Welcome to the Honors Natural Science series. The branch of science you will explore the term is biology, and the theme for this term is the History of Science. We will examine the major themes in modern biology and explore their historical origins in order to develop a stronger understanding of the nature of science.

Class expectations

- Students are expected to attend all class meetings and labs. If you miss a class, it is your responsibility to catch up on the material that you missed.
- Students are expected to turn in all assignments on time. Late work will be graded down 1 point per day that it is late.
- Students are expected to contribute positively to class discussions and activities and preserve a safe learning environment. You can disagree without being disagreeable.

Assignments

- **Daily work:** Most class sessions will include a short written assignment that will be turned in. These will be collected as your daily work. Daily assignments cannot be made up. One point is assigned to each daily work assignment, and the percentage of assignments turned in is used as your daily work grade.

- **Reading logs (6 logs at 5 points each):** Each unit has a set of assigned readings from the texts. For each reading set, you will write a summary (1-2 pages) that describes 1) the main points of the readings (1 pt), 2) the most important discoveries made by the people in the readings (1 pt), and 3) a short reflection on the ties between the historical figures and any influence you can see on modern science (3 pts). The log for each unit is due on the last class day of that unit.

- **Term paper (100 points):** For this paper, you will select two figures from different time periods in the history of the life sciences, one of whom clearly influenced the other. Your paper will be a narrative that describes the work of both people and trace the conceptual links between the first person and the second. The paper should be about 5 pages long, with references. The paper is due November 15.

- **Lab reports (9 labs at 10 points each):** For each lab, you will write a short report describing the purpose of the lab, the procedures that you used, results, and conclusions. More details, and any variations from this format, will be given at each lab session. In addition, there will be a set of homework questions for each lab that will be due at the start of the next class session.

- **Exams:** There will be two midterms and a final exam. Each exam will consist of a multiple-choice and short answer section on science concepts, and an essay section on the history of scientific ideas. You will be given the essay topic and scoring rubric before the exam, but you may not use notes or outlines during the exam.

Cheating policy:
During a quiz or exam any written, digital, or spoken interaction with other students will be regarded as cheating. The use of crib notes (i.e., pre-prepared notes), text-messaging during a quiz, use of electronic devices that have not been pre-approved, and looking at other student’s test papers will be regarded as cheating. In the case of cheating, a 0 will be given on the assignment. Further infractions will result in disciplinary action according to WOU policies.

Disabilities statement:
Students who may need accommodations due to documented disabilities, who have medical information which the instructor should know about, or who need special arrangements in an emergency, should speak with the instructor during the first week of class. If you have not accessed services and think you may need them, please contact the Office of Disability Services at 838-8250 or email ods@wou.edu
Grading scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>90% - 100%</td>
</tr>
<tr>
<td>B</td>
<td>80% - 89%</td>
</tr>
<tr>
<td>C</td>
<td>70% - 79%</td>
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<tr>
<td>D</td>
<td>60% - 69%</td>
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<tr>
<td>F</td>
<td>59% and below</td>
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Percent of grade from:

- Daily work = 10%
- Reading logs = 15%
- Term paper = 15%
- Lab grade = 25%
- Midterms = 20%
- Final exam = 15%

Texts

- Association for the Advancement of Science (1990). *Science For All Americans*, online edition http://www.project2061.org/publications/sfaa/online/sfaatoc.htm

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Lab</th>
<th>Readings</th>
<th>Work due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept 24</td>
<td>Nature of Science</td>
<td>Investigating Life</td>
<td>Farber, intro SFAA, Ch 1 Serafini: Ch 2 Ch 4 (Pliny and Galen only) Ch 5 Ch 6 Ch 9, first section (Harvey)</td>
</tr>
<tr>
<td>2</td>
<td>Oct 1</td>
<td>Cells</td>
<td>The evolution of cell theory</td>
<td>Serafini, Chs 11, 13 (up to 133) King, Chs 1, 3 Handout</td>
</tr>
<tr>
<td>3</td>
<td>Oct 8</td>
<td>Diversity of Life I</td>
<td>How do we order nature?</td>
<td>King, Ch 9 Farber, Ch 1 (Linnaeus, Buffon) Serafini, Ch 14 (Linnaeus, Jussieu Cuvier, Buffon, E. Darwin) Handout</td>
</tr>
<tr>
<td>4</td>
<td>Oct 15</td>
<td>Transmission of Traits</td>
<td>Patterns of Inheritance</td>
<td>King, Chs 6, 7 Serafini, Chs 17, 22, 23 Handout</td>
</tr>
<tr>
<td>5</td>
<td>Oct 22</td>
<td>DNA</td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>Oct 29</td>
<td>Diversity of Life II</td>
<td>The record in the rocks</td>
<td>King, Ch 8 Serafini, Chs 15 (Lamarck, Spallanzani), 16 (overview), 18 (Mendel) Farber, Chs 5 (C. Darwin), 8 (Dobzhansky, Mayr) Handout</td>
</tr>
<tr>
<td>7</td>
<td>Nov 5</td>
<td>Population genetics</td>
<td>Cladistics and phylogeny</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nov 12</td>
<td>Ecological theory: where does diversity come from?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nov 19</td>
<td>Ecology</td>
<td>No Lab (Thanksgiving Week)</td>
<td>King, Ch 21 Farber, Chs 7, 9 (E.O. Wilson)</td>
</tr>
<tr>
<td>10</td>
<td>Nov 26</td>
<td></td>
<td>No Lab</td>
<td></td>
</tr>
</tbody>
</table>

Final Exam: 10:00 – 12:00, Thursday, December 7.
Grading Rubrics

Reading Logs (5 points each)
- Summarizes main points of the readings = 1 point
- Lists major discoveries by historical figures in the readings = 1 point
- Reflection on the reading = up to 3 points

The reflection portion should make historical connections between the ideas of the people you read about, and between their ideas and modern science. This is to help you trace the path of the themes we are studying as they developed. This is also a chance to demonstrate your thinking skills. The reflection is graded as follows:

3 points:
- Shows clear understanding of the topics
- Uses several examples from the readings to illustrate the main points
- Asks questions that demonstrate deep thinking
- Makes links between historical figures, and between historical and modern science

2 points:
- Shows good understanding, but minor confusion over some points of the readings.
- Uses at least one example from the readings to illustrate a point.
- Asks at least one question that demonstrates good thinking about the reading.
- Makes at least one link between historical figures or between history and modern science.

1 point:
- Shows incomplete understanding, or confusion over several points in the readings
- Uses no examples or irrelevant examples from the readings when discussing points
- Asks no questions or irrelevant questions regarding the reading
- Makes no links or irrelevant links between historical figures or between history and modern science.

0 points:
- Shows poor understanding of most of the topics of the reading
- Describes the student’s prior ideas about the topic instead of knowledge gained from the content of the readings
- Asks no questions or irrelevant questions regarding the reading
- Makes no links or irrelevant links between historical figures or between history and modern science.

Lab Reports

Each lab report should include the following five elements, 2 points for each section:

1. **Background**: This section is a short review of literature that leads up to the problem of the lab.
2. **Statement of the problem**: There should be a clear understanding of the purpose of the lab, a clear question and (if appropriate to the lab activity) hypothesis and prediction.
3. **Procedures**: This section should summarize what you and your group did to explore the question. It can be a written narrative or a list of steps, whichever seems appropriate. It does not have to list every detail, but there should be a clear reason for each of the procedures.
4. **Data and analysis**: Data should be presented in a format appropriate to the lab and the type of data gathered. Your data may be in the form of tables, graphs, illustrations, etc. If lots of numerical data has been gathered, you may wish to put only summary data in the report. In this section you also describe what the data mean.
5. **Conclusions**: In this section, you use the data that you gathered to reach a conclusion and (we hope) answer your question. If you tested a hypothesis, state whether the hypothesis was supported or refuted by the data. A conclusions section may also suggest future studies that would help illuminate the problem.
Sample lab report
Lab 1: Investigating Life

Background

“What is life?” is still a relevant question in biology today. Astrobiologists who search for life on other planets work to develop a set of characteristics they can use to distinguish living from non-living objects. Microbiologists are still working to understand nanobacteria and decide if they are living or not.

Living organisms on earth are made from the same materials as non-living matter (AAAS, 1990), but known living organisms are distinguished from non-living material by a set of characteristics that are not seen all together in non-living matter (King, 2003). The assumption made in biology textbooks is that if some given population of entities shows the entire set of characteristics, it is most probably alive. One characteristic, that of having cells, seems to belong to living organisms alone, at least on earth. Using the characteristics of living things as criteria, it should be possible to test material to see if it contains living organisms or not.

Statement of the problem

In this lab, we were given three samples of unknown substances. The questions we asked were:
1. do any of the samples contain living organisms?
2. do any of the samples contain a mixture of living organisms and non-living material?

We decided to use a null hypothesis for this study: None of the samples contain living things.

Our prediction was: If none of the samples contain living things, then we should not find enough characteristics of living things to call the material living.

Procedures

We started by developing a list of characteristics of living things that we could test in lab using the materials available. While this list does not contain all characteristics that are usually listed in textbooks, we thought that if we could see at least these characteristics, then it was likely that the sample contained living things, though more study might be needed. Our list included: takes in food, produces waste (such as waste gas), has cells, reproduces, has enzymes (which suggests a metabolism).

Takes in food/produces waste: We tested this by adding small amounts of the samples to water in test tubes and adding a small amount of glucose solution. Most living things on earth use glucose for energy. We observed any changes in the samples, especially any production of gas bubbles suggesting that the glucose was being broken down.

Has a metabolism: If the sample uses glucose and produces waste, that is a sign of a metabolism. As an additional test, we added hydrogen peroxide to a small sample. Hydrogen peroxide is broken down by the enzyme catalase, which is found in many living things on earth. Catalase suggests a living cell with a metabolism. We watched for bubbles of oxygen gas being released.

Has cells: Small amounts of the samples were mixed with water and methylene blue and observed under a microscope to see if any cells were present. Methylene blue is a stain that makes cell parts visible.

Reproduces: A small amount of each sample was added to water in a small beaker and fed a small amount of glucose. Samples were taken several times during the lab to see if cell-like structures were present, and if their number increased.

Data and analysis

The following table summarizes our data:

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed the samples glucose</td>
<td>Sample A showed bubbles after 20 minutes, suggesting food consumption and waste production. The other samples did not.</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>Sample A bubbled, showing the presence of catalase enzyme. The other samples did not.</td>
</tr>
<tr>
<td>Has cells.</td>
<td>Sample A had small, round structures that could be cells. Sample B had sharp granules that did not dissolve in water. Sample C dissolved completely in water.</td>
</tr>
<tr>
<td>Reproduces.</td>
<td>Sample A showed an increase in the number of small, cell-like structures over time, suggesting reproduction. The other samples did not.</td>
</tr>
</tbody>
</table>

Conclusions

The data refute our null hypothesis. Sample A showed positive results in all of our tests for the characteristics of life, suggesting it contains living organisms. The other samples did not. Further tests would be needed to form more definite conclusions, such as growing Sample A on an agar plate as a better test for reproduction, or trying different forms of food on the other samples. We should also develop tests for other characteristics, such as response to the environment.
Throughout this term, you will be learning about how various well-known scientists formulated their discoveries, usually building on the work of people who came before them. For your term paper, you will select two figures from the history of life science: one from the 20th century and one from an earlier century. Your paper should be in the form of a narrative consisting of three parts: 1) A brief biography of the early scientist or naturalist that highlights important discoveries, particularly discoveries that influenced the 20th century biologist, 2) a brief biography of the 20th century scientist that describes that scientists important discoveries that can be traced to influences of the earlier scientist, and 3) a projection into the future, discussing the 20th century scientist’s work and where that person’s field is going. Where might that person’s influence lead? Note: Darwin is too easy! All of 20th century biology has been influenced by Darwin’s Theory of Natural Selection, so please choose someone else as your early scientist or naturalist. Your best plan may be to choose your 20th century scientist first, then read a good biography that will help you find an earlier scientist that your chosen 20th century person looked up to.

Length: 5 pages minimum, 10 maximum, plus a title page, double-spaced, 12 point Times or Times New Roman, 1 inch margins. Also include a list of references cited in your paper (not included in the 5 page count). If there are important references that you consulted but did not cite, you can include them under a separate heading of “Bibliography.”

References: You may use online references if they are good quality and posted by a well-known academic institution or by a scholar who is an expert on one of the people you are interested in (not Wikipedia). You must include at least one academic-quality book and two journal articles, preferably academic journals. Use the journal databases on our library’s web site to search academic journals. If possible, find original published material by either or both of the people you are highlighting (the difficulty of this will depend on who you choose and how long ago they lived).

Due dates:
Proposal and reference list: Thursday, October 11
Your term paper proposal should state which two people you have chosen, summarize the main discoveries that you intend to write about, and describe the links between the two people sufficiently that it is clear why you chose them. List the references that you have located and intend to use, using the format below. 1-2 pages should be sufficient.
Term paper: Thursday, November 15. You may turn in a draft up to one week before if you want feedback.

You must take your paper to the WOU writing center at least once. The writing center can help you with outlining, organizing ideas, checking for style, and other stages. Visit http://www.wou.edu/las/humanities/writingctr/ to learn more about the services that the writing center offers. Include a note with your paper signed by someone at the writing center testifying that you visited the center and documenting the services you received there.

Technical Aspects

To format the paper, use the APA style manual, 5th edition. For information on using APA style, see:
http://apastyle.apa.org/
http://owl.english.purdue.edu/owl/resource/560/01/
http://www.ccc.commnet.edu/apa/

Using and citing sources
Include a reference list at the end of your paper. When you use facts and ideas that come from your references, include the last name of the author and the date of publication in parentheses following the statement. If your fact came from more than one source, separate your citations with semi-colons inside the parentheses. Citations like these help support your ideas.

Example:
Not all scientists were satisfied with Darwinian gradualism, however. Stephen Jay Gould and Niles Eldredge noticed that most fossil sequences showed long periods of little change, interrupted by periods of rapid change. Based on these sequences, they developed the theory of Punctuated Equilibria to explain the patterns they were seeing (Eldredge & Gould, 1972; Gould & Eldredge, 1986).
Your paper must be written in your own words. It is fine to use a quote to illustrate a point, but do not write a paper that is little more than a string of quotes tacked together with a few “as so-and-so said” phrases. Quotes longer than a sentence should be offset as an indented paragraph. Include the page numbers in the citations when quoting.

Examples:

Wrong way (string of unconnected quotes with little of the student’s own writing):

Darwin thought that new species could “arise in only two ways: by the transformation of an entire population from one state to another (phyletic evolution) or by the splitting of a lineage (speciation). The second process must occur; otherwise there could be no increase in the numbers of taxa and life would cease to exist.” (Eldredge & Gould, 1972, p. 87). But as Eldredge and Gould (1972) say, “Thus, the challenge to gene flow that seemed to question the stability of species in time ends by reinforcing that stability even more strongly.” (p. 114) So that means “That local populations do not differentiate into species, even though no external bar prevents it, stands as strong testimony to the inherit stability of species in time.” (Eldredge & Gould, 1972, pp. 114-115)

Right way (student’s own words, supported by a small quote)

Darwin described two ways in which species could arise: an entire population could undergo change, or two different lines could arise out of one population, such as when a population is split. Eventually, the second way leads to two different species. What Gould and Eldredge proposed was that change doesn’t just happen gradually: it happens in response to big changes in the environment, and when it does happen, change is rapid. Unless there are changes in selective pressures, species remain stable. “That local populations do not differentiate into species, even though no external bar prevents it, stands as strong testimony to the inherit stability of species in time.” (Eldredge & Gould, 1972, pp. 114-115)

Longer quote (offset and indented):

Eldredge and Gould noted in their paper that scientists should be cautious about looking back into the evolutionary past. It’s all too easy to form the idea that the change that we see now was both gradual and inevitable:

From this vantage point, it is very difficult to view evolution as anything but an easy and inevitable result of mere existence, as something that unfolds in a natural and orderly fashion. Yet we urge a different view. The norm for a species or, by extension, a community is stability. Speciation is a rare and difficult event that punctuates a system in homeostatic equilibrium. (Eldredge & Gould, 1972, p. 115)

Reference list and Bibliography

Your reference list (required) and bibliography (if you include one) should list the references in alphabetical order by the author’s last name. The reference list should be double-spaced. Use a hanging indent for each entry. Use the following formats (APA style) to format each entry:

**Book:**


**Journal article:**


**Article in a book:**


**Website:**

Term paper grading rubric:

<table>
<thead>
<tr>
<th>You'll be graded on…</th>
<th>I'll be looking for…</th>
<th>Point value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>In an introductory paragraph or two, discuss in general terms the main scientific theme that will tie your chosen two scientists together.</td>
<td>5</td>
</tr>
</tbody>
</table>
| **Summary of early scientist/naturalist** | In this section, you will lay the foundations for your later discussion of your 20th century scientist’s work. Include:  
• Culture in which the scientist lived and issues that arose from that time.  
• Major life events that contributed to this person’s accomplishments.  
• Major accomplishments that were highly influential to science. | 20          |
| **Summary of 20th century scientist/naturalist** | In this section, you will pick up the thread with the 20th century figure, discussing how this person was influenced by the first person. Include the following:  
• Culture in which the scientist lived and issues that arose from that time.  
• How the 20th century person encountered the work of the earlier person and what parts of the early scientist’s work were so influential to the 20th century scientist.  
• Major life events that contributed to this person’s accomplishments.  
• Major accomplishments that influenced modern science. | 20          |
| **Analysis**        | In this section, you will use your two chosen figures of science history to show that science is a people-driven process, and that no scientist works in a vacuum. Include the following:  
• Project into the future. Where is the field of your 20th century scientist going?  
• What specific work has that person carried out (or is carrying out) that will influence the future?  
• Choose two or three of the tenets of the Nature of Science that we discuss in the first week and discuss how your story from the history of science illustrates these aspects of NOS. | 30          |
| **APA Style**       | Use APA style throughout your paper. I will pay particular attention to correct usage of citations and references. | 10          |
| **Basic mechanics: punctuation, grammar, spelling** | Be sure to spell-check. Use standard English grammar and punctuation. | 15          |

Examples of 20th century biologists you could choose from:
- Niles Eldridge (evolutionary biology)
- Rosalind Franklin (genetics)
- Stephen Jay Gould (evolutionary biology)
- Hans Krebs (biochemistry)
- Rachel Carson (ecology)
- Barbara McClintock (genetics)
- Edward O. Wilson (ecology, entomology)
- J.B.S. Haldane (genetics)
- Theodosius Dobzhansky (evolutionary biology)
- George Simpson (evolutionary biology)
- Ernst Mayr (evolutionary biology)
- Jane Goodall (animal behavior, ecology)
- James Watson (genetics)
- Francis Crick (genetics)