

## Lesson Plan on Nanoscience

This lesson plan demonstrates the use of research, writing, and learning skills in analysing concepts associated with the topic of nanoscience. We have provided all the necessary resources and links for the activity on the [Science Portal for Ontario Teachers \(SPOT\)](#) website. You can use this activity in conjunction with the downloadable student worksheet on that website.

**Subject / Course:** Chemistry / SCH4U

**Grade Level:** Grade 12

**Big Idea:** Structure and Properties of Matter - Nanoscience

**Specific Ontario Curriculum Expectations Met:**

- A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data; solve problems involving quantitative data; determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and error; and suggest improvements to the inquiry to reduce the likelihood of error
- A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias
- A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions with reference to scientific knowledge
- C1.2 evaluate the benefits to society, and the impact on the environment, of specialized materials that have been created on the basis of scientific research into the structure of matter and chemical bonding (e.g., bulletproof fabric, nanotechnologies, superconductors, instant adhesives)

**Purpose:**

The purpose of this lesson is to provide students with an opportunity to develop and practice research, learning, and writing skills that will be required for them to make a successful transition from high school to post-secondary education.

**Lesson Objectives:**

By the end of this lesson, students will be able to

- locate a specific journal article by searching an online directory
- identify organizational strategies for and components of an original research article
- read and analyze effectively to identify a journal article's main points
- paraphrase and summarize information from a journal article in their own words

**Time Required:**

1 hour of instruction time

**Background Information (for teachers):**

- *Periodical*: a publication that is issued at regular intervals; the term can be used to refer to scholarly journals, trade journals, popular magazines, newspapers, etc.
- *Scholarly journals* may also be referred to as *academic*, *peer-reviewed*, or *refereed* journals.

- *Peer-reviewed (or refereed)* journals refer to scholarly journals that require a submitted article to be reviewed by several other experts or academics (peers) in the same subject area before being published.
- Two main types of articles are found in scholarly journals:
  - *original research articles (or primary research articles)*; these publish the methods and results for the authors' own research)
  - *review articles* (these publish results gathered from a number of studies and contain no original research by the authors)
- *Open access* is a term referring to unrestricted online access to peer-reviewed scholarly journal articles, free of charge, allowing readers to read, download, copy, distribute, print, search, or link to the full texts of these articles.

#### Helpful Resources:

- About Directory of Open Access Journals (DOAJ) ([www.doaj.org](http://www.doaj.org))
- See "Distinguishing Scholarly Journals from Other Periodicals" (<http://olinuris.library.cornell.edu/ref/research/skill20.html>) to find useful descriptions and examples of *scholarly, academic, peer-reviewed, and refereed* journals.
- Modules on SPOT:
  - "[Searching for Scientific Journal Articles](#)"
  - "[Paraphrasing](#)"
  - [A Guide for University Learning](#)

#### Required Resources (Materials/Equipment):

- Data projector
- This lesson plan on Enzymes
- One copy per student of the journal article "Synthesis, characterization, and in vitro evaluation of novel polymer-coated magnetic nanoparticles for controlled delivery of doxorubicin" (unless students are obtaining the article themselves)
- One copy per student of the [Student Worksheet](#)
- Instructor Solutions – available from [learning@uoquelp.ca](mailto:learning@uoquelp.ca) upon request

#### Journal Article to Analyse:

Akbarzadeh A, Zarghami N, Mikaeili H, Asgari D, Goganian AM, Khiabani HK, Samiei M, Davaran S (2012). Synthesis, characterization, and in vitro evaluation of novel polymer-coated magnetic nanoparticles for controlled delivery of doxorubicin. *Nanotechnology, Science and Applications* 5:13-25.  
doi:10.2147/NSA.S24328

#### Advance Preparation:

- Review the "[Searching for Scientific Journal Articles](#)" module to decide whether you will obtain the journal article for the students or allow them to do the search (if you have access to a computer lab for the session).
- Obtain a PDF of the article using the following steps (described in detail in the "Searching for Scientific Journal Articles" module):
  - Go to the Directory of Open Access Journals at [www.doaj.org](http://www.doaj.org) and select Search.

- Type in the key terms “nanoparticle” AND “doxorubicin” AND “polymer,” OR type in the full name of the journal article. (Note – using the key terms produces a list of several articles. You will need to pick the one identified for this lesson plan.)
- Locate the article in the list.
- Click on the button for Full Text.
- Look for and select a link to the PDF.
- Review the section “Learning from Textbooks” in the resource [A Guide for University Learning](#) to decide how you will use it with your students.
- Review the [“Paraphrasing”](#) module to decide how you will use it with your students.
- Read the journal article and determine what science background you will provide to help students understand the content and/or vocabulary.

### Lesson Plan:

#### A. “Minds on” – Focus Student Attention and Assess Prior Knowledge

Use some of the following discussion questions to get students started thinking about the concept of journal articles:

- What kinds of publications can you use to find research information for a science project or paper? (responses could include books, chapters in books, periodicals (newspapers, magazines, journals), government reports, theses and dissertations, websites)
- What methods can you use to search for those publications? (responses could include library card catalogue; online library catalogues; databases; providers such as ProQuest, EBSCOHost, etc.; search engines such as Google; specialized journal search engines such as Google Scholar)
- What are advantages/disadvantages of some of these methods? (responses could include that searching Google will provide a variety of sources, not all of them academic or credible; searching a database that specifically accesses academic journals will be more effective)
- How can you be sure that your source is credible? (responses could include choosing peer-reviewed/scholarly articles vs. Wikipedia or webpages with no review process)
- What kinds of scientific articles are published in scholarly, peer-reviewed journals? (responses could include original/primary research articles, review articles, opinion letters/editorials) *Tip:* You could show them a table of contents for a journal accessed through DOAJ so they can see the various kinds of articles.
- What is the purpose of an original research article? (responses could include that it reports on a particular study, that it provides information about the significance of the study and how it fits into the overall topic area, that it includes materials and methods so that the study could be replicated, that the authors provide their results as well as a discussion of what the results might mean)
- What are the parts of an original research article? (responses could include Abstract, Intro, M&M, Results, Discussion) *Tip:* You could compare this structure to a lab report they may have written in their science courses.

**B. “Action!” – Provide Guided Practice**

- **Research Skills—Obtaining the article:**
  - Introduce DOAJ as a search engine and guide students through the [“Searching for Scientific Journal Articles”](#) module (provided on the SPOT website as a PowerPoint presentation).
  - Provide students with a copy of the journal article for this lesson OR have them obtain it themselves from DOAJ.
- **Learning Skills—Reading the article:**
  - Reading critically, highlighting, and taking good notes are important skills required in post-secondary education. Guide students through the section “Learning from Textbooks” in the resource [A Guide for University Learning](#) to review effective reading strategies.
  - Have students skim the journal article.
  - Have students read the [Student Worksheet](#) so they know what kind of information they will need to obtain from their more focused reading.
  - Work through the journal article (or use a different article as an example) to discuss the different sections and to identify where they can find the kind of information asked for on the worksheet.
  - Discuss the science background (vocabulary or content) needed to understand the article.
- **Writing Skills—Analyzing and writing about the article:**
  - To succeed in post-secondary education, students must learn about the concept of plagiarism and how to avoid it by citing their sources and writing in their own words. Provide students with an opportunity to practise paraphrasing using the [“Paraphrasing”](#) module (provided on the SPOT website as a PowerPoint presentation).
  - Have students re-read the article carefully using notetaking and highlighting techniques.
  - Have students fill in the [Student Worksheet](#). *Teaching Strategies:* (1) Students could work individually or in pairs. (2) Students/pairs could each be assigned a different section rather than the entire article. (3) The student worksheet could be assigned as homework.

**C. “Consolidate” – Provide Closure**

- Have students review worksheet answers with each other and with you as the instructor.
- Have students share paraphrasing strategies.
- Have students connect content in the journal article to knowledge of nanoparticles.

*For suggested solutions to the student worksheet, please email: [learning@uoquelfh.ca](mailto:learning@uoquelfh.ca)*