In this course students will consider the defining principles of ecosystem ecology. Ecosystem ecology is somewhat unique in that it considers the flow of both energy and materials through living (e.g., plants, animals, microbes, humans) and non-living (e.g., lithosphere, hydrosphere, atmosphere) components of environments. As such, the course includes material ranging from biophysical and chemical to biological. Using the framework developed by G. Evelyn Hutchinson in his book, *The Ecological Theater and the Evolutionary Play*, we will begin by examining the “abiotic stage” (e.g., ecosystem water and energy balance, climate, geology and soils) on which the major ecological players perform some truly incredible roles (e.g., primary production, decomposition, nutrient cycling and nutrient use). We will consider a number of fundamental concepts in the field (e.g., succession, disturbance, ecological stoichiometry), then turn our attention to the major element cycles (carbon, nitrogen, phosphorus), what drives them, how element fluxes vary in space and time, and what that means for the planet, and we will consider some strategies for managing and sustaining ecosystems. Along the way, we will use some specific case studies from the primary literature to help synthesize the information we are covering.

The overall goal of this course is help students develop an understanding the relationships between ecosystem structure and the way they function. Through the semester, I hope to weave logical connections between ideas, and to demonstrate how complex processes can be understood from basic principles. Most of the course will be lecture-based, but we will have plenty of group discussion of concepts and primary literature. Everyone will take exams, and homework may be assigned periodically to help reinforce concepts. Participation in class discussions will also be a significant part of the course grade, and will be assessed, in part, via quizzes covering the assigned readings. In addition, students will be responsible for completing a short independent project (ecological synthesis, review, or meta-analysis) that addresses an ecosystems-related question in an ecosystem of interest. Finally, all students will be responsible for preparing and delivering presentations summarizing the information from their independent projects in an *Ecosystem Ecology Symposium* held at the end of the semester.

*Required Textbook:*
Course Schedule (Fall 2022):

<table>
<thead>
<tr>
<th>Class#</th>
<th>Date</th>
<th>Topic</th>
<th>Required Reading</th>
<th>Recommended Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8/31</td>
<td>The State Factor Approach to Ecosystems – Hawaii as a case study</td>
<td></td>
<td>Vitousek et al. (1997)</td>
</tr>
<tr>
<td>3</td>
<td>9/5</td>
<td>Labor Day – No class</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>9/7</td>
<td>The Atmosphere, Climate and Ecosystems, Part 1</td>
<td>Ch 2</td>
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<tr>
<td>5</td>
<td>9/12</td>
<td>Climate &amp; Ecosystems, Part 2</td>
<td>Ch 2</td>
<td></td>
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<tr>
<td>6</td>
<td>9/14</td>
<td>Geology &amp; Soils, Part 1</td>
<td>Ch 3</td>
<td></td>
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<tr>
<td>7</td>
<td>9/19</td>
<td>Geology &amp; Soils, Part 2</td>
<td>Ch 3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>9/21</td>
<td>Energy &amp; Water</td>
<td>Ch 4</td>
<td>Wright et al. (2017)</td>
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<tr>
<td>10</td>
<td>9/28</td>
<td>C Cycle 1 – Photosynthesis &amp; GPP</td>
<td>Ch 5</td>
<td>Chapin et al. (2006)</td>
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<tr>
<td>11</td>
<td>10/3</td>
<td>C Cycle 2 – GPP/NPP</td>
<td>Ch 6</td>
<td>Cleveland et al. (2015)</td>
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<tr>
<td>12</td>
<td>10/5</td>
<td>No Class</td>
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<tr>
<td>13</td>
<td>10/12</td>
<td>C Cycle 3 – NPP &amp; Decomposition</td>
<td>Ch 5/6</td>
<td>Cleveland et al. (2014); Wickings et al. (2012)</td>
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<td>14</td>
<td>10/17</td>
<td>Midterm 1</td>
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<td>16</td>
<td>10/24</td>
<td>Nutrients &amp; Nutrient Acquisition</td>
<td>Ch 8</td>
<td>Lambers et al. (2008)</td>
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<td>17</td>
<td>10/26</td>
<td>Nutrient Use</td>
<td>Ch 8</td>
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<td>18</td>
<td>10/31</td>
<td>Nutrient Cycling - Nitrogen</td>
<td>Ch 9; Galloway et al. (2008)</td>
<td>Laliberte et al. (2012)</td>
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<tr>
<td>19</td>
<td>11/2</td>
<td>Project meetings</td>
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<tr>
<td>20</td>
<td>11/7</td>
<td>Nutrient Cycling</td>
<td>Ch 9</td>
<td>Schindler et al. (2008)</td>
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<td>21</td>
<td>11/9</td>
<td>Trophic Dynamics</td>
<td>Ch 10</td>
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<td>22</td>
<td>11/14</td>
<td>Exam 2</td>
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<tr>
<td>23</td>
<td>11/16</td>
<td>Ecosystem Dynamics &amp; Succession</td>
<td>Ch 12; Odum (1969)</td>
<td>Vitousek &amp; Reiners (1975)</td>
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<td>24</td>
<td>11/21</td>
<td>Species Effects on Ecosystems</td>
<td>Ch 11</td>
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<tr>
<td>Date</td>
<td>Day</td>
<td>Event/Activity</td>
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<tr>
<td>11/23</td>
<td>Travel Day – No Class</td>
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<td>11/28</td>
<td>Ecosystems &amp; Global Change Ch. 14</td>
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<tr>
<td>11/30</td>
<td>Ecosystems Symposium Presentations</td>
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<tr>
<td>12/5</td>
<td>Ecosystems Symposium Presentations</td>
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<tr>
<td>12/7</td>
<td>Ecosystems Symposium Presentations</td>
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</table>

Note: “Ch” refers to chapters in the Chapin et al. textbook. Recommended reading is just that, but I encourage you to read these papers as well, as time allows.

**Course Details, Guidelines, and Policies:**

**Required Assignments and Proportion of Grade**

- Midterm 1: 25%
- Midterm 2: 25%
- Final Project (written): 25%
- Symposium Presentation: 10%
- Participation/Homework: 15%

**Reading Group**

The course includes a required reading group. This additional meeting will allow us to read and discuss some of the most important studies that address the topics we cover in lecture in more detail. Prior to each discussion, students should read the assigned papers carefully and come to class prepared to discuss them. Prior to each session, I will ask for two volunteers to co-lead the discussion, and encourage them to prepare a set of questions or a short assignment to help guide the conversations. Each person can expect to lead two discussions. I have already assembled a list of papers, and PDFs of all reading are available on the course UM Box folder. However, I am open to other suggestions should individual group leads prefer to discuss another paper. The discussion section will count towards your participation grade in the course.

Unless otherwise informed and as conditions allow, we will plan to meet TBD. I would encourage you to bring a laptop/tablet to class, if possible, so that you can all access course materials as needed.

**Students with Disabilities**

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Office for Disability Equity. If you think you have a disability that adversely affects your academic performance, and you have not already registered with Disability Equity, please contact Disability Equity in Aber Hall (1st Floor) or call 406.243.5330. I will work with you and Disability Equity to provide an appropriate modification.

**Academic Honesty**

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. Academic misconduct includes plagiarism. Don’t plagiarize someone else’s work, period.

**Health and Safety**

COVID is still with us, but we are learning to live with it. As such, in most cases, we will meet in person for both lecture and reading group, but will all follow all relevant UM safety protocols.
In the unlikely event that we are forced to temporarily transition to remote instruction, I will provide instructions on how that will unfold. While we are in class, I would encourage everyone to wear masks. Not required, and I may not always wear a mask while lecturing, but I would hope everyone will do their best to ensure the safety of others. If you do not feel well for any reason, please do not come to class. I will upload all my lecture materials to the course UM Box folder, so you should be able to keep up, even if you miss a lecture or two. Please contact DSS for either an accommodation to be completely remote for the semester or for any safety protocol modification you may need (depending on the needs we may or may not be able to accommodate the modification without requesting that you complete the class remotely). If, at any point, students decide not to follow all safety protocols, I will immediately adjust any existing F2F activities and commit to full remote learning for the entire class for the remainder of the semester. More information and updates to UM’s Healthy Fall plan can be found on the UM website.

UM COVID Guidance
The university encourages COVID-19 vaccines and boosters, which are offered for both students and employees at the Health Services Pharmacy inside Curry Health Center.

Masks are only required inside Curry Health Center and in some medical/research laboratories on campus. This requirement will be clearly posted. Required or not, we respect those choosing to wear a mask to reduce the spread of respiratory viruses.

COVID testing for students is available at Curry Health Center. For employees, contact your primary care provider or visit a walk-in clinic. Free at-home tests can be ordered online or there may be tests available through the Health Services Pharmacy, call 243-5171.

Students who test positive need to isolate and not attend in-person classes for at least five days. (Please see link for CDC guidelines referring to isolation).

As with any other illness, please work to accommodate student absences. Consider ways to make course content available in the event of multiple student absences.

Refer to this page for additional resources and guidance on supporting students who miss classes due to illness.

Drop/Add Deadlines
The UM website contains all relevant information on drop/add deadlines. Please read them carefully.
Additional Course Reading (Available on UM Box)


Some other potentially useful references:


<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Required Reading</th>
<th>Discussion Leaders</th>
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<tr>
<td>6</td>
<td>10/3</td>
<td>No Recitation</td>
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<tr>
<td>Week</td>
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<td>Topic</td>
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</table>
https://doi.org/10.1890/08-0127.1 |
| 13   | 11/21  | Thanksgiving Break                   | No Recitation                                                                                                                                |