Overview of the Unit

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Welcome to Unit 2 of the English courses! In this unit, you will investigate practical advances in Nanotechnology that help slow down climate change. An example of this is turning light into heat. You will also learn how the scientific community works together to create new discoveries through expert interviews and readings. Lastly, you will develop your own research skills by learning how to choose good sources and cite them in your research.

Learning Objectives

By the end of this unit, you will:

- Demonstrate understanding of potential uses of Nanotechnology
- Choose good sources for research
- Understand importance of citing sources in own research
- Use future possibility and probability modals
- Read, watch, and listen to a variety of texts and multimedia sources.
- Demonstrate your understanding of these texts and key course ideas through comprehension check quizzes, a discussion board and a peer-reviewed assignment.

PART II: Creating a Scientific Community

COURSE 05

How do Scientists Share Discoveries?

Hello, in unit one we discussed how important it is for scientist to share their work. It allows other scientists to test their findings, which helps to prove or disapprove the results. It also helps to build a larger number of resources that scientists can use for their own research.

In this COURSE, we will learn about some of the ways scientists share their findings through publications, public speaking and then news media. For scientist publishing findings is the most important way to share your work. **To publish means to have something you wrote printed in a scientific journal or a book.**

Most academic journals **are peer reviewed** which means that the **research is checked by a group of scientists to make sure that the evidence supports the findings**. For many scientists their careers depend on how many articles they have published and what types of journals their work is included in. So the scientist who publishes a new discovery in an important journal benefits personally and the whole scientific community benefits as well. That is because the academic journals describe what ***the experiment was, exactly how it was done and what the results were.***

Written text in journals or books are the foundation of scientific knowledge. Scientist also share their research at **conferences** and other public speaking events, they might give a presentation on an article that they just published. Or they might sit on **a panel discussion**, **which is a group of people who take part in a discussion for an audience**. Speaking at in an important conference, is also a way to build your reputation, but even more importantly it's an opportunity for many scientists to meet in one place and discuss their work.

At conferences scientists can share their ideas and form future partnerships. Scientists also show their work with the general public so people in the community can understand the science behind important issues like for example, climate change. There are numerous science magazines and websites that write news, opinions and reports about scientific research for a general audience. The writers are not usually the scientists, themselves but they understand the science well and are skilled at writing in a simpler way, so non-scientists can understand it. With the increase of online news sites and 24 hour news on television there is also been an increase in scientific stories being shared outside the scientific community.

For scientists this is an opportunity to get the general public aware of and interested in their work. And it can be a boost to a scientist's career if they become well-known to the public as an expert in their field.

There are some who have concerns about how science is portrayed in newspapers and television though. There are some fears that news organizations don't do enough to distinguish between good research, based on good reasoning, information or judgement and poor research. There is also a concern that news stories sometimes gives only the basic facts of the story and they simplify scientific ideas so much that readers might be misinformed. This often happens with news about health.

Let's say you read a new story about a new medicine that lower's the risk of heart disease by 50%. That number 50% could have many very different meanings in scientific research but news stories often don't tell you exactly what it means. If you don't really know what it means you might get the wrong idea about the research. So while it is helpful to learn about recent science news in the media you need to decide for yourself if the article seems **credible** that ***means able to be believed or trusted.***

In this COURSE we learned about some of the ways scientists share their findings through publications, public speaking, and the news media. In the next COURSE, we will talk about how to choose good sources and the importance of citing them.

COURSE 06

Choosing Good Sources and the Importance of Citing Them

Hello, in the last COURSE, we learned how scientists share their discoveries. One of the most important ways we discussed sharing discoveries was by publishing their work. In assessment two of this unit, you will answer a question and cite the sources that help you answer it.

In this COURSE, we will learn how to choose good sources by examining the reputation of the source, both the publication and the author. **Whether it is a primary source or a secondary source, the date of the publication, and the reference list**.

When you are gathering information for an experiment, research paper, or any kind of writing about Science, you want to make sure that the sources, where you get your information are **reputable**. That means **they're respected and trusted by most people**.

In general, academic text, which are peer reviewed by other scientists, are the most reputable. They're considered to be the most accurate and have the least bias. If you're sources are not reputable, your readers may not trust your work. But what's worse is the information that you are getting from the source may not be complete or correct. So some of the most important questions to ask yourself are, *who is the author? Is this person an expert in the field? You also want to ask yourself if this is a primary source or a secondary source.*

If it is a primary source, it is the original work. It is written by the scientist who did the research or by the person who had the original idea.

If it is a secondary source, someone who read the original article or book wrote it. Generally speaking, it is always better to use the original source if possible. There's always a chance that someone who wrote the secondary source didn't understand the information correctly, or may not have included all of the important details.

Now, in Assessment 2, you may choose to use sources from news media to answer our question. News stories about scientific research are, of course, secondary sources. But a good news story will make it possible for you to find the primary source. Look for links to primary sources, and the names of the scientists, and ask yourself if the primary sources are reputable. It is also important that you look at the date the article or book was written. While there are many important research articles that were written a long time ago and are still important today.

In general, you want to try to read the most up-to-date information you can for your research. For general articles, that means to make sure they are looking at the most recent articles about the topic.

For books, you also want to make sure you're reading the most recent editions of the books. When you are deciding whether to use a journal article or book in your research, you should look at its references **which are the books or articles mentioned in a text.** Then, ask the same questions we just discussed. **What kinds of sources did the author choose? Were they from reputable journals? Were they written in the last 5 years or are they more than 10 to 20 years old?**

In this COURSE, we learned how to choose good sources. By examining the reputation of the source, both the publication and the author, whether it is a primary source or a secondary source, the date of the publication, and the references. This will be helpful for assessment, too, of this unit. Because you'll be asked to cite the sources that you will use to come up with your answer. In the next COURSE, you will learn how to cite your sources.

COURSE 07

Language Focus: Citing your Sources

Hello, in the last COURSE we learned about choosing good sources. In this language focused COURSE, we will discuss when we should cite a source, and how to make an in-text citation. This will help you with assessment two of this unit.

You will be describing how the scientific community might work together to reduce the causes and, or impacts of climate change. You will be using your own research and sources to support your claim, and will need to cite them within your text. You'll need to use what you learn in this COURSE to decide which sources to cite and how to cite them.

Citations are an important part of any academic paper. They serve two main purposes. ***One, to give credit or recognition to the author who originally published the information or idea. And, two, to give your readers a guide as to where that information can be found.*** So, when should you cite a source?

As a general rule, you should cite a source any time the information in your paper is something you did not know before you started reading about the topic. This includes quoting, paraphrasing, summarizing or referring to something from another source or text. ***Sources can include books, newspaper articles, magazine articles, academic articles, blogs, websites, interviews, films, music, etc.***

To cite something in your paper, you need to include two things, **an in-text citation and more details about the source in a list of references**. In this COURSE, we are going to focus on how to include in-text citations in your writing.

An in-text citation is exactly what it sounds like**. It is a citation you include in the text of your paper**. Different academic journals have different rules for citations, but they often include two things. First, **the author's last name, and second, the date the source was published**. It looks something like this.

Let's look at a specific example together. Let's imagine you are writing a paper about ways to rid the environment of carbon dioxide, and want to use the following quote from the article we read earlier, entitled, "Can the Earth be saved by turning CO_2 to stone?" written by Lea Terhune. The quote you want to use states the following. ***CO_2 can be captured anywhere, because it's in the air in similar concentrations worldwide. If captured near volcanic rock and water, the CO_2 could be injected and mineralized on the spot- cost-effectively***. To cite this source in your text, you would include the author's last name and the year the article was published, in parentheses, at the end of the quote. It would look like this. Notice how the period goes outside of the parentheses. If you wanted to take this same example, but include a paraphrase of the idea rather than a direct quote in your paper, it would look something like this. CO_2 is in the air everywhere. **CO_2 can be removed from the air cheaply when it is located near volcanic rock and water. This is possible because CO_2 can be injected into rock formations close by and mineralized immediately**. Notice how the citation comes at the end of the sentence and the period comes after it.

Remember that the references at the end of a paper include the full detail of the source so readers know exactly where they can find the full text. Here's an example of how a reference list might look. Usually, sources in a reference list show the author's last name, just like in your in text citation.

For assessment two, the reference list will be optional. You will only have to cite your sources in the text of your response. And you can choose to create a reference list if you want. In this COURSE, we learned when we should cite a source, and how to make an in-text citation. Next, you will play a game to apply what you've learned about citing sources, and then apply what you've learned in assessment two.

1.Question 1 Read each statement about citing sources and choose whether it is true or false

1. The *only* **purpose of citing a source is to give credit to the author who originally published the information or idea.**

○ true

◉ false

2.Question 2, As a general rule, you should cite a source any time the information in your paper is something that you did not know before you started researching or writing about the topic.

◉ true

○ false

3.Question 3An in-text citation usually includes the name of the journal where you found the information.

○ true

◉ false

4.Question 4 You should not cite a source if you paraphrase the writer's words.

○ true

◉ false

5.Question 5 The period goes outside of the parenthesis when using an in-text citation like this: (Lee 32).

○ true

◉ false

Assessment 2: Peer Review: Reducing the Impacts of Climate Change

Describe how the scientific community might work together to reduce the causes and/or impacts of climate change. Use your own research or any of the articles from the course to support your prediction and cite your source(s).

Grading Criteria Overview

Detailed Instructions

1. Describe how the scientific community might work together to reduce the causes and/or impacts of climate change.

2. Cite at least one source that helped you come up with your idea. OPTIONAL: If you want, you can also choose to include a reference list. Follow the example given below.

3. Make sure to use future probability modals in your example.

4. Use language that you have learned in this Unit.

Model response

The scientific community in the United States **will** work together to design energy systems that use renewable energy sources that are cleaner than fossil fuels. If they are successful, they **should** be able to reduce some of the greenhouse gases in the atmosphere and slow down climate change. Already, researchers at U.S. universities are working on nanotechnologies that **might** someday make energy generation and storage more efficient. For example, at the University of Wisconsin-Madison's Wisconsin Energy Institute, scientists in materials engineering and chemistry are working on the technology for electricity-generating floors and solar-powered batteries (Content, 2016). Researchers at Stanford University are using powerful microscopes to study nanostructures that **should** make batteries more efficient and longer-lasting (Kubota, 2017). If research like this leads to practical new devices, we **will not** need to use as much fossil fuel in the future.

References

T. Content, "Madison’s labs of promise seek renewable energy," in Milwaukee Journal Sentinel, 2016.

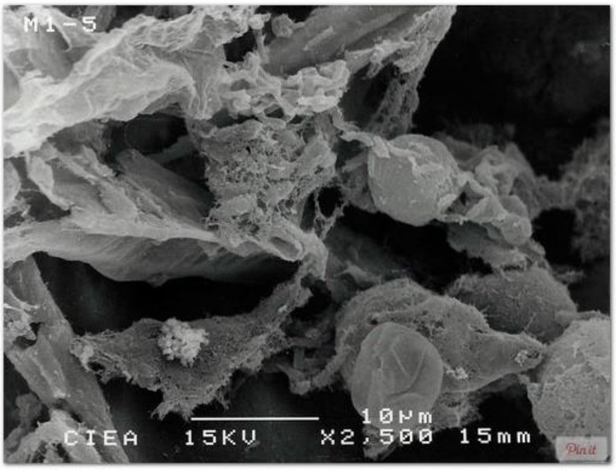
T. Kubota, "Nanoscale view of energy storage," in Stanford News, Stanford University Communications, 2017. [Online]. Available: http://news.stanford.edu/2017/01/16/nanoscale-view-energy-storage/. Accessed: Jan. 20, 2017.

READING 01

Biofilter Made from Peanut Shell Degrades Air Pollutants

In order to clean the air of pollutants such as methanol and solvents used in the industry, biotechnology expert Raul Pineda Olmedo, of the National University of Mexico (UNAM), designed a biofilter that uses microorganisms living in the shell of the peanut.

The research from the department of Environmental Technology noted that microorganisms grow naturally on peanut shell, which can be used to clean the air. Furthermore, in Mexico this material is generated in large amounts and is considered a worthless agricultural residue.



Microphotography of a peanut shell.

The idea is a prototype filter with peanut shells, which cultivates the microorganisms to degrade toxic pollutants into carbon dioxide and water, thereby achieving clean air.

"The peanut shell is special for these applications because it is naturally hollow and has an area of contact with air, which favors the development of microorganisms," said Pineda Olmedo.

He also said it has been observed that this organic material can be applied to biotechnology as biological filters similar to those used by cars, but instead of stopping dust it can degrade the contaminants.

Olmedo Pineda development focuses on solving the problem of air pollution in companies dedicated to handling inks or solvents, which have a contaminated workplace.

The experiment was developed in collaboration with doctors Frédéric Thalasso Sire and Fermin Perez Guevara from the Research Center of Advanced Studies (CINVESTAV) in Mexico.

The prototype is similar to a bell or kitchen extractor, but it not only absorbs and stores polluting vapors, it degrades and purifies the air.

The design consists of a filter made with peanut shells containing microorganisms, which purify the air. For optimum development it should be in a temperature controlled environment.

Olmedo Pineda explained that the filter takes on average 28 days to synthesize microorganisms such as Fusarium and Brevibacterium. Bacteria and fungi take the carbon from pollution to reproduce and breathe.

In Mexico this technology has not been exploited extensively. The researcher currently seeks to commercialize the innovation, which is a solution applicable to everyday life. They will create a demonstration prototype for schools, making it accessible to students, who can apply and replicate it.

Nanowerk News. (2016, January 8). Biofilter made from peanut shells degrades air pollutants. Retrieved from http://www.nanowerk.com/news2/green/newsid=42272.php

1.Question 1: Which of these live inside peanut shells and help to degrade air pollutants?

- ( ) Peanuts
- (•) Microorganisms
- ( ) Peanut shells
- ( ) Molecules

2.Question 2 How is this peanut shell prototype similar to a bell or kitchen extractor?

- ( ) Both cost the same amount of money.
- ( ) Both were designed by Raul Pineda Olmedo.
- ( ) Both use microorganisms to clean the air.
- (•) Both absorb and store polluting vapors.

3.Question 3 Where should peanut shell filters be stored for optimum development?

- (•) A temperature controlled environment
- ( ) An environment with freezing temperatures
- ( ) An environment with boiling temperatures
- ( ) An environment with changing or fluctuating temperatures

4.Question 4How do the microorganisms clean the air?

- ( ) They eat the carbon from pollution as a food.
- ( ) They store the carbon from pollution in the peanut shell.
- (•) They take the carbon from pollution to reproduce and breathe.
- ( ) None of the above

1.Question 1 Choose the word that best matches the definition.

1. Very small; one billionth the size of something

- ○ technology
- ○ prefix
- ● nano

2. Question 2 The science of working with atoms and molecules at the nanoscale to build devices that are extremely small

- ○ engineering
- ● nanotechnology
- ○ environmental science

3.Question 3 A unit of measurement that is one billionth of a meter

- ○ nanosecond
- ● nanometer
- ○ nanotechnology

4.Question 4 The scale in which nanometers are measured.

- ○ technology scale
- ○ meter scale
- ● nanoscale

READING 02

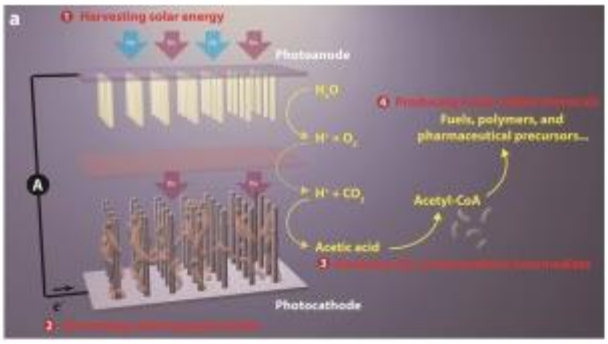
Major Advance in Artificial Photosynthesis Poses Win/Win for the Environment

A major advance in artificial photosynthesis poses win/win for the environment – using sequestered CO2 for green chemistry, including renewable fuel production. (Photo by Caitlin Givens)

A potentially game-changing breakthrough in artificial photosynthesis has been achieved with the development of a system that can capture carbon dioxide emissions before they are vented into the atmosphere and then, powered by solar energy, convert that carbon dioxide into valuable chemical products, including biodegradable plastics, pharmaceutical drugs and even liquid fuels.

Scientists with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) and the University of California (UC) Berkeley have created a hybrid system of semiconducting nanowires and bacteria that mimics the natural photosynthetic process by which plants use the energy in sunlight to synthesize carbohydrates from carbon dioxide and water. However, this new artificial photosynthetic system synthesizes the combination of carbon dioxide and water into acetate, the most common building block today for biosynthesis.

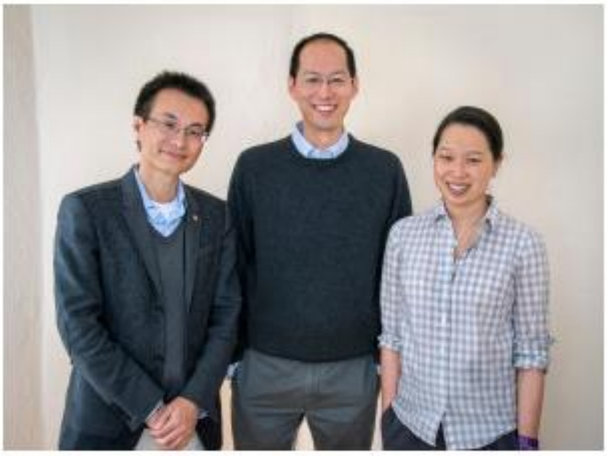
“We believe our system is a revolutionary leap forward in the field of artificial photosynthesis,” says Peidong Yang, a chemist with Berkeley Lab's Materials Sciences Division and one of the leaders of this study. “Our system has the potential to fundamentally change the chemical and oil industry in that we can produce chemicals and fuels in a totally renewable way, rather than extracting them from deep below the ground.”



This break-through artificial photosynthesis system has four general components: (1) harvesting solar energy, (2) generating reducing equivalents, (3) reducing CO2 to biosynthetic intermediates, and (4) producing value-added chemicals.

Yang, who also holds appointments with UC Berkeley and the Kavli Energy NanoSciences Institute (Kavli-ENSI) at Berkeley, is one of three corresponding authors of a paper describing this research in the journal *Nano Letters*.The paper is titled "Nanowire-bacteria hybrids for unassisted solar carbon dioxide fixation to value-added chemicals." The other corresponding authors and leaders of this research are chemists Christopher Chang and Michelle Chang. Both also hold joint appointments with Berkeley Lab and UC Berkeley. In addition, Chris Chang is a Howard Hughes Medical Institute (HHMI) investigator. (See below for a full list of the paper's authors.)

The more carbon dioxide that is released into the atmosphere the warmer the atmosphere becomes. Atmospheric carbon dioxide is now at its highest level in at least three million years, primarily as a result of the burning of fossil fuels. Yet fossil fuels, especially coal, will remain a significant source of energy to meet human needs for the foreseeable future. Technologies for sequestering carbon before it escapes into the atmosphere are being pursued but all require the captured carbon to be stored, a requirement that comes with its own environmental challenges.



(From left) Peidong Yang, Christopher Chang and Michelle Chang led the development of an artificial photosynthesis system that can convert CO2 into valuable chemical products using only water and sunlight. (Photo by Roy Kaltschmidt)

The artificial photosynthetic technique developed by the Berkeley researchers solves the storage problem by putting the captured carbon dioxide to good use.

“In natural photosynthesis, leaves harvest solar energy and carbon dioxide is reduced and combined with water for the synthesis of molecular products that form biomass,” says Chris Chang, an expert in catalysts for carbon-neutral energy conversions. “In our system, nanowires harvest solar energy and deliver electrons to bacteria, where carbon dioxide is reduced and combined with water for the synthesis of a variety of targeted, value-added chemical products.”

By combining biocompatible light-capturing nanowire arrays with select bacterial populations, the new artificial photosynthesis system offers a win/win situation for the environment: solar-powered green chemistry using sequestered carbon dioxide.

“Our system represents an emerging alliance between the fields of materials sciences and biology, where opportunities to make new functional devices can mix and match components of each discipline,” says Michelle Chang, an expert in biosynthesis. “For example, the morphology of the nanowire array protects the bacteria like Easter eggs buried in tall grass so that these usually-oxygen sensitive organisms can survive in environmental carbon-dioxide sources such as flue gases.”

The system starts with an “artificial forest” of nanowire heterostructures, consisting of silicon and titanium oxide nanowires, developed earlier by Yang and his research group.

“Our artificial forest is similar to the chloroplasts in green plants,” Yang says. “When sunlight is absorbed, photo-excited electron−hole pairs are generated in the silicon and titanium oxide nanowires, which absorb different regions of the solar spectrum. The photo-generated electrons in the silicon will be passed onto bacteria for the CO2 reduction while the photo-generated holes in the titanium oxide split water molecules to make oxygen."

Cross-sectional SEM image of the nanowire/bacteria hybrid array used in a revolutionary new artificial photosynthesis system.

Once the forest of nanowire arrays is established, it is populated with microbial populations that produce enzymes known to selectively catalyze the reduction of carbon dioxide. For this study, the Berkeley team used *Sporomusa ovata*, an anaerobic bacterium that readily accepts electrons directly from the surrounding environment and uses them to reduce carbon dioxide.

"*S. ovata* is a great carbon dioxide catalyst as it makes acetate, a versatile chemical intermediate that can be used to manufacture a diverse array of useful chemicals," says Michelle Chang. "We were able to uniformly populate our nanowire array with *S. ovata* using buffered brackish water with trace vitamins as the only organic component."

Once the carbon dioxide has been reduced by *S. ovata* to acetate (or some other biosynthetic intermediate), genetically engineered *E.coli are* used to synthesize targeted chemical products. To improve the yields of targeted chemical products, the *S. ovata* and *E.coli* were kept separate for this study. In the future, these two activities – catalyzing and synthesizing – could be combined into a single step process.

A key to the success of their artificial photosynthesis system is the separation of the demanding requirements for light-capture efficiency and catalytic activity that is made possible by the nanowire/bacteria hybrid technology. With this approach, the Berkeley team achieved a solar energy conversion efficiency of up to 0.38-percent for about 200 hours under simulated sunlight, which is about the same as that of a leaf.

The yields of target chemical molecules produced from the acetate were also encouraging – as high as 26-percent for butanol, a fuel comparable to gasoline, 25-percent for amorphadiene, a precursor to the antimaleria drug artemisinin, and 52-percent for the renewable and biodegradable plastic PHB. Improved performances are anticipated with further refinements of the technology.

"We are currently working on our second generation system which has a solar-to-chemical conversion efficiency of three-percent," Yang says. "Once we can reach a conversion efficiency of 10-percent in a cost effective manner, the technology should be commercially viable."

In addition to the corresponding authors, other co-authors of the *Nano Letters* paper describing this research were Chong Liu, Joseph Gallagher, Kelsey Sakimoto and Eva Nichols.

This research was primarily funded by the DOE Office of Science.

Nanowerk News. (2015, August 7). Major Advance in Artificial Photosynthesis Poses Win/Win for the Environment. Retrieved from http://newscenter.lbl.gov/2015/04/16/major-advance-in-artificial-photosynthesis/

1.Question 1 Comprehension Check Instructions:
What is the main idea of this reading?

- Using sunlight to extract oil and gas from the ground for energy
- Using sunlight to trap carbon dioxide emissions and create useful products
- Using sunlight to desalinate seawater to create freshwater and minerals

2.Question 2 **How are the researchers using nanotechnology in this process?**

- they have created nano-cells that magnify the power of the sun
- They have created an artificial forest of nanowires
- They have created a greenhouse composed of reflective nanomaterial

3.Question 3 What does the number 200 refer to in the article?

- The number of years that global carbon levels have been rising
- The number of researchers who were involved in the project
- The number of hours of sunlight that the artificial material was exposed to

4.Question 4In the researchers' technique, what happens to the carbon dioxide after it is captured?

- it is heated and separated into its component molecules
- it is expanded and absorbed by natural plants
- it is reduced and combined with water