

## Biobased Fuels, Energy, and Chemicals

### Schedule:

### Instructors:

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### Course Description:

This course provides an in-depth survey of production of biomass (algae and plants); conversion and use of that biomass to produce fuels, chemicals, and energy; characterization of biofuel properties in engines; and economic and environmental assessment of biobased production processes. The course will consist of lectures, discussions, laboratory demonstrations, active learning activities, and local field trips.

Both the topics and the student population for this course span many disciplines, and thus every student in the course will encounter topics for which they do not have formal educational preparation. The instructors will address this issue by (a) providing lists of recommended background articles and books, (b) having students work in teams with representation from different educational backgrounds, and (c) focusing on topics that integrate concepts rather than those that require specialized knowledge.

### Text and Additional Class Material:

There is no required text. Supplemental reading, including current journal articles, will be provided by the instructors. This reading material can be found under the files tab for the Course in Canvas.

### Course Objective(s):

The objective of this course is to provide students with knowledge of biobased production technologies and issues.

Upon completion of the course, students will

- understand the primary science and engineering aspects of biomass production, biomass conversion to products and energy, and biofuel properties;
- understand the issues involved in environmental and economic assessment of biobased fuel/chemical production; and
- be able to critically evaluate life cycle assessments to assess the boundary conditions and determine the sustainability of biofuels production scenarios.

### Instructional Methodology:

The class will meet as a group three hours per week for a lecture and group discussion. Homework assignments will involve the analysis of journal articles, current events, and the production of educational videos.

### Methods of Evaluation:

Quizzes	20%
Critical review of Journal Articles	20%
Current Events	10%
Other Assignments	10%
Educational Videos (3)	40%

### Quizzes

Each week a background reading quiz will be posted on canvas. This quiz must be completed by the start of class. Additional quizzes related to other content may be posted. The lowest two quiz grades will be dropped.

### Critical Review of Journal Articles

We will assign regular reading assignments of current research articles that will be first discussed in class to improve overall understanding in class. Following class discussions, you will write a 1 to 2 page critique of the

article following the guidelines provided to you with the assignment.

**Current Events**

The purpose of these assignments is to encourage you to think about the course content outside of class and to encourage you to be aware of the rapid advancement of research and technology of the topics covered in this course.

**Educational Videos**

One of the best ways to learn a topic is to teach it. For these assignments, each group will prepare a video explaining a topic in the biobased production of fuels, energy or chemicals to a lay audience. A total of 3 videos will be produced throughout the course of the semester.

**Example Course Topics/Weekly Schedule (Subject to change):**

<b>Week</b>	<b>Date</b>	<b>Content</b>	<b>Leader</b>
1		Introduction Field Trip: Seed lab/Greenhouse	Jahn Jahn
2		Plants, photosynthesis, and critical considerations Field Trip: ARDEC	Jahn Jahn
3		Bioenergy Crops	Jahn
4		Algae and cyanobacteria	Peebles
5		Thermochemical Conversion	Peebles
6		Chemical Conversion Front Range Bioenergy	Peebles Jahn
7		Biomass Deconstruction	Peebles
8		Fermentation	Peebles
9		Genetic Engineering, Metabolic Engineering, Synthetic Biology	Peebles
10		Energy Ethics	Jahn
11		Fuel Properties/ Engines Field Trip: Engines lab Tour	Marchese Marchese
12		Sustainability Life Cycle Assessment	Miller Sheehan
13		Bioproducts	Peebles
		Thanksgiving break Thanksgiving break	
14		Energy and Process Economics	Jahn
15		Energy Policy	Jahn

**Critical Review of Journal Articles - Assignment Guidelines**

For each assigned article, you should include the following in your write-up (about 2 pages, single spaced, 12 pt font, 1 inch margins).

You may use ideas that came from class discussions.

- (a) What was the goal of the study (briefly and in your own words)?
- (b) Briefly summarize the main findings, conclusions, and significance of this paper.
- (c) Discuss some criticisms you have of the article (positive and negative points). You must provide at least 3 substantial critique points. They should be mainly focused on the science.

In these entries, you are expected to use:

- Complete sentences, even if you use bulleted lists to organize your points in each section
- Good grammar and spelling (remember that word processing programs have spell checkers)
- Organization
- Your own words: do not copy sentences (complete or nearly so) from the paper

**Grading Rubric**

category	description	points available
paper summary	Explanation of the goal of the study, brief summary of the main findings and methods	4
conclusions and significance	summarize conclusions and significance of this work	2
critique	At least 3 substantial critique points, positive and/or negative.	3
writing quality		1

## Biobased Fuels, Energy, and Chemicals Current Events

The intent with this part of your grade is not for busy work, but to get you thinking about the course content outside of class.

Biobased fuels, energy, and chemicals current events assignment (100 total points, with two turn in dates) will be graded based on some combination of projects listed below. You are allowed and encouraged to work together but you must write up and turn in your reviews and critiques separately (Identical reviews will receive no credit).

Projects must be turned in through SafeAssign (on the canvas homepage). This must be done by the final due date or you will receive a zero for your projects. You must upload in one file; the program will not accept multiple files. Please talk to me if you have questions. The document must be 12-point font, have 1 inch margins and can be double spaced.

Each project folder should include the following:

1. Title page (don't forget your name!)
2. Table of contents-individual projects listed in order and the number of points you should receive for full credit
3. Individual projects
4. Reference page (for any sources you use)

The hard copy of the Projects should be in a single folder, binder or stapled together. And will be graded on the content of each project, grammar and spelling, and fulfillment of project directions. The projects must be written in full sentences. No bullet points please.

Project list options:

- A. Movie/book/television reviews:** (30 pt, up to 2 entries of this type). One-page write up that contains a short plot summary of the movie (4-5 sentences) and description of the main characters and their motivations. And addresses several of these questions: Do you feel the movie/book/television show was accurate (Why)? What would have made it better and what would you have changed (and why)? What did you like or not like (and why)? From which perspective was the movie/book/TV show trying to convey or sway the viewer?
- B. Popular news:** (10 pt, up to 4 entries of this type) Entries should be from various topics covered in class. For example, you could have 4 entries (one on policy, two on feedstocks, on one new engineering technology). These should be a half of a page and contain the "who, what, where, when and why".

- C. Seminars and talks on campus or in Colorado:** (15 pt, up to 3 entries of this type). I will announce seminars in class as I hear of them. You are also welcome to suggest seminars to the class. These should be full page summaries and also include the “who, what, where, when and why”. There should be a statement of why this seminar is course related. They can also include what you didn’t understand and anything you did not agree with and why.
- D. Creative works:** including poetry (short poem 0.25 of a page (3 pt), half page (7 pt), full page 15 points, 20 points possible), comics (20 pt, 2 entries possible), artwork with creative description (20 pt, one entry possible), short movies (40 pt, one entry possible). For artwork and movies prior approval should be sought.
- E. Website review:** (10 pt, 2 possible entries) These half page entries should contain the weblink, describe the website, the target audience, describe if there an agenda, describe what is good/bad (and why), what you would add/remove/or change. If more than one entry, these need to be from different websites.
- F. Your ideas!:** Your chance to be creative. Depending on what you are proposing, it may be up to full 100 points. These projects must be cleared with me in advance with a mutual understanding of how many points are possible.

## Educational Video Assignments

One of the best ways to learn a topic is to teach it. For these assignments, each group will prepare a video explaining a topic in the biobased production of fuels, energy or chemicals to a lay audience. A total of 3 videos will be produced throughout the course of the semester. If the video is well produced, it may be used for future outreach activities with your permission.

**Audience:** Pick one of the following audiences ...

3-5<sup>th</sup> grade students

6-8<sup>th</sup> grade students

9-12<sup>th</sup> grade students

Educated adult (non-expert in field)

**Maximum Length:** 5 minutes

**Topic:** Pick any topic related to material covered in ...

**Video 1:** Week 2 thru 4 –

**Video 2:** Week 5 thru 9 –

**Video 3:** Week 10 thru 15 –

**Format:** You choose the format that best serves your purpose. Here are a few example videos to give you inspiration.

Khan Academy: <https://www.khanacademy.org/science/biology/photosynthesis-in-plants/the-light-dependent-reactions-of-photosynthesis/v/conceptual-overview-of-light-dependent-reactions>

Prezi: <https://prezi.com/bbopmajuswpi/the-biofuels-story/>

You Tube: <https://www.youtube.com/channel/UCiFXuor4e2agZo5aApgVpTQ>

**Resources:** Feel free to use your own resources. The library has a variety of useful resources that you can use.

Video Camera: <http://lib.colostate.edu/services/computers/videocamera>

Video Production: <http://lib.colostate.edu/services/computers/video-studio>

Wacom Intuos Tablets: <http://lib.colostate.edu/services/computers/wacomtablet>

**Extra Credit:** 10 pts extra credit will be given if you create a learning activity to reinforce your video content for the target audience [see this website for some ideas:

<https://www.glbrc.org/education>

## Grading Rubric

Category	Unacceptable (0 pts)	Significantly Below Expectations (0-4 pts)	Below Expectations (6 pts)	Meet Expectations (8 pts)	Outstanding (10 pts)	Weight	Score
<b>Quality and Accuracy of Content</b> (Focuses on 1 topic area which is clearly defined)	Too many content errors to count	Multiple major errors in content	Many minor errors or one major error in content	A few minor errors in regards to the content	Excellent content with no errors	5x	
<b>Accessible to target audience</b> (i.e. used terminology audience can understand, engaging, etc.)	Totally inaccessible to target audience		A presentation that is either does not engage the audience or is too technically advanced for target audience		An engaging presentation that is easy to understand by target audience	2x	
<b>Creativity</b> (visually and audibly appealing to watch, unique way to present material, etc.)	Not creative at all		A solid presentation that is not particularly visually or audibly appealing or is presented in a way that is very common.		A beautiful presentation that is presented in a creative way.	2x	
<b>Production</b> (meets time limit, quality of video, appropriate title, references and credits)	Poorly produced, over time or way under time, many video editing errors, no title, references, and credits		Multiple minor flaws or one major flaw in production.		A high quality video that paid attention to details.	1x	