**Learn tropical biodiversity through integration of artificial intelligence, data science, leadership roles, google tools and HHMI-Biointeractive tools. Implications for Tropical Medicine.**

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**Abstract**

**Scientific context & literacy, leadership roles, data science, data tools, simulations and artificial intelligence are important skills to be included in the course curriculum. Integrating either individually or in group, these skills can enhance the knowledge, critical thinking and creativity. In this guide, I provide an overview of how above listed skills can be integrated into class activities to help students understand tropical ecology. Through the activities, students develop an understanding that tropical science is an interdisciplinary, transdisciplinary and multidisciplinary field to study tropical biodiversity and its implications in medicine. Using simulations, students use the HHMI Biointeractive to learn about tropical rainforests. By studying the *biodiversity richness*, students can apply these concepts to create conservation programs as well. This lesson highlights the biotic and abiotic nature of tropical sites and provides introduction of key concepts in tropical ecology.**

**Description**

In this lesson students will learn concepts of tropical biology, tropical ecology, tropical ecosystem, biodiversity and implication of tropical sciences in tropical medicine. Additionally, students will attain advanced knowledge and skills to understand, apply, and explore how biotic and abiotic factors influence biodiversity and whilst development of conservation program. Students will learn through lecture slides, videos, and simulations. Students will engage in learning activities to advance knowledge and attain transferable skills. Students will also participate in individual and group work taking up leadership roles, exploring simulations, and applying artificial intelligence tools to learn about tropical biodiversity.

**Tropical forests are exposed to varied climate and temperature, which may impact the biodiversity.**

Rainforest is one of kind of a tropical ecosystem which is home to incredible diversity of species which have evolved in a complex interdependent relationship over millions of years. The ecosystems are rich in flora and fauna which have cultural, economic and ecological significance as the communities depend upon them. The anthropogenic pressure such as deforestation, climate changes and pollution levels have led to decline in biodiversity in many tropical regions. Biodiversity and conservation efforts are required as many species are showing decline, or under threatened or endangered with more prompting towards urgent conservation efforts. This module will engage students in exploration and scientific thinking to understand the tropical biodiversity by integrating HHMI-Biointeractive, HHMI-Data Explorer, google tools, artificial intelligence and data science. The students will be able to understand the tropical ecosystem, create & interpret graphs and analyse how the biodiversity is impacted by biotic and abiotic factors. Further students will be able to create a conservation program to conserve the tropical biodiversity and usefulness towards tropical medicine.

**Learning objectives**

* Describe tropical ecosystem and biodiversity.
* Explain the role of biotic and abiotic factors in tropical biodiversity
* Create and elaborate a programme to conserve to tropical biodiversity.
* Evaluate the implications of tropical biodiversity in tropical medicine.

| **Course Name** | **Biology**  |
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| Grade Level / Student Ages | Undergraduates - Senior / 22 |
| Prior Knowledge | Prior knowledge with AI, Web application and Simulations will be better |
| Learning Goals | Tropical Biology: Biodiversity and Tropical Medicine |
| Materials and Technology | Concept of leadership will be introduced by instructors to students first and then leadership roles will be assigned to each group of students. During the group work, students will also provide feedback to each other as well using Flash Cards. As students are working in groups and taking on different roles, they will be using NCBI Pubmed & Google Scholar to search for articles describing tropical biology, tropical ecology, tropical ecosystem, tropical biodiversity and tropical medicine, then download the articles, take different roles to evaluate the scientific structure of the article. In critiquing the articles, students will apply both IMRAD analysis (Introduction, Method, Results and Discussion) and the CRAP Critical Thinking Tool (Currency, Reliability, Authority, and Purpose) on a selected article. During group work, students will use assign sub-leadership roles and give feedback to each other while completing IMRAD analysis. The groups will create the materials for a presentation of tropical site they have selected to explore and evaluate, organize the materials, prepare the presentation, and finally deliver it during the post-implementation phase. Textbook - Students can also refer to the undergraduate biology textbook - Fundamentals of Biology by Dr Pankaj Mehrotra - [https://tophat.com/catalog/science-&-math/biology/full-course/fundamentals-of-biology/3894/](https://tophat.com/catalog/science-%26-math/biology/full-course/fundamentals-of-biology/3894/)Artificial Intelligence (AI) - AI tools such as Copilot or Gemini will be used and prompts will be shared to obtain initial information and students will then also create prompts. The instructor will have example prompts to use and guide a study plan about gene expression. For example, *How do tropical biodiversity vary in different tropical regions. Are they are regulated by biotic and abiotic factors?*Course and institution policy to guide students on citation etiquette and transparency of AI usage Simulations - HHMI-Biointeractive Biome Viewer and HHMI-Data ViewerHHMI-Biointeractive Biome Viewer - <https://www.biointeractive.org/classroom-resources/biomeviewer>HHMI Biointeractive Data Explorer - <https://www.biointeractive.org/classroom-resources/data-explorer>Google Tools : Students will be using Google doc for collaborative work and also for preparation of presentation. |
| Estimated Time | 1h:30 min for Phase I and II plus additional time for Phase II |

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| **Phase I – Pre-implementation** |   |
| Warm Up |  |
| *Ecology Instructor will* | *Student will* |
| Inquiry Based learning- engage students in stump your partner activity i.e. ask students to think and write a challenging question one with AI and another without AI. | TASK - Students will use the available resources like research articles (available on NCBI PubMed), books, AI, and science communication articles to think and search for a challenging question related to tropical biodiversity. |
| **Exploration** |  |
| *Ecology Instructor will* | *Student will* |
| Instructors will give instructions to students to identify the components and their function of HHMI – Biointeractive Biome Viewer and HHMI-Biointeractive Data Explorer. | Students will explore the click and learn type simulations independently and then in peer groups.  |
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| **Explanation** |  |
| *Ecology Instructor will* | *Student will* |
| Instructor will help familiarize students with new terms by conducting a one-word association and one-sentence summary. For example, in the one word story –instructor will engage the whole class or a group of students and start the process by announcing a term, say, “biotic factors”, then one of the students can add another term, say “abiotic factor”, then next student may add, “ ecosystem” and so on. Next, instructors will select a component of the simulation and ask the student to describe its function. After all students participate in the one word story, each student will use the Google doc to either say or write a one sentence summary of any of the terms. | Students will actively engage with each other in adding words/terms first to one word story and later one sentence summary. |
|  |  |
| **Phase II - Implementation Phase** |  |
| **Elaboration** |  |
| Ecology Instructor will | Student will |
| Instructor will ask students in groups to explore further both the click & learn type HHMI – Biome Viewer and Data Explorer.Instructor will help students review how to identity the tropical biodiversity in their region by creating a table in which they list some national regions. Then they will further classify the regions into sub-regions like east, west, north and south. Students can use AI or google search to classify them into other types of sub-regions as well. Finally, they can use the same table to add some biodiversity richness data.Instructor will then explain how biodiversity is impacted by intrinsic and extrinsic factors. They Then Ask students to use the biome viewer to understand biodiversity richness and factors regulating it. One part of the simulation helps students understand how the abiotic factors fluctuate in a region. The other part of simulation demonstrates how abiotic factors impacts biotic factors and biodiversity richness.Instructor will then guide students to use self-documentation tools to create evidence supporting each member's learning outcomes (see student column for specifics). | Students in the group will open HHMI Click and Learn type HHMI-Biointeractive Biome Viewer - <https://www.biointeractive.org/classroom-resources/biomeviewer>And thenHHMI Biointeractive Data Explorer - <https://www.biointeractive.org/classroom-resources/data-explorer>Students will then list the components of each of above click and learn type simulation for example Biomes tool box on the left hand side of the simulation (Anthromes, temperature , precipitation), below the Biomes tool box – longitudinal region and on the right hand side of the box – search box for location.Students will then get involved in real life discussion of what biodiversity and climatic conditions of their regions they belong to. The students will create a table to list first the regions to list, sort and classify the regions into biodiversity richness index. Each student will create their own table.Students will then use biome viewer and explorer simulation HHMI-Biointeractive - Students will then use click and learn type HHMI animation to explore the biodiversity of a tropical rain forest, collect both biotic & abiotic data, organize the biological data, then do data science of at least two tropical rainforest sites per group. Students in the group will further compare the biological data by constructing graphs, utilizing HHMI-Data Explorer, MS Sheets and Google Sheet, also by taking leadership roles and then give feedback to each other on flash cards.Students will be asked individually to take a screenshot of each of two click and learn type simulations when they play the simulation to show their understanding of tropical biology, tropical ecology, tropical rainforest biodiversity richness, biotic and abiotic factor and then may also be exploring the importance in everyday real-life examples of their regions they belong to i.e. biodiversity examples from their local regions. Students will then annotate the screen shots. |
| **Post - Implementation Phase III** |  |
| **Evaluation** |  |
| *Ecology Instructor will* | *Student will* |
| Instructor will create a gallery walk so that students can submit their individual and group work.Instructor will then organize a mini- colloquium so that each group gets the opportunity to share their learning outcomes. For example if there were four groups then two groups present and two groups move to the group presenting to listen and ask questions. And then they move to the second group. Finally, the two groups which did not present – they get the opportunity to present and each group which presented earlier moves around to each group to ask questions to the presenting group. | Students will then submit their individual and group learning evidence ( screenshots from simulation usage, comparison of biodiversity of two tropical rain forests and IMRAD and CRAP tool analysis) to the instructor for presentation on board or power point slides to be shown on small screen television.Students present evidence of how biodiversity are regulated due to biotic and abiotic factors by presenting their individual research.Each member of the group will present what they have learned.Students will then move to other groups to listen and ask questions. |
| **Extension** |  |
| *Ecology Instructor will* | *Students will* |
| Instructor may give this work in classroom or out of classroom | Students can extend this activity by searching for research articles on NCBI PubMed and then discussing various future research directions related to designing of tropical management program and implication for tropical medicine. Students can explore tropical rainforest that interest them and can research those ecosystem which may be transforming into tropical ecosystem.  |