Course Approval Form

For instructions see: *http://registrar.gmu.edu/facultystaff/catalog-revisions/course/*

Action Requested:
- [x] Create new course
- [ ] Inactivate existing course
- [ ] Reinstate inactive course
- [ ] Modify existing course (check all that apply)
  - [ ] Title
  - [ ] Prereq/coreq
  - [ ] Other:
  - [ ] Credits
  - [ ] Schedule Type
  - [ ] Repeat Status
  - [ ] Restrictions
  - [ ] Grade Type

Course Level:
- [x] Undergraduate
- [ ] Graduate

College/School: College of Science **Department:** Biology
Submitted by: **Ext:** **Email:**

Subject Code: BIOL **Number:** 444
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term:
- [ ] Fall
- [x] Spring
- [ ] Summer

Year 2016

Title:
Current
Banner (30 characters max w/ spaces)
New: Tropical Ecology Laboratory

Fulfills Mason Core Req? (undergrad only)
- [ ] Currently fulfills requirement
- [ ] Submission in progress

Credits: (check one)
- [x] Fixed
- [ ] Variable

or
to

Repeat Status: (check one)
- [x] Not Repeatable (NR)
- [ ] Repeatable within degree (RD)
- [ ] Repeatable within term (RT)

Maximum credits allowed: 1

Grade Mode: (check one)
- [x] Regular (A, B, C, etc.)
- [ ] Satisfactory/No Credit
- [ ] Special (A, B C, etc. +IP)

Schedule Type: (check one) LEC can include LAB or RCT
- [ ] Lecture (LEC)
- [x] Lab (LAB)
- [ ] Recitation (RCT)
- [ ] Internship (INT)
- [ ] Independent Study (IND)
- [ ] Seminar (SEM)
- [ ] Studio (STU)

Prerequisite(s): BIOL 308 or POI
Corequisite(s):

Instructional Mode:
- [ ] 100% face-to-face
- [ ] Hybrid: ≤ 50% electronically delivered
- [ ] 100% electronically delivered

Restrictions Enforced by System: Major, College, Degree, Program, etc. Include Code.

Are there equivalent course(s)?
- [ ] Yes
- [ ] No

If yes, please list

Catalog Copy for NEW Courses Only (Consult University Catalog for models)

Description (No more than 60 words, use verb phrases and present tense)	**Notes** (List additional information for the course)
An introduction to field-based scientific research. This course focuses on methods for testing hypotheses related to tropical plant and animal biology.	

Indicate number of contact hours: Hours of Lecture or Seminar per week: Hours of Lab or Studio: 3
When Offered: (check all that apply) [ ] Fall [ ] Summer [x] Spring

Approval Signatures

Department Approval Date College/School Approval Date

If this course includes subject matter currently dealt with by any other units, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.

Unit Name	Unit Approval Name	Unit Approver's Signature	Date

For Graduate Courses Only

Graduate Council Member Provost Office Graduate Council Approval Date

For Registrar Office's Use Only: Banner Catalog

revised 10/16/14

Course Proposal Submitted to the Curriculum Committee of The College of Science

1. **COURSE NUMBER AND TITLE**: BIOL 444: Tropical Ecology Laboratory

   Course Prerequisites: BIOL 308 or permission of instructor

   Catalog Description: BIOL 444 is an introduction to field-based scientific research methods. The course will consist of travel and experimentation in Costa Rican habitats, including visits to cloud forest, lowland wet forest, volcanos, and riverine & coastal aquatic systems.

2. **COURSE JUSTIFICATION**: BIOL 444 accompanies the BIOL 443 lecture to provide students training in field and laboratory-based experimental methods.

   Course Objectives: The purpose of this class is to introduce students to research techniques within the context of tropical biology. Upon completion of this course, students are expected to:

   - Outline and discuss the pros and cons of different experimental techniques commonly used in plant and animal field research.
   - Discuss current paradigms regarding the structure, diversity, and evolution of tropical plant and animal communities and identify limitations to testing those hypotheses in the field.
   - Identify the most common plant and animal taxa found in lowland Central American rainforests, as well as the names of taxonomic groups and life forms adapted to different structural layers of the rainforest.
   - Discuss some of the conservation and economic issues associated with exploitation of tropical communities, including both agricultural exploitation and non-timber forest products.

   Course Necessity: This course fills a need for upper level laboratory courses for biology students pursuing conservation, environmental sciences, or certificates. It is critical for students interested in plant evolution and conservation or animal behavior, conservation, or evolution.

   Course Relationship to Existing Programs: This will be a laboratory elective within the BA and BS in Biology.

   Course Relationship to Existing Courses: This course is similar Tropical Ecosystems, previously taught as BIOL 543, but this course will be phased out due to declining enrollment interest at the graduate level. Enrollment in BIOL 543 in Spring 2014 was 13 students; however, only 2 were graduate students.

3. **APPROVAL HISTORY**: This course was previously taught in Spring 2014 as BIOL 440.

4. **SCHEDULING AND PROPOSED INSTRUCTORS:** To be offered in March in the Spring Semester of even numbered years.

   Semester of Initial Offering: Spring 2016

   Proposed Instructors: Dr. Rebecca Forkner, Dr. David Luther

5. **TENTATIVE SYLLABUS**: See attached.

BIOL 444
Tropical Ecology Laboratory
Spring 2016

Instructor: Dr. Rebecca Forkner
3016 David King Hall
Email: rforkner@gmu.edu
Phone: (703) 993-4683

Course Objectives

The purpose of this class is to allow you to apply what you have learned in BIOL 443 (i.e., the basic scientific concepts of tropical biology, including the origin of tropical forests, their structure, and their plant and animal diversity) to investigations of patterns of tropical diversity in the field. The course will consist of a 9-day field trip to Costa Rica, including visits to cloud forest, lowland wet forest, volcanos, and riverine & coastal aquatic systems.

Student learning objectives:

After finishing this course, you should be able to

1) Discuss the structure and diversity of tropical lowland rainforests, including providing an explanation of their vertical structure and the names of taxonomic groups adapted to each layer and to gap and shade habitats,
2) Discuss some of the common plant-animal interactions and their role in supporting diversity, including providing an explanation of the degree to which animals can act as drivers of the morphology and diversity of plants,
3) Discuss some of the unique types of habitats and interactions that occur only in wet tropical habitats, including interactions specific to birds, bats, amphibians and primates,
4) Discuss some of the conservation and economic issues associated with exploitation of tropical communities, including both agricultural exploitation and non-timber forest products.

Preliminary Itinerary

Date	Location	Itinerary	Activities
Fri, Mar 7	Leave IAD 10:00 AM Arrive San Jose 4:05 PM	San Jose	Pre-trip comments and information session 6:00 – Dinner at Hotel Robledal
Sat, Mar 8	San Jose, Volcan Poas	Volcanic and waterfall habitats	6:00 a.m. - Bird Walk 7:00 a.m. - Breakfast 9:00 a.m. - Visit Volcan Poas 12:00 p.m. - Lunch on route to La Selva Field Station via waterfall La Paz 7:00 p.m. - Night Hike
Sun, Mar 9	Organization for Tropical Studies Field Station (OTS), La Selva	Lowland forest hikes, Sarapiqui & Puerto Viejo Rivers	7:00 a.m. - Breakfast @ La Selva 9:00 a.m. - Morning Hike 12:00 p.m. - Lunch @ La Selva 1:00 p.m. - Boat Tour of 6:00 p.m. - Dinner @ La Selva 7:30 p.m. - Selva Verde Lodge for frog viewing and cocktails
Mon, Mar 10	OTS La Selva, Costa Rica	Banana Plantation, Lowland Rainforest	8:00 a.m. – morning Banana Plantation tour 12:00 a.m. – Lunch @ La Selva 1:00 p.m. – Lowland forest hike 6:00 p.m. – Dinner @ La Selva 8:00 p.m. – Night Hike
Tues, Mar 11	OTS La Selva, Costa Rica Volcan Arenal	Lowland Rainforest and Volcanic habitats	6:00 a.m. – Bird Walk 7:00 a.m. - Breakfast 12:00 p.m. – Lunch on route to viisit Volcan Arenal Afternoon hike at Arenal 7:00 p.m. Dinner @ Monteverde
Wed, Mar 12	Monteverde Lodge	Cloud Forest, Coffee plantation	6:00 a.m. – Bird Walk 7:00 a.m. - Breakfast 8:00 a.m. - Hike to continental divide 12:00 p.m. - Lunch @ Monteverde 1:00 p.m. - Fina La Bella Coffee Tour 7:00 p.m. – Dinner @ Monteverde 8:00 p.m. - Night Hike
Thurs, Mar 13	Manuel Antonio National Park	Coastal Forest	6:00 a.m. – pack/ready to depart 7:00 a.m. - Breakfast Morning and Lunch – in route to MANP 6:00 p.m. – Dinner at Hotel
Fri, Mar 14		Coastal Forest	7:00 a.m. Breakfast Full day @ MANP, hiking & snorkeling Scuba optional Lunch on your own 6:00 p.m. - Dinner at Hotel
Sat, Mar 15		Mangrove and Beach habitats, Damas Island	6:00 a.m. - Early Breakfast 7:00 a.m. - Mangrove boat tour 12:00 p.m.- Lunch at hotel Afternoon – Packing & free time at beach 3:00 p.m. - Departure for San Jose 7:00 p.m. – Dinner at Hotel Robledal
Sun, Mar 16	Depart San Jose 5:00 PM Arrive IAD 1:55 AM	Airport	

Lab Exercises, Costa Rica

Directions

Below are three field exercises you will conduct during your trip to Costa Rica. Read each exercise carefully before we arrive at IAD. During our pre-trip briefing, ask for clarification if the objectives of any of the exercises are unclear. You will be provided with necessary field supplies but should remember to bring a camera with you. During the week, you may recruit the assistance of faculty or your classmates in order to conduct enough field observations to get the data and photographs you need.

Your final submissions should be in the form of a large poster or a formal lab report (including an introduction to the ideas you are testing, methods and results sections, and a discussion). Reports should include both quantitative (statistical) and qualitative summaries of your findings (e.g., tables, species lists, averages, etc.). Your reports should be no longer than 5 pages, typed, single-spaced, and should include citations to primary literature where necessary. Posters may be designed in Powerpoint, Microsoft Publisher, Photoshop or other software program. Your final poster may be printed on the poster printer in the Biology Department. See your instructor for directions and more information when you have a final document ready to print.

Your lab report or photo-mosaic poster is due by 4:15 p.m. on May 9th.

Exercise 1. Photomosaic Poster – Tropical Rainforest Plant Diversity and Forest Structure

Choose one of the following two exercises to complete.

1. Documenting vertical structure

   Background:

   Despite a paucity of studies supporting a difference in vertical strata between temperate and tropical forests, biologists generally agree with and teach the concept of ***vertical stratification*** of tropical forests. In particular, you have been taught that tropical forests have at least 4 distinct plant strata – herbaceous ground, understory, canopy, and emergent layers. In class, we discussed data from Parker and Brown (2000), which demonstrated that, of the 10 different ways in which researchers typically defined "stratification," there was evidence that forests did conform to at least two of these definitions. First, forests showed a *nonrandom (clumped) distribution of leaf biomass with height*. In addition, forests *contained species with consistently different top heights*.

   Assignment:

   As you travel through Costa Rica, find and photograph examples these possible layers – either from the road or trail, within the forests, at forest edges, or viewed from the river – and examples of plants within each layer.

   In addition, find and photograph examples of plants that *do not* seem to conform to the concept of vertical stratification, such as lianas, epiphytes, other plant growth forms, or forest patches that seem to show no structure.

   Product:

   Using the information and photographs you collected on vertical structure and the photographs and information on different plant species, create a photo mosaic poster in which you present the concept of tropical forest vertical stratification and reconstruct a tropical forest, placing the common plant genera you observed in their correct strata. Along with your poster, provide a two page summary of your evidence in support of or refuting the concept. Remember that the objective is to produce a "teaching poster" to assist other students in learning the concept.

Helpful Resources

Designing effective posters: www.hsl.unc.edu/services/tutorials/poster_design/home.htm

Helpful Citations:

Parker, G. G. and M. J. Brown. 2000. Forest Canopy Stratification – Is it useful? *American Naturalist* 155:473-484.

2. Documenting plant diversity –

Background:

Tropical rainforests are famous for their extreme levels of diversity of both flora and fauna. In class, we have investigated a large number of plant families common to lowland tropical rainforests. We discussed the biogeographic origins of such taxa and talked about the many ways in which tropical plants have been cultivated as crops or sold as exotic flowers. In addition, you have been taught a variety of characteristics that are found in tropical plants but not in temperate or boreal forest plants, such as sympoidal growth for sunlight acquisition or drip tips that assist in reducing leaf wetness. The goal of this exercise is to help you learn 1) to describe the array of traits that tropical plants have evolved to cope with their unique abiotic environment, 2) to identify plant life forms unique to tropical rainforests, and 3) to memorize the most commonly encountered plant taxa.

Assignment:

As you travel through Costa Rica, find and photograph an example of each of the Neotropical plant genera or families provided in the list below. You are not limited to this list buy may include additional plants that you encounter. Remember that you should focus on a variety of forest regions – old growth, secondary growth, gaps, etc. – and, therefore, should not take all of your photographs while we are traveling on the road.

For each plant photographed record 1) its location, 2) the stratum in which it occurs, 3) the life form in which it is growing (e.g., as a liana, an epiphyte, a shrub, an emergent tree, a myrmecophyte, etc.) and if it hosts any other plant life forms or animals (e.g., epiphylls, strangler figs, ants, etc.), 4) any adaptations (e.g., drip tips, cauliflory, macrophylls or megaphylls, buttresses, etc.) unique to tropical forests, and 5) the plant's habitat (e.g., gap, closed understory, cloud forest, lowland, successional, riverine, cultivated crop, etc.). When you return to campus, use your notes, textbook, and published materials to identify the biogeographic origin of each taxon you photographed (e.g., newly evolved in the Neotropics, African in origin, Gondwanaland in origin).

Product:

Using the photographs and information you collected on different plant species, create a photo mosaic poster in which you construct a generalized Neotropical Rainforest, placing the common plant genera you observed in their correct strata and forest location. For each plant, provide its identity and an important characteristic or service it provides or other life it supports. You may use as many of your photographs as you would like, and if your images do not turn out well you may supplement occasionally with additional freely licensed media where necessary. Remember that the objective is to provide a "teaching poster" that will assist other students as a field guide to tropical plants.

Plant taxa and families:

Cecropia (Urticaceae) - Yurumo
Psychotria (Rubiacae) – Hot lips plant
Colocasia (Aracae) – Elephant ear plant
Gunnera (Gunneracaea) – Poor man's umbrella
Piper or *Pepperomia* (Piperaceae) – Black pepper
Ficus (Moraceae) – Figs and rubber trees
Heliconia (Heliconiaceae) – Lobster claw flower
Cieba (Malvaceae) – Kapok tree
Bactris or *Welfia* (Aracaceae) – Tree palms
Pentaclethera (Fabaceae) – Oil tree
Dipteryx panamensis (Fabaceae) – Tonka bean, almendro
Miconia (Melostomacea) – Velvet tree
Bursera (Burseraceae) – Gumbo limbo or Tourist tree
Musa (Musaceae) – Wild and cultivated banana
Passiflora (Passifloraceae) – Passion flower
Monstera (Araceae) – Shingle plant or Swiss cheese plant, broadleafed philodendrons
Cyathea (Cyatheaceae) – Tree fern
Tabebuia (Bignoniaceae) – Trumpet tree
Ochroma (Bombacoideae) – Balsa
Theobroma - Cocoa
Bromeliaceae – tank bromeliads
Solanaceae – Night shade family – "tree tomatoes"
Orchidaceae – Orchid family

Helpful Resources

Designing effective posters: www.hsl.unc.edu/services/tutorials/poster_design/home.htm

Helpful Field Guides:

Condit, R. 2010. Trees of Panama and Cost Rica. Princeton Field Guide. Princeton University Press, NJ.

Gentry. A. 1996. A field guide to the Families and Genera of Woody Plants of North West South America. University of Chicago Press, Chicago, IL.

Exercise 2 – Fruit and Pollination Syndromes

1. In their classic paper, Gauiter-Hion et al. (1985) proposed and tested the idea that "fruit dispersal" syndromes exist for plants. That is, they argued that different animals choose among available fruit on the basis of different morphological and chemical characteristics, and thereby reduce competition by partitioning available resources. They argued that, as a result of these choices, biologists could identify fruits as "monkey fruits" or "bird fruits" and so forth based on these characteristics (see figure). Alternatively, this may be viewed from the perspective of the plant by arguing that different plants, over time, have evolved to increase the fidelity of their seed dispersers by offering rewards relevant to the consumers' needs or by being appropriately colored based on the dispersers' visual capacity. Similarly, pollination biologists have promoted the idea of "pollination syndromes" for birds, bats, insects and other pollinators on the basis of flower morphology, floral scent, and nectar or pollen availability (see table), and this idea pre-dates the idea of fruit dispersal syndromes (Fraegri and van der Pijl 1966). Studies that tried to document pollination syndromes, however, showed that generalization – flowers receiving pollen from many different floral visitors – was more common in nature. Forty years later, biologists are still debating the utility and accuracy of the concept of pollination and fruit syndromes.

   Choose 2 of the pollination syndromes from the table below. During the week, observe and record as many pollination events (i.e. flower visits by the respective animals) for that syndrome as you can. (Remember that bat visits may be difficult to observe unless you time your observations appropriately.) Record the following information for each observation: 1) flower color(s) and pattern, relative size, and orientation (upward, hanging, inside or outside foliage), 2) approximate corolla length (long, medium, short) and width (narrow, shallow), 3) petal size and shape (including the presence of adaptation that might reduce nectar loss as was discussed in class), 4) pollinating organisms, and 5) presence of other potential pollinators or floral visitors.

2. Summarize your observations in tabular form for each pollination syndrome you chose. Based on what you recorded, answer the following questions:

   A. Do your observations support the idea of pollination syndromes? That is, were the organisms you observed visiting the expected flower types based on the table provided? If so, how closely did they match predictions (matched characters in all columns of the table or just a few)?

   B. When observing floral visits, did you see more than one type of organisms present at any one flower? If so, what was the average number and type of flower visitor for any given flower type (e.g., red flowers or flowers with long corollas)? Do you

observe any evidence of "cheaters" (species that remove pollen or nectar in ways that wouldn't promote pollination, such as piercing the bottom of the corolla)?

C. What advantages do you think would exist for a plant to attract more than one flower visitor? Disadvantages?

3. Summarize your conclusions to provide an argument in support of or refuting the idea that pollination syndromes exist. Your final paper should be in the format of a formal lab report, including an introduction, methods, results, and conclusion section (approx. 4 – 5 pages with references).

Helpful references:

Fenster et al. (2004) Pollination syndromes and floral specialization. *Annual Review of Ecology and Systematics* 35:375 – 403.

Gauiter-Hion, A., Duplantier, J.M., Quris, R., Feer, F., Sourd, C., Decoux, J.P., Dubost, G., Emmons, L., Erard, C., Hecketsweiler, P., Moungazi, A., Roussilhon, C., & Thiollay, J.M. (1985) Fruit Characters as a Basis of Fruit Choice and Seed Dispersal in a Tropical Forest Vertebrate Community. *Oecologia* 65, 324-337.

Glover, B. J. (2007) Pollination Syndromes – The evidence. Chapter 19, *in* Understanding Flowers and Flowering: An Integrated Approach. Oxford Scholarship Online.

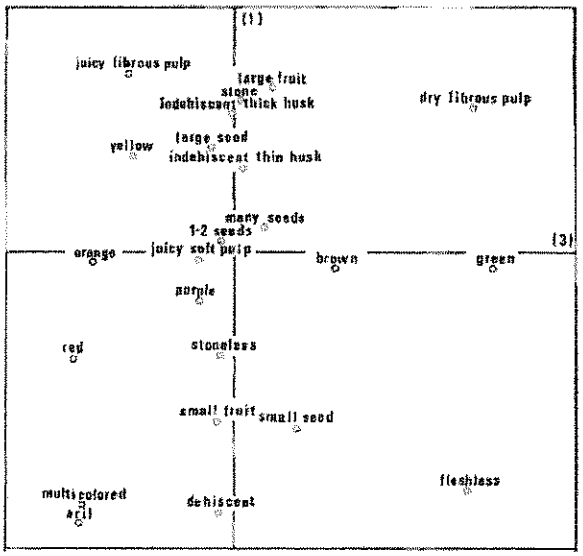

Fig. 1. Factorial plane 1–3 of the multifactorial analysis showing contingencies among the different characters of fruits (*white circle*: active variable; *white square*: supplementary variable)

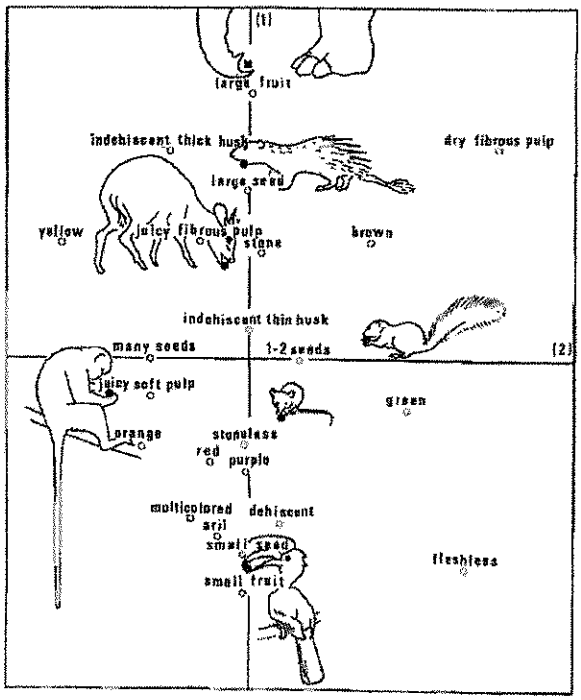

Fig. 2. Factorial plane 1–2 of the multifactorial analysis showing the interrelationships among the six group of consumers and the fruit characters (*white circle*: active variable for fruit; *black circle*: active variable for consumers; *white square*: supplementary variable for fruit; *black square*: supplementary variable for consumer

Table 1. Floral characteristics of different pollination syndromes

Type	Pollinator	Flower depth/shape	Flower scent	Flower color	Time of flowering	Reward
Chiropterophily	Frugivorous Bat	Bowl shaped or wide short corolla	Moderate	White or dull	Nocturnal or Crepuscular	Edible pith or fruit, Pollen
Chiropterophily	Nectivorous Bat	Wide short corolla	Moderate, sweet	White or dull	Nocturnal or Crepuscular	Nectar
Ornithophily	Hummingbird	Narrow, tubular corolla	Moderate, sweet	Red, Pink	Diurnal	Nectar
Melittophily	Hymenoptera (Bees)	No depth or very shallow	Fresh, sweet	Bright - yellow, white, blue	Diurnal	Pollen, Nectar
Myophily	Diptera (Bee mimic flies – Bombyllidae, Syrphidae)	No depth, flat	Weakly sweet	Same as melittophily	Diurnal	Nectar, Pollen (Syrphidae)
Sapromyophily	Diptera (flesh and garbage flies - Muscoid)	Wide, open with flat surfaces	Decaying, putrid	Dull - purple, green, brown, pink	Diurnal/ Nocturnal	None, Nectar
Cantharophily	Coleoptera	Bowl or dish shaped	Strong, fruity	Dull – white, yellow	Diurnal/ Nocturnal	Edible flower parts
Phalaenophily	Lepidoptera (Moths)	Large tubular, pendant	Strong, sweet	Light – white, pale green	Nocturnal or Crepuscular	Nectar
Psychophily	Lepidoptera (Butterflies)	Small tubular, upright	Fresh, sweet	Red or pink, yellow, blue	Diurnal	Nectar
Sphecophily	Hymenoptera (Fig Wasps)	No depth or very shallow	Sweet, pheromone	White or yellow	Diurnal	Developing flower/fruit tissue, Place to live

Exercise 3 – Bromeliad fauna

1. Bromeliad-held water is a unique habitat exclusive to moist tropical habitats. Tank bromeliads are the primary habitat for many anurans, including Dedrobatidae and Hylidae anurans. To support these organisms, additional fauna must be present within the pytotelmata to support higher order consumers. These may include aquatic and terrestrial insects and other invertebrates.

   Phytotelmata like tank bromeliads are often referred to as "limnological isolated environments." To be considered a habitat type on the order of what we consider for other ecological classifications (e.g., "grassland habitat" or estuary), the organisms associated with phytotelmata must be more than just random associations of animals that fell into the tank. Moreover, over time, if they were more than just random assemblages of organisms, we would expect organisms to evolve traits that promote their association with phytotelmata (over other available habitats) and/or with other phytotelmata inhabitants.

   During the week, find and document the fauna associated with at least 10 different tank bromeliads. For each bromeliad, record 1) date and location, 2) plant on which the bromeliad occurred (if known) and height of bromeliad above ground (terrestrial or epiphytic), 3) additional features of the bromeliad, including leaf morphology (shape, color, presence of spines, etc.), 4) relative volume of water held, 5) condition of water (clear, turbid, etc.), 6) presence of decaying organic material (leaves, stems, fungi, etc.), 7) presence of any vertebrate organisms within or near the tank, and 8) presence and relative abundance of any macro-invertebrates (ants, dragonflies, termites, mosquitos, spiders, etc.) near the tank or in the phytotelmata.

   (*Nota bene* – any vertebrates present should be recorded but not collected. Water and associated organisms can be removed and placed in a plastic bag for inspection, but invertebrates (and any tadpole larvae) should be returned to the original bromeliad or nearest natural water source.)

2. Summarize the observations you collected. Based on your observations, answer the following questions:

   A. Which invertebrates were the most common tank inhabitants? Which invertebrates were the most commonly encountered species outside of bromeliads? If bromeliads are unique environments, would you expect the invertebrates collected to be proportional to their relative abundance in all environments (terrestrial or aquatic) or would you expect them to be a non-random collection of species? Which do your observations support – non-random or proportionate?

      (In order of terrestrial abundances – termites > ants > diptera (adult mosquitos and flies) > coleoptera > odonates (dragonflies) > isopods > Araneae (spiders) > gastropods (snails). In order of aquatic abundances – Amphipods > Larval Diptera > Trichoptera (caddisflies) > Coleoptera (beetles) > Odonates. Please ask for assistance if you need help identifying invertebrates.)

B. Does the composition of bromeliad fauna differ between terrestrial (such as pineapple) and epiphytic tanks? Which organisms would you expect to be in greater abundances in epiphytic tanks and which in terrestrial ones and why?

C. Which invertebrate or vertebrate organisms would you expect to actively recruit to phytotelmata, either because adult organisms preferentially lay eggs or deposit offspring within tanks or because individuals seek out these aquatic habitats? Are there traits that might make it easier for an organism to colonize the tank of a bromeliad? Of an epiphytic tank? Which organisms would you expect to be present more often in terrestrial bromeliad tanks? Do your observations support your expectations?

D. What would be advantageous about colonizing or living in bromeliads compared to other aquatic environments like streams or lakes? Disadvantageous?

3. Summarize your conclusions to provide an argument in support of or refuting the idea that bromeliad phytotelmata represent unique "limnological isolated environments." Your final paper should be in the format of a formal lab report, including an introduction, methods, results, and conclusion section, and should also include an appendix with a complete list of organisms encountered and their relative abundances (approx. 4 – 5 pages with references).