Leveraging local environments and cross-cutting themes to implement 4DEE

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Water Cooler Chat
ESA Education

Chat box introductions

Name (pronouns), Institution, City, State

Chat box Question

What is the primary level that you teach?

(100, 200, 300, 400)

Our Institutional Setting: Rowan University

- 4th fastest growing public research university in 2022
- Relatively small biological sciences department with MANY majors
- Shifting towards:
  - increasing class sizes (most science currently capped at 24)
  - incorporating certificates into degree programs
  - online courses (more so since the pandemic)
  - hyper-efficient use of resources

Science Hall

Our Curricular Structure: 4-course intro sequence

- Non-traditional
- emphasizes skill development
- prominently features ecological science (“capstone”)

100-Level:

1. Introduction to **Evolution** and Scientific Inquiry
2. Introduction to **Genetics**

200-Level:

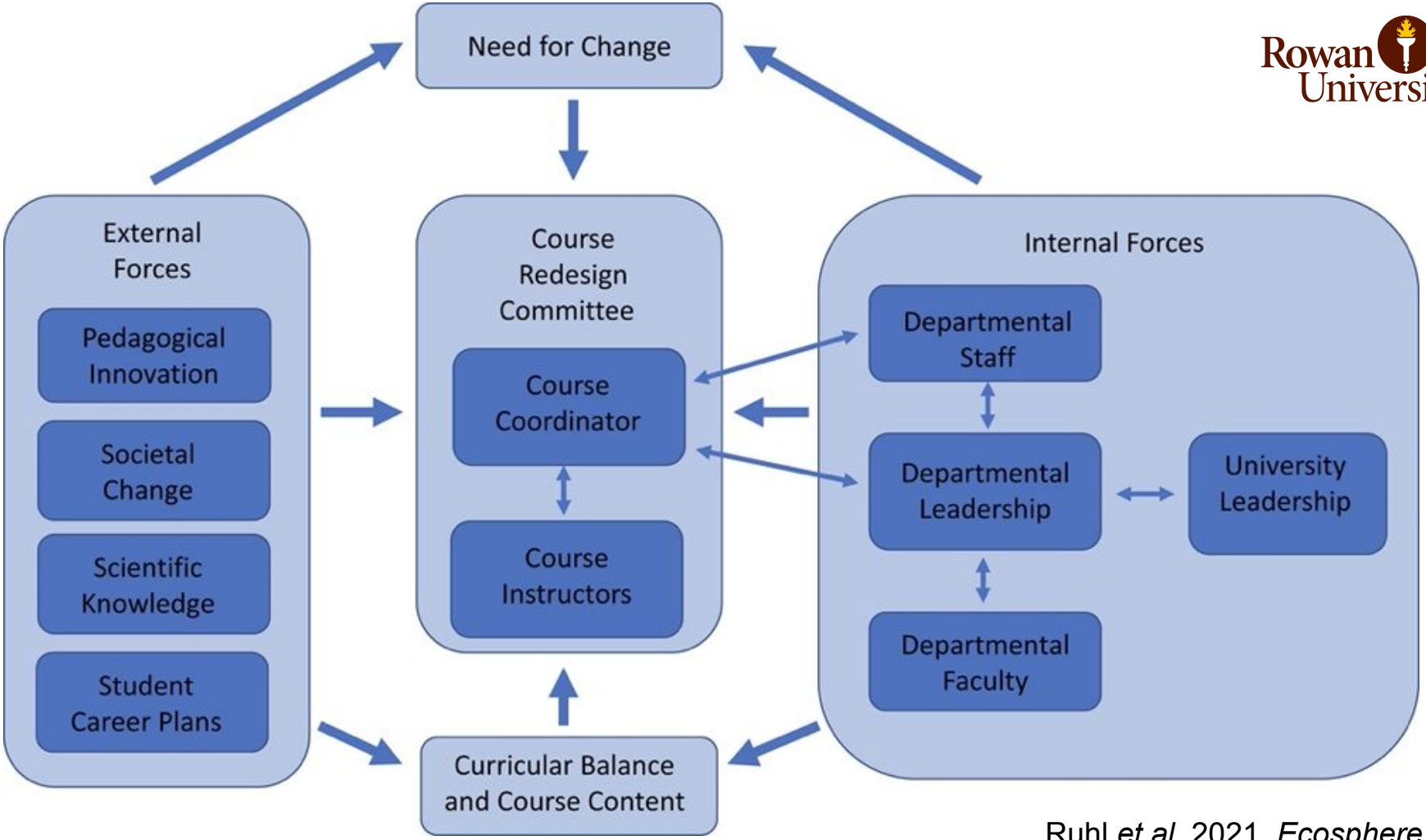
3. Introduction to **Cell Biology** (gateway to MCB upper-level courses)
4. Introduction to **Ecology (gateway to EEOB upper-level courses)**

Challenges

One challenge we faced:

the value of a required ecology course was questioned

1. To what extent does your administration/campus community support ecology curriculum? Does your biology department require an ecology course for a degree?
2. How do you negotiate overlap between “environmental science” and “ecology”?
3. What are the practical benefits of integrating 4DEE into your curriculum?
    - https://www.esa.org/4DEE/



Ruhl *et al.* 2021. *Ecosphere*

What we did

- Argued for the emphasis on skills and human interactions that ecology brings
- Emphasized the support of **4DEE** by the ESA
- Touted the **assessment potential** of 4DEE
- Used the word “CURE” (more on this later)
  - Provides larger proportion of our students an authentic research experience.
  - Requires subject-matter expertise and coordination among many sections.

May 2020

Form Committee

- Course Coordinator
- Full-Time Instructors

May 2020

Identify and Discuss Problems

- Logistical and Financial Barriers
- Lack of Robust Assessment
- New Instructional Modalities
  - Maintain Curricular Balance
  - Experiential Learning
- Need for Undergraduate Research Experiences
- Pandemic-Specific Issues
- Barriers to Entry for New Faculty

June 2020

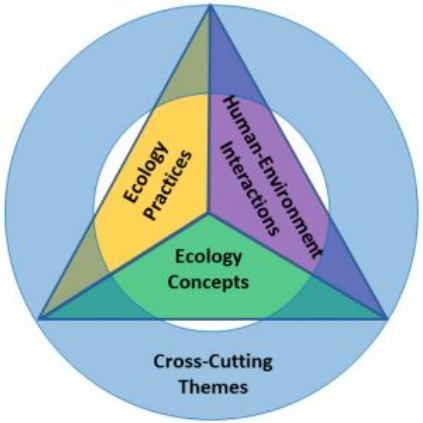
Identify and Discuss Solutions

- Flexible Course Alignment Composed of Targets and Objectives
  - Informed by 4DEE
- Course-based Undergraduate Research Experience (CURE)
  - Tailored to our needs and experience
  - Informed by 4DEE

July 2020

Build and Share Alignment

- Draft Alignment by Coordinator, Integrated with 4DEE
- Committee Edits of Alignment and Discussion
- Shared with Part-Time Instructors of Course

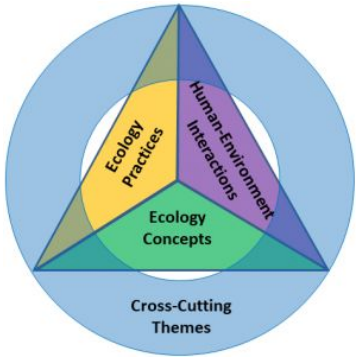


Ruhl *et al.* 2021. *Ecosphere*

Another challenge (within our department):

different perspectives of what “ecology” should include

1. Do your peers see human actions as being part of ecology curriculum?
2. Should our emphasis be on facts or competencies? Why? What is our goal?
3. How does 4DEE differ from classical ecology education?
    - https://www.esa.org/4DEE/



What we did

- Reduced the extent of **modeling** in our previous version of the course to allow for additional topics to be included.
    - Lost: Detailed pool & flux and Lotka-Volterra models using **modeling software**
    - Maintained: Basic modeling using **Excel** (e.g., exponential and logistic growth, life tables, trophic transfer efficiencies, basic statistics in Excel that can be used for CURE)
    - Added/modified:
        - ➢ Two discussion boards:
            - **What is a "model" in science?**
            - **How do we use modeling to solve ecological problems?**
                - Emphasizes the utility of ecology - climate change, biodiversity loss, disease spread
        - ➢ Students also listen to a podcast about modeling Covid-19 (from April 2020)

What we did

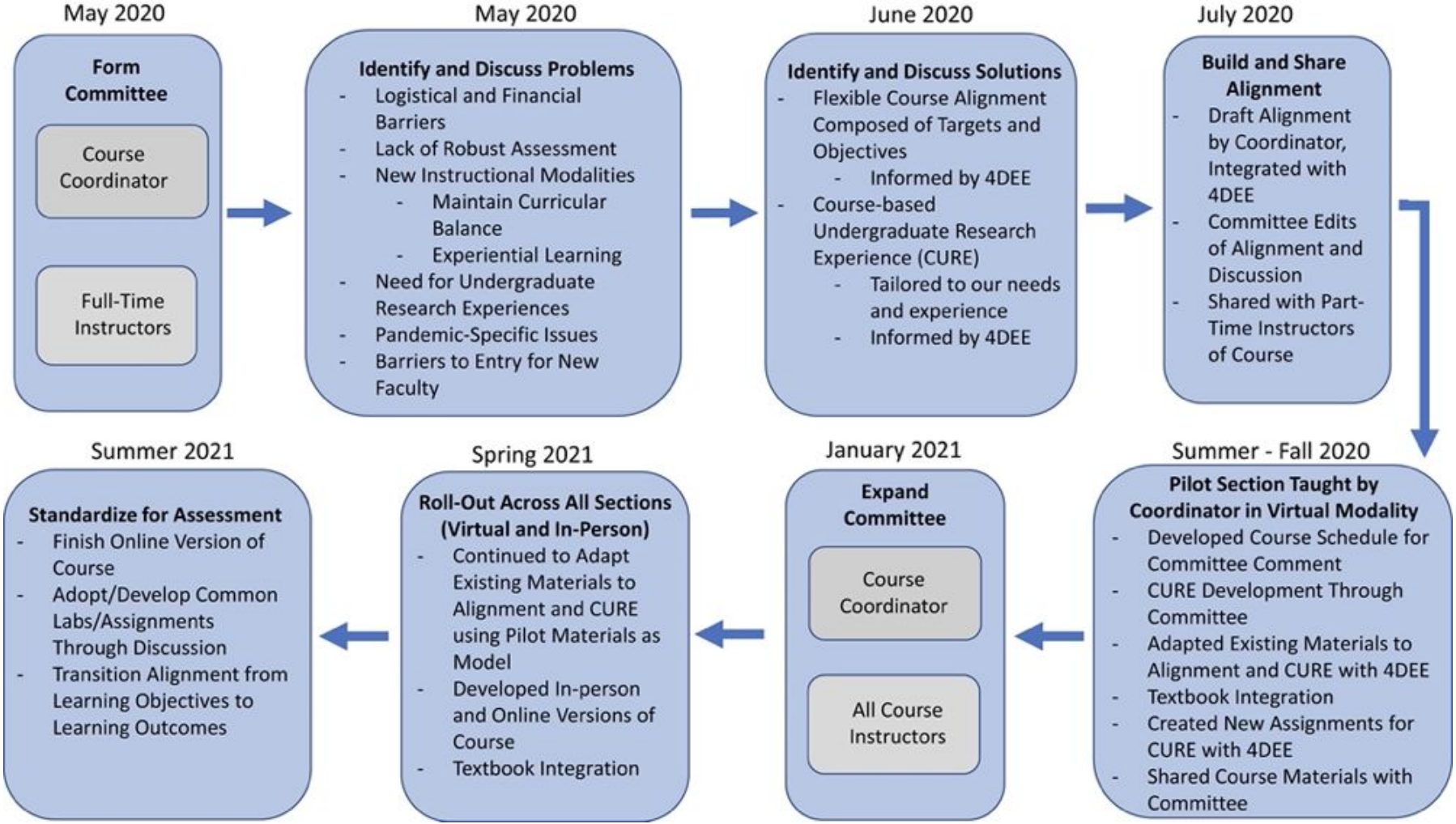
- Increased discussion of **human impacts** on the environment.
    - Climate change, IPCC report
    - Air & water pollution
    - Urban environments
    - Landscape use/conversion
    - Habitat fragmentation
    - Biodiversity loss
- Added a **CURE** (more later) to replace our previous set of lab assignments.
    - centers on environmental gradients (e.g., urban to rural)
    - emphasizes scientific practices

Student reflections - evidence of positive impacts

“Growing up I heard a lot about global warming in school, but **I never truly understood the severity of what humans are doing** to the environment.”

“We think of usually smaller scale impacts that things such as wildfires can have on the ecosystem directly around the fire, but to think of the impact it can have on a bigger scale was honestly amazing.”

“The first step to helping solve the problem of climate change is by understanding the basic mechanisms by which humans have disrupted natural nutrient cycles.”



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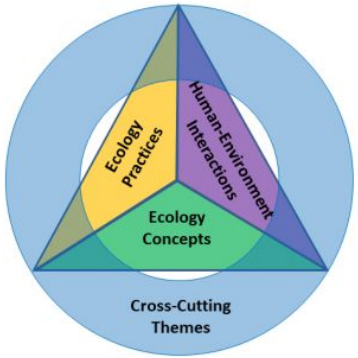
4DEE Opportunities



One of our longstanding curriculum goals:

experiential, hands-on, authentic scientific experience
(additional newer goal: in any modality)

1. Who are your students? Where do they live? Do they see themselves as part of nature or removed from nature? Do your students view themselves as “scientists in training?”

2. How do we welcome our students into the field of ecology? How do we teach norms, while also encouraging future innovation? What are students doing that makes them feel like a scientist?

3. **Which unique aspects of your local campus environment/region can be leveraged to achieve *human-environment interactions* x *ecology practices* dimensions of 4DEE?**

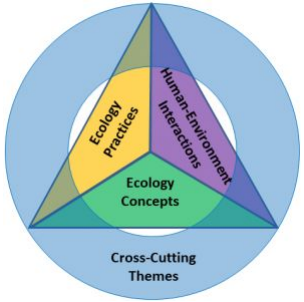
What we did

- Explicitly told the students they are **“scientists in training”**
  - Repeatedly explained why we were completing various tasks throughout the semester.
  - Asked students to find and read scientific articles.
  - Gave students large (for them) datasets to analyze.
  - Required students to present their findings in graphical, written, and oral formats.

- **Collaboratively collected multidimensional data** for individual projects
  - Students have a say in what we measure.

- Leveraged our **Local environment**
  - We are suburban but live near a major urban area.
  - We are a very regional institution.
  - We live in a mosaic landscape: city, suburbs, agriculture, pine barrens, marine ecosystems

What we did



- Added a **Cross-cutting CURE**
    - Read and dissect literature, learn to find & cite references (in-text & bibliographic)
    - Identify species in their local environment
    - **Build quadrats (at home or in the classroom)** and use them to measure traits
    - Measure a variety of adaptive traits in a species that exists along an environmental gradient (e.g., urban to rural)
    - Perform simple analyses in Excel (t-tests and correlations)
        - Collective data from all students is available for use in individual projects
    - Present their results (written reports, oral and poster presentations)

Student reflections - evidence of positive impacts

“I think it is really neat that we can do scientific research in nearby parks, this proves that **scientific research is not limited to labs (as most of the people think). There are plenty of opportunities around us** to start scientific research.”

“I love going into the field and collecting my own data, it **gives me a sense of involvement with my peers** conducting the same research and **it’s fun to get outside and be active for once** during these times where it’s easy to stay inside all day.”

“I like the on hands approach of scientific research. It **makes me feel like I am in the making of a scientist researcher.”**

“I enjoy the fact that **I can feel like I am a part of real scientific research.”**

One of our newer curriculum goals:

exposure to collaboration, “big data,” and accessibility of ecological science in the 21st century

1. How do your students view the global community of ecologists/scientists?

2. Do your students understand how ecological data is generated? How do we enable students to find and evaluate quality information? And use it with academic integrity?

3. How do we teach “collaboration” in the digital/online era? How can we leverage student technology preferences?

What we did

- **Discussed plagiarism** while finding & citing literature

- **Collaborated on projects** using Google Suite
  - Google Sheets for data entry
  - Google Slides for posters
  - Google Docs for peer-review of written papers

- Added two discussion boards to emphasize **accessibility** & **collaboration**:

1. **Profile an Ecologist**
   - Used press releases from ecology journals to identify scientists
   - Learned about titles of scientists at various stages of training
   - Identified and shared personal websites, key words, CVs, ResearchGate pages, etc.
   - Social media!

2. **Collaborations and Research Networks**
   - Featuring “big data”: remote-sensing (NEON), global forest censusing (ForestGEO)
     - Excellent YouTube videos that feature diversity and collaboration!
   - Identified and shared data collection procedures
   - Contrasted scales of NEON and ForestGEO with our CURE

Student reflections - **DIVERSITY of ecologists, PATHS**

“This may be silly, but I was actually drawn to your discussion post because one of the mentor's **last names is very similar to mine**.”

“My ecologist also got her PhD from Stanford University; however, **she started in community college…That just shows how education is all the same** and can get you to the same places no matter where the degree is from.”

“I am seeing more ecologists from outside the US than I expected.”

“On Villar's website if you go to the "news" tab there is a link that says "CV and more about me." If you click on that it brings you to the "about me" page which lists his timeline as well as skills.”

Student reflections - **UTILITY & “coolness” of ecology**

“I was drawn to your article title and as I read further into it, I found it quite intriguing. I think **it's amazing how hunting has an effect on forests in a way that we can't see directly,** more so in terms of seed dispersal.”

“I think it's amazing that Dr. Pelletier **brought attention to such a neglected matter** and she took a huge first step in preventing such toxins from being consumed by innocent animals. It seems that she **tends to focus on more population biology.”**

“I read your description, and getting to stay to study for a few years on the Serengeti sounds very fun... **Being able to travel so much to conduct research and connect with other scientists is really cool**, because you never know who you will end up meeting and what you will end up learning.”

Student reflections - **TRUSTWORTHINESS of ecologists**

“From the National Geographic link, I read that he led an expedition in Alaska to rediscover the oldest running plot network. **In my opinion, Dr. Buma seems really devoted in his work. With discussions of Global Warming, I wonder what Dr. Buma's personal thoughts and possible predictions** of ecological changes would be for Alaska, Colorado and other cold climates.”

Student reflections - **DIVERSE research TECHNIQUES**

“On the ForestGEO website, I learned more about their **arthropod monitoring protocols**. The researchers use various methods to collect and study different types of arthropods.

- One way they sample butterflies and termites, for example, is to follow a transect for about 30 minutes. While also observing and collecting butterflies along a **500 m transect**, the researcher also gathers data on **air temperature, relative humidity, wind speed, and the percentage of cloudiness**.
- On the other hand, the soil, the forest floor, and both alive and dead trunks and branches are observed and sampled for termites during termite transects.
- For different arthropods, they will use certain types of **traps or baits** best suited for the types of arthropods desired, some being light traps, winklers, McPhail traps, and bee baits. The various traps and baits are also created to ensure that samples are as undisturbed as possible. For example, light traps protect the collected samples from rain.
- Along with establishing traps, baits, and transects, the researchers also collect information through **DNA barcoding** and on seed predation. To learn about **seed predation**, the researchers will collect and process healthy fruits and seeds from the plants of interest, place them in containers, and monitor them for a total of three months, checking them at least two times a week for any parasites or larvae.”

“ForestGEO had many different techniques and protocols. **Aboveground Biomass Protocols** was the first technique I read about. Biomass is calculated by using data collected on tree diameter, height, and wood density in the area they are studying. With that data, depending on what region they are in, they use different types of **allometric equations** to calculate above-ground biomass.”

THANK YOU - have a nice weekend!

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