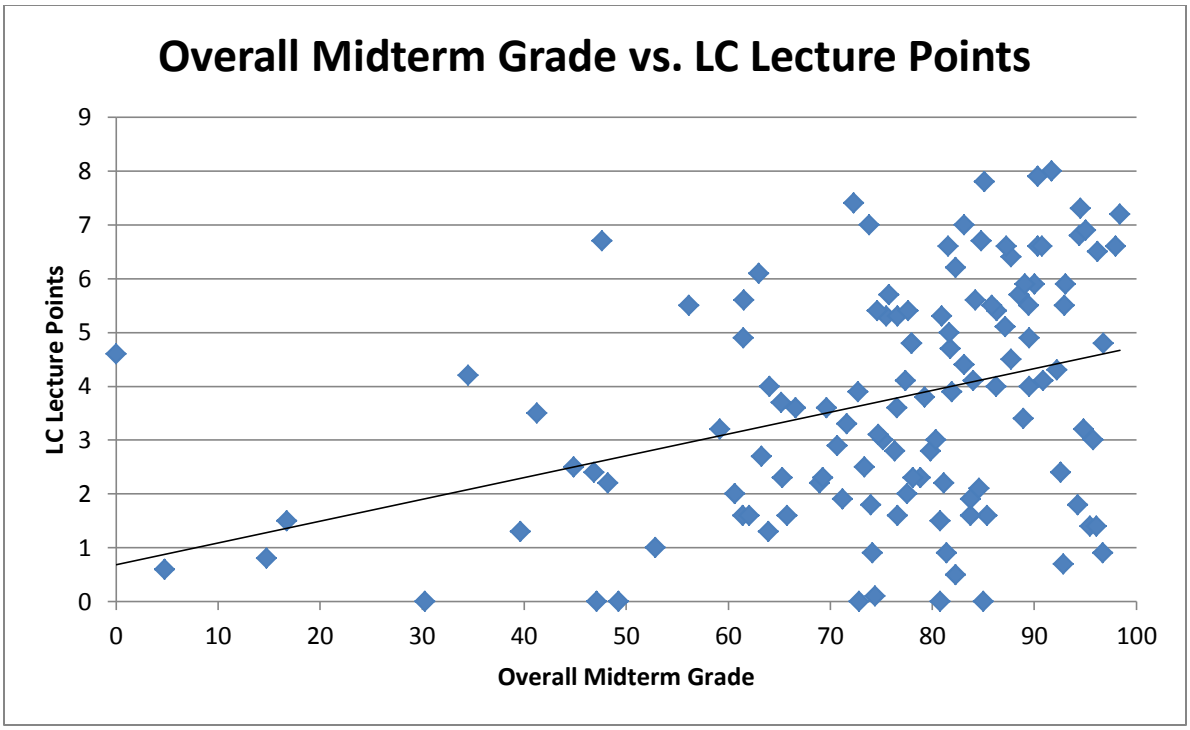


Figure 1. Regression of students' overall midterm grade and points earned from the Learning Catalytics (LC) sessions in lecture.

Future Plans and Connections

RUBIES Partners

In collaboration with RU's International Education Center, higher education institutions will be identified near the biomes of the earth, and will be contacted to determine if common interest exists to develop the RUBIES program at their respective institutions.

Mobile Mesh Network

A mobile mesh network based on emerging smart-phone technology will allow students in RUBIES to interact with their peers, professors, collect and share data, update social media outlets, and other internet-based information. Since some of the biomes of interest are located in remote areas where internet access may be limited, a mobile mesh network will be field tested in AY 2014-2015 at RU's Selu Conservancy.

K-12 Schools

In collaboration with the Office of Sponsored Programs, extramural funding will be sought to connect interested K-12 schools located near these biomes for inclusion in RUBIES.