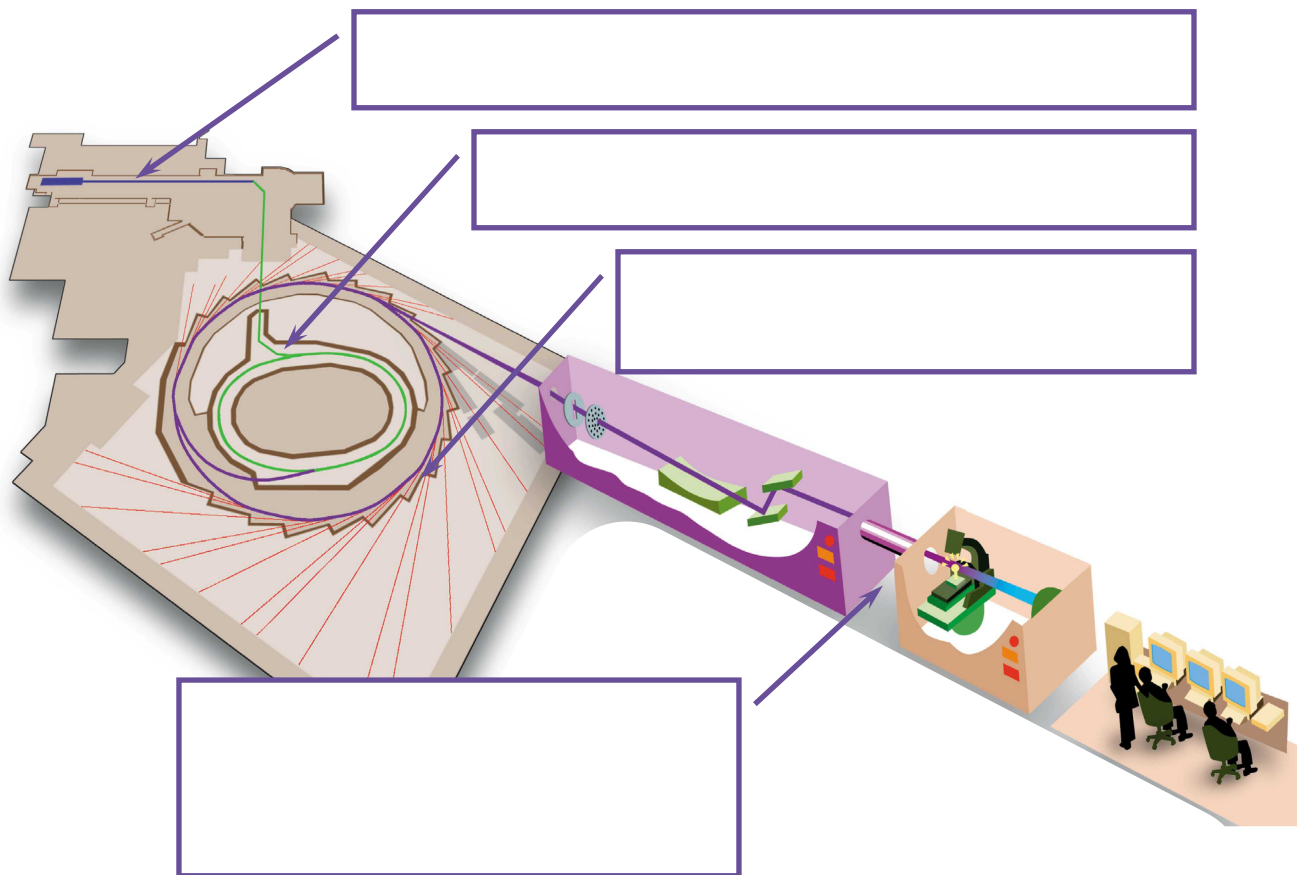




# Student Pages

## Synchrotron 101

1. Identify the names of the four main parts of the Canadian Light Source Synchrotron:



2. Scientific applications of the synchrotron can be divided into three main categories.

Provide two specific examples of each category:

Materials studies \_\_\_\_\_  
\_\_\_\_\_

Environmental studies \_\_\_\_\_

Life Sciences \_\_\_\_\_

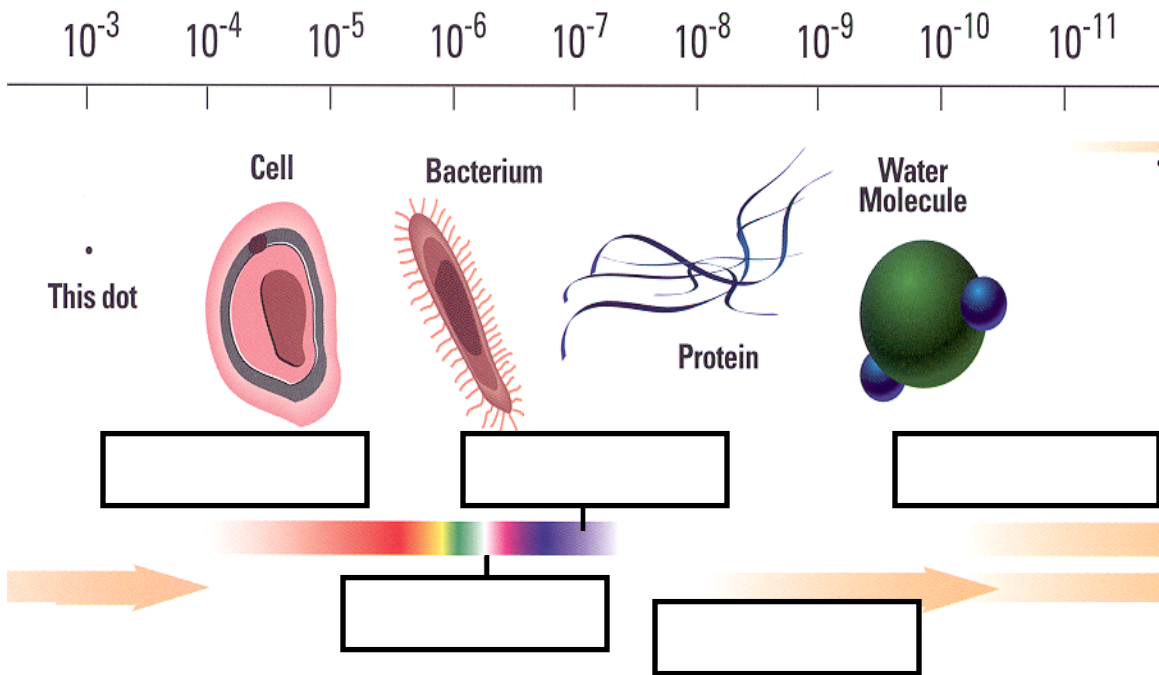
3. CLS uses six different types of magnets (dipole, quadrupole, sextupole, kicker, wiggler, and undulators). What is the role that these magnets play in the synchrotron?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. First, fill in the boxes to identify the five different types of light produced by a synchrotron, and then answer the questions using the diagram of the different wavelengths of light (the exponents measure the size of the wavelength in metres).



a) What type of light has the shortest wavelengths? \_\_\_\_\_

b) How long does the wavelength of light have to be for us to see it? \_\_\_\_\_

c) What do CLS scientists & technicians use to detect types of light we can't see? \_\_\_\_\_

d) What range of wavelengths do you think scientists would use to look for traces of gold or uranium in a core sample supplied by a mining company? \_\_\_\_\_

e) What is the name of the diagram you are using to answer these questions? (Hint: it is the Electromagnetic \_\_\_\_\_)

5. There are 100 people working at CLS. Obviously there are scientists. List four other types of careers that are employed at a synchrotron.

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6. How many synchrotrons are there in Canada? In the world?

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7. In your own words, what does the following mean?

a) superconducting \_\_\_\_\_

b) absolute zero \_\_\_\_\_

c) photon \_\_\_\_\_

d) monochromator \_\_\_\_\_

e) spectrum \_\_\_\_\_

f) crystallography \_\_\_\_\_

g) speciation \_\_\_\_\_

h) resolution \_\_\_\_\_

i) beamline \_\_\_\_\_

j) nanotechnology \_\_\_\_\_

8. If researchers at CLS are not using visible light, and they are not using a microscope, how do they 'see' the molecules they are studying? \_\_\_\_\_

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9. Explain the difference between the X-ray images that can be produced at the University Hospital and those that will be produced by our Bio-Medical Imaging Beamline when it is completed.

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10. Researchers can analyse and learn more about any sample they put in front of the light at a synchrotron. This means that anything that can be transported to a synchrotron can be studied.

a) Of all of the research that you have learned about, which one do you find most interesting? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b) If you could choose anything to study using synchrotron techniques, what would you choose to put in front of the light? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

11. The Engineers that have designed and built the CLS facility have been recognized with several awards. What are two special features of construction that are remarkable? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

12. Identify two safety concerns at the CLS facility and then explain how the CLS has met these safety challenges. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

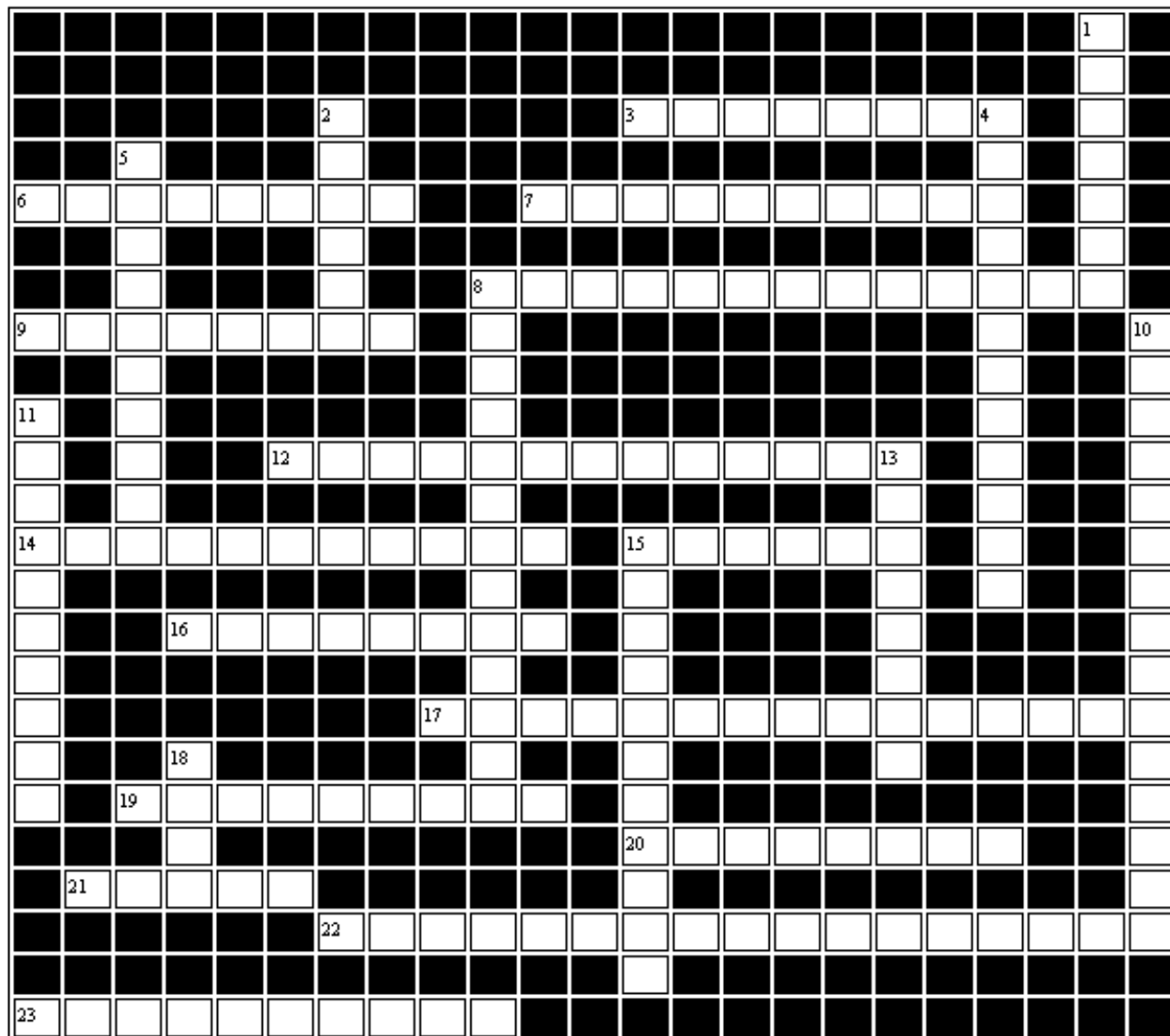
**List of terms:**

tungsten  
accelerate  
electromagnets  
superconducting  
absolute zero  
photon  
insertion device

dipole magnet  
quadruple magnet  
wiggler  
undulator  
wavelength  
emission  
monochromator

refraction  
diffraction  
resolution  
spectrum  
polymer  
speciation

## Cross Word



### Across

3. unit of measurement of radiation doses
6. negatively charged sub-atomic particle
7. magnetic system composed of two dipoles oppositely directed moment
8. divides light into frequencies
9. where the light goes
12. chemical analysis on a small or minute scale
14. super brilliant light producer
15. a pair of equal magnetic poles of opposite sign
16. long wavelengths of light
17. disappearance of electrical resistance in a substance
19. device to measure exposure to radiation
20. element with weak electron bonds
21. short wavelengths of light
22. the study of light and matter on a scale too small to see
23. a method of producing a three-dimensional image of the internal structures of a solid object

### Down

1. insertion device that moves electrons back and forth
2. light particle
4. the study of matter through its interaction with light
5. light deflected as it passes from one substance into another
8. a large molecule as in protein or rubber
10. study of macromolecules using x-ray diffraction
11. where the research happens
13. range of wavelengths or frequencies of electromagnetic radiation
15. light deflected as it passes by something
18. unit of measurement for vaccum system



## *Synchrotron Word Find*

d f o r i b m a g n e t i a l e o r s a e n t t  
m t m d e e o n p l r o c t n o i c b t a n i o  
o e t u a s i n e d s e o r y n r s a g e t n a  
s c n i r t o l d c r s l p c y o r n t e o r o  
d e a c a t a l y s t o o s r e r u n i e d a  
e v i r o e c r u e m c m t p l n n g t l i c a  
u a g h o y d e u t s m a t e o g a a u f n s h  
s w p m i o e n p o i l i c c s m d e f d y p r  
n o i t a i d a r s l o c c t o i e r y n l e e  
e r u t c u r t s o n a n e r x l a n c e l c o  
l c e n l u c i g u t i n t o o c r h u g n i o  
o i b a c e o r a f p a c o m t a r e g e r a e  
p m t m p n a i i d c e m o i a o n i l n i t n  
u o u s i p m r o c l s r o c t n w a r e e i r  
r y l n h u m s u e w c n c r n a v i l e n o e  
d s g y c t i u c n a o e o o h b r a n y d n m  
a i t c e m c t t m v l n i s n c e b t c s i i  
u e a e e l r c c i e n i n c g d o a i s t i s  
q v c t c o o a t r l g r d o n r u n m v a p s

absorption  
accelerate  
accelerator  
analysis  
beamline  
bonds  
catalyst  
commissioning  
crystallography  
data  
diffraction  
dipole  
dosimeter  
electromagnet  
electron

emission  
endstation  
grating  
industry  
infrared  
insertion  
macromolecule  
magnet  
microanalysis  
microscopy  
microwave  
monochromator  
nanostructure  
oxidation  
photon

polymer  
protein  
quadrupole  
radiation  
refraction  
resolution  
spectrum  
spectroscopy  
sextupole  
sieverts  
speciation  
spectromicroscopy  
superconducting  
synchrotron  
tungsten

undulator  
vacuum  
valence  
vibrational  
wavelength  
wiggler  
x-ray