

Activity **10**



Molecular Structure and Problem-based Learning

Activity developed at Collège de Bois-de-Boulogne
By **JULIE BOUCHER**

Molecular Structure and Problem-based Learning

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Author's Name

Julie Boucher

Originating Cegep

Collège de Bois-de-Boulogne

Author's E-Mail Address

julie.boucher@bdeb.qc.ca

Scientific Discipline

Chemistry

Average Age of Students

17-18 years old

Course Title and Number

General Chemistry (202-NYA)

Duration of Activity

**4 fifty-minute periods
spread over four week**

NOTE

In this document, the masculine is used without discrimination and solely to make the text easier to read.

Appendices are available in PDF and Word format on the CD provided with this document.

In addition, an instructional analysis of the activity is available in the pedagogical treasures section (*Trésors pédagogiques*) on the Saut Quantique Web site at:

<http://www.apsq.org/sautquantique>.

Use of this text is authorized for instructional purposes, provided that author's name and college are mentioned.

Adherence to these recommendations will encourage authors to share their experience.



Molecular Structure and Problem-based Learning

Description of Activity

OVERVIEW

The proposed activity uses a problem-based (PBL¹) learning approach. Essentially, this pedagogical approach is separated into three phases.

During the first phase, the teacher presents the problem situation dealing with molecular structures, entitled *Good-tasting Medicine*, to teams of 8 to 10 students. After the students read it, he facilitates a discussion during which students identify keywords and make assumptions.

During the second phase, students confirm or reject these assumptions, further to some individual reading and work done outside of the classroom.

Finally, during the third phase, students team up and explain their understanding of the problem to each other.

RELEVANCE AND ORIGINALITY OF ACTIVITY

This activity uses an active student-based pedagogical approach.

Objectives and Relation to the Program

PEDAGOGICAL OBJECTIVES OR TARGETED COMPETENCIES

Solve problems pertaining to the structure and states of matter using modern theories of chemistry.

LINK BETWEEN THE ACTIVITY AND THE PROGRAM

General Program Goals Targeted

This activity targets the following general goals of the *Science* program:

- To apply the experimental method;
- To communicate effectively;
- To learn autonomously;
- To work as members of a team.

Link with Course

Most classroom and laboratory time is spent on various learning activities, allowing students to be the *key players* in their education. We mostly use a PBL approach.

Link with Other Courses

This course is part of the *Science* program, in the learning profile called *CHEMINEMENT SCIENCES EN ACTION*. Chemistry, physics and biology courses in this program are developed in the form of student-based learning activities. For further information, refer to the following Web page: www.bdeb.qc.ca/cours_programmes/sciences_en_action.htm.

⁴ To learn more about problem-based learning, refer to the section Apprentissage par problèmes (problem-based learning) on the Saut quantique Website at www.apsq.org/sautquantique/doss/d-app.html.

Number of Students and Educational Support

APPROXIMATE NUMBER OF STUDENTS IN CLASS

24 to 30 students

NUMBER OF STUDENTS PER TEAM

Three teams of 8 to 10 people

EDUCATIONAL SUPPORT

This teacher's role during the activity is to:

- Present the problem situation available in Appendix T.1;
- Distribute a Study Guide (see Appendix T.1);
- Facilitate discussions during the first and third phases of the learning process, by ensuring the participation of all students;
- Assist student groups in their learning process;
- Foster collaborative work;
- Motivate students to work hard and effectively to complete the required assignments;
- Verify the accuracy of student notes and make corrections if required;
- Identify the most difficult concepts, and present of brief overview of them;
- Evaluate learnings.

Conducting the Activity

CONDUCTING THE ACTIVITY AND TIME REQUIRED TO COMPLETE EACH STEP

Before

The teacher familiarizes himself with the problem situation, study guide, and various steps of the learning sequence (see Appendix T.1).

During

Phase I: Analyzing the Problem Situation (50 minutes):

- The teacher distributes the problem situation *Good-tasting Medicine* (see Appendix T.1). Students first read it individually. Afterwards, they team up to analyze the problem situation. They point out misunderstood concepts, formulate questions, and make assumptions to understand the problem.

Phase II: Individual Assignment (outside of the classroom):

- Students individually familiarize themselves with the theoretical contents associated with the problem situation by attempting to answer the questions and verifying their assumptions. To guide the students in their individual learning process, the teacher hands them a study guide, which includes the learning objectives, a list of questions and exercises taken from the reference manual (see Appendix T.1). Students must answer the questions, complete the exercises, and hand in their assignment when recapping the problem situation.

Phase III: Recapping the Problem Situation (approximately 3 weeks after Phase I, 3 hours):

• Step 1 (50 minutes):

The teacher distributes documents about sweeteners to the teams (see the Media Directory).



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Students individually read the documents (15 minutes) and team up to answer the questions in Appendix T.1 (25 minutes).

The teacher invites each team to share its answers with the entire class (10 minutes).

• **Step 2** (50 minutes):

Students team up to review each of the assumptions they put forth in Phase I, and either confirm or reject them. There is a possibility that certain assumptions will be unverifiable (15 minutes).

Students team up to review the following terminal objectives, and explain them among themselves (15 minutes):

- Identify a compound by the nature of the chemical bonds it contains in order to characterize it.
- Represent the three-dimensional structure of molecular compounds.

The teacher asks a representative of each team to provide a brief explanation of one of these objectives, and ensures that what is said is accurate (20 min).

• **Step 3** (50 minutes):

The teacher answers the following:

- Molecular formula of cyclamate
- Lewis structure of cyclamate
- 3D formula and bond angles of cyclamate
- What gives cyclamate a sweet taste?

He takes this opportunity to recap the various learnings provided by this activity.

For further information, please refer to Appendix T.1.

After

The teacher recaps the activity and evaluates student learnings.

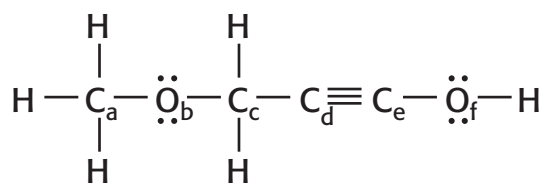
Evaluation and Required Material

SUGGESTED EVALUATIONS

The suggested evaluation is formative and can be done one week after the activity is completed.

Questions could include:

- In the following molecule, where the atoms of the main chain are identified by letters, indicate the hybridization of each of the following atoms.



C_a _____ O_b _____

C_e _____

- How many lone pairs are there in this molecule?
- Complete the following table.

Atoms	Bond Angle
C _c - C _d - C _e	
C _a - O _b - C _c	
H - C _a - O _b	
C _e - O _f - H	

REQUIRED MATERIAL

General chemistry manual (see the Media Directory)

You can use another general chemistry manual. In this case, corresponding matches will be required.

APPENDICES

Teacher

Appendix T.1: Pedagogical Guide

Note:

Appendices are available in PDF and Word format on the CD provided with this document.

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WAWRZYNIAK, Jean-Jacques. *Les édulcorants*, (page viewed on January 17, 2006). [Online]. URL Address: <http://membres.lycos.fr/jjww/edulcorants.htm>

WAWRZYNIAK, Jean-Jacques. *Les édulcorants*, (page viewed on January 17, 2006). [Online]. URL Address: <http://membres.lycos.fr/jjww/edulcorants1.htm>

Other Suggestions and Media Directory

ACKNOWLEDGEMENTS

Our heartfelt thanks go to Mr. Yves Mauffette, biology professor at UQAM, for his invaluable advice.

MEDIA DIRECTORY

KOTZ, John C. and Paul M. TREICHEL (2005). *Chimie générale*, Groupe Beauchemin, 420 p.

LAVERGNE, Didier. *Édulcorant*, (page viewed on January 17, 2006). [Online]. URL Address: <http://www.universalis-edu.com/corpus2.php?napp=&nref=T321964>



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