# Says Who?

***Deciphering a Scientific Article***

**Authors:** Hamutahl Cohen, Ph.D student, UC Santa Cruz, Santa Cruz, CA

Dan Johnston, Science Teacher, Watsonville High School, Watsonville, CA

**Field tested:** AP Biology, Watsonville High School, Watsonville, CA. (Fall 2014)

**Module Type:** Class Activity

**Duration:** 2-hr class session

**Key materials:**

* Pad of poster paper
* Pens and Colored Markers
* Highlighters
* Activity Handouts (included)
* Activity Articles (included)
* Activity PowerPoint (included)

**Concepts:** Research Sources, Literature Review, Environmental Writing, Library Services, Primary Research Literature

**Skills:** Students will know why we read scientific articles, how to read scientific literature, what are the component parts of a scientific paper, and how to give credit by citing researchers in APA style.

**Standards:**

**NGSS DCI:** LS2.A: Interdependent Relationships in Ecosystems, ESS3C: Human Impacts on Earth Systems

**NGSS Practices:** 8. Obtaining, evaluating, and communicating information

**NGSS CCC:** 2. Cause and effect: Mechanism and explanation

# Overview:

This project is an opportunity for students to learn:

* How to use scientific articles to answer a scientific question
* How to read a scientific paper
* How a scientific article is organized into an abstract, introduction, methods, results, etc.
* How to use the OWL Purdue style reference guide to cite information in APA format

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# Background for Teachers

**Why this matters:**

This module teaches students how to understand primary research literature (i.e. a scientific research article). This skill is important in order to understand how science works and how scientists communicate their work. This type of research is thus very helpful as preparation for college-level work. Additionally, this module is unique in that it can be modified to fit different classroom needs. The research question that students use can be adjusted to meet specific standards for classroom concepts.

**Assumed background:**

Students need to have a prior knowledge of how to use computers and Internet browser programs. Since this module uses a climate change example, familiarly with the carbon cycle and the greenhouse effect will be helpful, though not necessary.

**Special context:**

The goal of this module is to teach students how to read and understand scientific articles. This skill can be applied to answering a variety of research questions from different disciplines of science and engineering. The context for this inquiry is the impact of climate change on a species. Although climate change is the specific prompt used in this module, the prompt can be modified for different classroom topics and different courses.

**Scaffolding supplements:**

A lecture accompanies this module. The lecture introduces *why* we read scientific literature. It then defines primary literature, explains article components, and describes why citation is an important feature during a literature review. Within the lecture, YouTube videos are used to introduce a controversy that students have to investigate using the scientific literature. Additionally, the lecture utilizes an animated clip by the Purdue Library to explain why we read scientific literature. Links will be provided within the lecture slides to Owl Purdue’s citation reference guide so that students can learn how to cite using APA style. A link is also provided to Google Scholar so that the teacher can explain how to find scientific articles. A handout is used to guide students through their investigation and reading of a scientific article.

Module Description

## Materials:

* Pad of poster paper
* Pens and Colored Markers
* Highlighters
* Activity Handouts (included)
* Activity Articles (included)
* Activity PowerPoint (included)

## Preparation:

Teachers may want to change the investigation prompt/research question to better suit their classroom syllabus. This should be prepared in advance and requires the teacher to conduct a literature search to find relevant articles for students to read during the class-time. If the teacher uses the investigation prompt provided, it may be helpful for the teacher to thoroughly read the articles provided beforehand.

## General Timeline:

1. Inquiry Introduction (3 min)
2. Lecture (20 min)
3. Group formation & Question Picking (3 min)
4. Handing out articles and materials (3 min)
5. Students have work time (20 min)
6. Teacher Check-In (5 min)
7. Student work time (15 min)
8. Teacher presents poster prompt (5 min)
9. Poster preparation (15 min)

10. Poster session (30 min)

## Starting Point For Inquiry:

Begin by asking students what they already know about climate change and what, if any, environmental or global changes may occur. The teacher can then give a brief background on climate change, and then ask students what kind of questions they may have.

The teacher starts by presenting a picture (Slide 2, PowerPoint) of a polar bear on thin ice. This picture is controversial because climate change activists and educators, such as Al Gore, use it to describe the impact of climate change on animals. The first video (Slide 3, PowerPoint) shows the context in which the photo was used during an Al Gore presentation. The second video (Slide 3, PowerPoint) explains the discrepancies and controversies around the photo. What comes into question is whether or not polar bears are impacted by climate change. The teacher can ask students how they might resolve controversial questions when they are presented with conflicting information (Slide 4, PowerPoint). This is the starting point for understanding how we use and evaluate scientific articles for evidence.

The rest of the lecture (Slides 5-29, PowerPoint) explains why we read scientific articles, how they are structured, and how to cite articles. Students can then pick an animal with which to investigate the question “How does climate change impact animal species.” They may choose from a polar bear, a pika, or a sea turtle (Slides 30-35, PowerPoint). This point of inquiry leads to an activity handout and a poster session (Slide 36, PowerPoint) to assess student knowledge.

Keep in mind that the goal is not for students to learn an answer to a specific question, but to learn *how* to figure out what other researchers have already discovered about the question. For this reason, this starting point for this inquiry can be changed to address different classroom topics.

## Detailed Procedure:

1. Inquiry Introduction: Teacher will introduce the concept of climate change. Using YouTube videos, the teacher will highlight an instance in which the media disputed the use of a particular image to prove the impact of climate change on polar bears (Slides 2-3, PowerPoint).
   1. Teacher will ask students how we use science as evidence to answer questions?
   2. Teacher will introduce inquiry prompt: So does climate change impact species \_\_\_\_\_\_\_\_\_? If yes, how?
2. Lecture
   1. What is a scientific article? (Slide 5)
      1. Explain peer-review process
      2. Explain that articles are available through online databases through the library, but that abstracts and summaries are available through Google Scholar
      3. Open Google Scholar and do a sample search to pull up an article
   2. Why read it scientific articles? (Slide 6)
      1. (watch the “Why” section of Purdue website animation at <https://www.lib.purdue.edu/help/tutorials/scientific-paper>)
   3. How is a scientific article structured? (Slides 7-14)
   4. Tips for reading a scientific article (Slides 15-21)
      1. Ask students if they know what “skimming” is
      2. When to highlight and circle words
      3. How to decipher difficult-to-read methods by drawing the methods in a diagram or flow chart
   5. How to cite a scientific article? (22-36)
      1. Explain the difference between in-text and reference citations
      2. Why do we cite?
      3. Explain where to find citation formats on the Owl Purdue website
3. Teacher prompts group formation of 2-3 students to answer a question
   1. Students answer the question “How does climate change impact different species?”
4. Groups can pick from different possible avenues of inquiry, based on different species vulnerable to climate change. These species will be pre-picked, and for this module include: polar bears, Great Barrier Reef Green Turtles, and American pikas. Teacher can context these choices by showing pictures of animals on the lecture and giving students fun facts about the animals (Slides 32-35)
5. Teacher will handout pre-picked scientific articles (included in this module) based on the groups’ choices of species, as well as a scaffolding handout for reading the article
6. Students have work time
   1. Teacher will check in with students every 10-15 minutes as a classroom.
   2. During check-in, students from each group can share: What was the most challenging step so far in the handout? What word did they have to look up? What are their first impressions of reading a scientific article?
   3. Teacher and any aids will help students by moving around through groups and asking students to, just using what they learned in the abstract, to explain what the article is about. During a second teacher-group check-in, the teacher can ask each group to explain the methods.
7. Teacher will give a poster prompt and poster example
   1. The poster prompt will say: Answer your research question! Your poster should include a: title, a yes/no answer to the prompt, bullet points explaining why, diagrams/schematics/pictures of the methods the scientists used, and 1 APA-style citation for your research. You will have 3 minutes to present the poster and everyone in your group must help present.
8. Students work on poster (if poster isn’t finished, becomes a homework assignment)
9. Poster session
10. Wrap up: Review what the impacts of climate change are on the three animals. Review the parts of a scientific article. Bring the conversation back to the idea of media and using science to answer controversial questions.

## Assessment Methods:

Students can present the results of their research article analysis in a poster session. If students present and cite the evidence for their search in the poster, it will show that they understand the make-up of the article and can cite correctly. If students correctly cite their articles using APA style, it will show sufficient use of this skill. For more advanced groups, the teacher can ask the groups “What were the methods used by the researchers?” While methods can be difficult to understand at this level, most groups should be able to explain the rationale and results of each study. Lastly, the prompt may be modified for each classroom, and correct answers to the prompt will show understanding of the content.

## Possible pitfalls:

Students may have never heard of scientific articles or primary literature. The headers within the scientific articles, such as “Abstract,” may be entirely foreign. Additionally, scientific articles often contain language that is difficult to understand. For this reason, the teacher should include in the lecture how students can approach difficult words (by circling them, looking up definitions when it is important for the meaning of the article, etc). Students may also wonder how to develop their own research questions and how to obtain scientific literature. It may be worth teaching students how scientific articles are made available to the public through libraries and Google Scholar. Lastly, students may wonder how scientific articles are different from popular and grey literature. The concept of “peer review” may be useful for the teacher to know if this comes up. Another problem is that this module may not be very engaging for students.

## Glossary:

*Abstract:* a brief summary of a research article or other publication that may be used by the reader to determine the purpose of the paper.

*Introduction:* A citation of relevant documents to contextualize the purpose of the article along previous research on the topic.

*Methods:* A description of steps and empirical techniques used to acquire knowledge

*Results:* The outcome of the research methods and experiment, including data that is often represented in tabular or graphic forms

*Discussion/Conclusion:* This is a discussion and interpretation of the results, often relating the results and findings to the research motivation and purpose

*References*: A list of sources cited by the author(s), usually formatted in a style specific to the journal in which the article is published

*Scientific Article*: the publication of original research that reports empirical and theoretical work in the natural and social sciences

*Peer-Review*: A form of “quality-control” on the publication of scientific literature in which the article is evaluated by one or more people of similar competence and background to ensure standards of quality before publication.

## Optional:

Using Owl APA Style Guide:

<https://owl.english.purdue.edu/owl/section/2/10/>

Why, How, and Anatomy of a Scientific Article (Animation):

<https://www.lib.purdue.edu/help/tutorials/scientific-paper>

# NGSS Standards Addressed

**Disciplinary Core Ideas**

LS2.A: Interdependent Relationships in Ecosystems, ESS3C: Human Impacts on Earth Systems

**Science & Engineering Practices**

8. Obtaining, evaluating, and communicating information

**Cross Cutting Concepts**

2. Cause and effect: Mechanism and explanation

**Supplemental materials**

*Lecture Slides (Cohent\_SaysWho\_presentation.ppt)*

This is the accompanying lecture material for the module. It includes graphics, links to media videos, and links to websites.

*Lab Handout (Cohen\_SaysWho\_handout.doc)*

This is the handout that guides students through reading a scientific article. Hand this to students after the lecture is complete to guide their investigation.

*Articles (Cohen\_SaysWho\_PolarBears.pdf, Cohen\_SaysWho\_Pikas.pdf, Cohen\_SaysWho\_Turtles.pdf)*

These articles accompany the inquiry prompt. Each article corresponds to one avenue of inquiry. Student groups may pick which animal they want to investigate and are given the corresponding article.