

## *Research Proposal*

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### **Summary**

Length: 3-4 hour long classes

The students will write their own research proposal based on the topic they sign up for. This will let them think of how they could be involved and learn about the scientific research process. This lesson mimics the peer review process that is used at the Canadian Light Source. Peer review is a very important part of research that ensures research is accurate and reliable. The Canadian Light Source uses a peer review committee to allot beamtime, or select what research will be conducted. Once the research proposal is created the class will go through the peer review process with their peers. This lesson also encourages students to think of themselves as scientists and develop critical thinking skills. There are many objectives covered in the lesson and the depth and subject matter can be changed according to the grade, subject and/or the students. Students should be encouraged to challenge themselves and be creative. There is opportunity for connection to several other subjects such as: Art, Social Studies, and Language Arts. If you have any questions you can e-mail [outreach@lightsource.ca](mailto:outreach@lightsource.ca).

### **Pan-Canadian Objectives**

<b>Science Grade</b>	<b>Knowledge</b>	<b>Science, technology, society and the environment</b>	<b>Skills</b>	<b>ATTITUDES</b>
10-12	327	114-all, 115-3, 115-7, 116-all, 117-all, 118-all	212-all, 213-6, 213-7, 214-8, 214-9, 214-10, 214-11, 214-12, 214-15, 214-16, 214-17, 214-18, 215-all	436, 437, 438, 439, 440, 441, 442, 443, 445, 447
7-9	308-8, 308-11, 308-12	109-all, 110-4, 110-8, 111-all, 112-all, 113-all	208-all, 209-5, 210-12, 211-all	422, 423, 424, 425, 426, 427, 428, 430, 431,

### **Materials**

- ✿ Pages describing the different applications and techniques – available in Classroom Resource book and at <http://www.lightsource.ca/education/>
- ✿ Evaluation Criteria Sheet (attached) – for peer review process
- ✿ Internet access – for researching
- ✿ Attached rubric

## Motivational Set

Go and visit the synchrotron as a class or watch the videos (also available online <http://www.usask.ca/research/communications/videos.php>). If these are not option give the students an overview of how the synchrotron works, and what it does. This can be found on the website or in the Synchrotron Classroom Resources book.

## Activity

1. Give a brief overview of the research done at the synchrotron. This step can be skipped if you have been on a tour. (10-15 minutes)
2. Generate a list of questions with the students to help them come up with research topics. Example: What would Canadians find valuable to know?
3. Have students sign up to research a topic that they find interesting. Have a maximum number of students who can sign up for any given application. (5 minutes)
  - a. Cancer Treatment
  - b. Forensics
  - c. Cleaning the Environment
  - d. Agriculture
  - e. Medical Imaging
  - f. Alternative Fuels
  - g. Mining & Petroleum
  - h. Proteins and Disease
  - i. Nano-technology
  - j. Mysteries of the Past
  - k. Food
4. Have students write a research proposal in their group. (time varies on depth)
  - a. Investigate the research that has already been done in their area by a synchrotron. Check out the resources section!
  - b. Come up with a research idea based on their topic. Do research on their idea. Encourage students to be creative.
  - c. Develop a hypothesis. The amount of detail could be altered based on the grade. Specific techniques could be included.
5. Go over the peer review process with the students (see evaluation criteria sheet). They will fill out the peer review sheet and make comments, and recommendations based on their presentations. (10 minutes)
6. Presentations. Students who are not presenting are on the peer review committee, and they must be evaluating the other groups based on the criteria. (length dependent depth)

## Culminating Activity (15-30 minutes)

Have a discussion about the Canadian Light Source. This may include several of the following topics based on the Pan Canadian objectives:

- ✿ What issues will the research proposals raise in society? (118)
- ✿ How are individuals, society, and the environment interdependent with scientific and technological endeavours? (117)

- ✿ How do different disciplines work together toward a common end goal at the Canadian Light Source? (114)
- ✿ How does science and technology interact with and advance one another? What are some examples? (116)

## **Evaluation**

See attached rubric

## **Resources**

- ✿ Synchrotron Science Classroom Resources
  - Introduction to the CLS Synchrotron
  - One-pagers section
  - Techniques section
- ✿ <http://www.lightsources.org/cms/>
- ✿ [http://www-ssrl.slac.stanford.edu/sr\\_sources.html](http://www-ssrl.slac.stanford.edu/sr_sources.html)
- ✿ [www.lightsource.ca/education/](http://www.lightsource.ca/education/)
- ✿ <http://www.lightsource.ca/education/poster.php>

## **References**

- ✿ RubiStar at <http://rubistar.4teachers.org> was used to help make the rubric.

## Student Sheet: Peer Review

**Instructions** –Fill out the back of this sheet. Keeping the criteria in mind, make constructive comments. Each of the 5 evaluation criteria is worth 1 point. Assign the group a number out of 5 based on criteria. Repeat for each group.

**Evaluation Criteria** Reviewers evaluate each proposal based on:

- ✧ **Quality of scientific research in the context of the field (merit)**  
Does the proposal describe the importance of what is to be studied? Will the proposed research have a great impact on society and/or the science community?
- ✧ **Presentation**  
Was the presentation convincing? Did they make eye contact? Were there any visual aids?
- ✧ **Explanation**  
The group explains their idea in a way that makes it easy to understand what they are talking about.
- ✧ **Logic**  
Is the hypothesis clearly stated? Do they explain how data support or refute the hypothesis or prediction?
- ✧ **Preparedness**  
Presenters are completely prepared and have obviously practiced? Has research been done?

**Rating Scale** - Proposals are rated on a scale of 1 to 5. This is the rating scale used by the peer review committee: [http://www.lightsource.ca/uso/proposal\\_writing\\_tips.php](http://www.lightsource.ca/uso/proposal_writing_tips.php)

- ✧ **5 – Extraordinary:** The proposal involves highly innovative research of great scientific importance. Proposed research will significantly advance knowledge in a specific field or scientific discipline. Considerable societal relevance is demonstrated. Synchrotron radiation is essential.
- ✧ **4 – Excellent:** The proposed research is of high quality and has potential for making an important contribution to a specific field or scientific discipline. The work is cutting edge and is likely to be published in a leading scientific journal. Synchrotron radiation is required.
- ✧ **3 – Good:** The proposed research is routine but likely to produce publishable results. Impact on a specific field or scientific discipline is likely. Synchrotron radiation is essential to accomplish the intended goals of the research. The need for synchrotron radiation is evident.
- ✧ **2 – Fair:** The proposed research is of marginal interest but may not significantly impact a specific field or scientific discipline. Publication may or may not result from this research. The results from the research, although useful, are not likely to create excitement in the field.
- ✧ **1 – Poor:** The proposed research is not well planned or is not feasible. Results would not make important contributions to fundamental or applied understanding, and work is not likely to result in publication. The need for synchrotron radiation is not clear.

**Group Name:** \_\_\_\_\_ **Topic:** \_\_\_\_\_

Comments: \_\_\_\_\_

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\_\_\_\_\_ **Mark: /5**

**Group Name:** \_\_\_\_\_ **Topic:** \_\_\_\_\_

Comments: \_\_\_\_\_

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\_\_\_\_\_ **Mark: /5**

**Group Name:** \_\_\_\_\_ **Topic:** \_\_\_\_\_

Comments: \_\_\_\_\_

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\_\_\_\_\_ **Mark: /5**

**Group Name:** \_\_\_\_\_ **Topic:** \_\_\_\_\_

Comments: \_\_\_\_\_

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\_\_\_\_\_ **Mark: /5**

**Group Name:** \_\_\_\_\_ **Topic:** \_\_\_\_\_

Comments: \_\_\_\_\_

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\_\_\_\_\_ **Mark: /5**

## Student Sheet: Research Proposal Rubric

Group name: \_\_\_\_\_

Date: \_\_\_\_\_

	5	4	3	2	1
Idea	Independently identified a question which was interesting and which could possibly be researched. Includes a well supported hypothesis.	With little help made interesting question. Includes good hypothesis.	Some help in making a question. A vague hypothesis is included with flawed reasoning supporting it.	With a lot of help identified a question. Hypothesis included, but not supported.	Identified a question that did not merit investigation. Hypothesis was not included.
Enthusiasm	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Expression is used sometimes to generate interest.	Expression and body language seemed forced.	Little use did not generate much interest.	No expression was used, and little interest was generated.
Data Collection	Data was collected and clearly summarized independently. Uses credible sources.	Data was collected with little help and summarized on own.	Data collected and summarized with some help.	Extensive help was needed to collect data and summarize	Sources were given and data was summarized with excessive help.
Working with Peers	Almost always listens to, shares with, and supports the efforts of others in the group. Tries to keep people working well together.	Listens to, shares with, and supports the group most of the time.	Listens to, shares with, and supports the group some of the time. Little effort is made to keep on task.	Listens to, shares with, and supports the group rarely. Sometimes gets the group off task.	Does not listen to, share with, or support the efforts of others in the group. Often is not a good team member.
Peer Review (students marks)	Convincing, relevant, easy to understand presentation.	Mostly convincing, and interesting.	Prepared, but hard to understand.	Interesting, but not supported by research	Little merit and interest. Not prepared.