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| **Concept presentation : Aldehydes vs. ketones (Summary)**  (Group A): 7/13/2012  Unit : Organic compounds  Grade 12 U |
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**At the end of this unit, students should be able to:  
–**\_ Compare & contrast aldehydes & ketones

\_ Analyze, understand and justify why aldehydes are more reactive than ketones  
– design reactions for obtaining simple aldehydes and ketones  
– describe the occurrence of aldehydes and ketones in nature and give examples of the applications of them

***Introducing aldehydes & ketones : why are they important ??***

“In cases of severe diabetes, a patient’s tissues cannot break down glucose, and, instead, the body breaks down fat for its energy. The fats are broken down in the liver and muscles, producing several compounds called ***ketone bodies,*** one of which is acetone.”

Aldehydes and ketones are characterized with the carbonyl (C=O) functional group and have extremely important in many biological and industrial applications.

**Many ketones and aldehydes are used as flavorings and additives to foods, drugs and other products. Benzaldehyde is an aldehyde which is the primary component of almond extract and carvone (a ketone) and gives spearmint chewing gum its minty flavour.**

Ketones are **extremely important in the functioning of complex animal body systems.** They are useful as **chemical signals** for communication in animals. Some ants use a ketone called 2-heptanone to warn of danger. **Pheromones,** are a group of complex ketones are used by many insects and animals as sex attracters.

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| **Lesson sequence** |
| 1. Introducing aldehydes and ketones  2. Aldehydes & ketones: poisons, flavours & perfumes  3. Nomenclature for aldehydes & ketones  4. Physical properties of aldehydes & ketones  4. Preparation of aldehydes & ketone  3. The polarity of the carbonyl group  4. Some members of the series  5. Distinguishing between aldehydes & ketones  6. Simple addition reactions  7. Aldehydes & ketone : applications |

Introducing aldehydes & ketones

**Minds on : Students are made aware the importance of carbonyl compounds by connecting it to simple house hold items they can relate to.**

***Bringing in house hold items: making connections***

To make the student better understand and appreciate the exciting world of carbonyl compounds common household items that contain aldehydes and ketones like (solvents, nail polish remover, perfumes, etc.) are brought to the classroom

The students in groups will “think pair & share” and **record** on chart paper: the uses of the item, advantages/disadvantages for the environment and society, hazards,etc.

Extension: Students will try to create a model of some of the compounds with marshmallows and toothpicks (or other material).

**Nomenclature :**

Students are then gradually introduced to nomenclature using molecular models and interesting fun u tube clips , fun games ,flash cards etc.

Chemistry music video : It’s a family thing

<http://www.youtube.com/watch?v=mAjrnZ-znkY>

**The polarity of the carbonyl compounds : a key concept :**

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| **Concept introduced :** Carbonyl compounds are polar, containing a dipole along the carbon-oxygen double bond. |

Inquiry based learning incorporating role play & open ended meaningful questions .The concept of understanding polarity of carbonyl compounds can be made easy if it is made more concrete.

**Role play: General overview**

Student A : Oxygen

Student B : Carbon

Poles/sticks: Double bond (electrons)

2 Paper crowns with partial positive & negative signs

Students A and B can role play the polarity of the carbon and oxygen double bond by using two long sticks/poles. The two students will initially hold the ends of the two sticks. But slowly the student representing oxygen A, (being more electronegative) will be pulling the sticks more towards himself/herself and student B will be letting the sticks move more towards student A (oxygen)

When the sticks (representing electrons) move more towards student A, students will be asked open ended & meaning full questions. Students will be then asked where should the partially charged paper crowns be placed .

Student A representing oxygen : electrophilic: loves electrons: so the shared electrons are displaced more towards oxygen : making it partially electronegative : partially negative crown is therefore placed on student A.

An eager volunteer from the class comes and brings a paper crown with partial - sign and places it on student A

Similarly a paper crown showing partial + charge is placed on the student B(carbon) .

**Distinguishing aldehydes & ketones (Inquiry based learning )**

Problem statement : What effect does the bulkiness of the alkyl groups (steric hindrance) have on the reactivity of ketones when you compare with aldehydes?

**Aldehydes vs ketones : Reactivity**

Generally, aldehydes are more reactive than ketones. There is a combination of steric hindrance and inductive effects that make ketones react slower than the corresponding aldehydes .

This concept is very important and since it can at times be confusing and demanding ,students can loose interest. So it is essential that the concept should be presented in such a way that students can make simple , straight forward &meaningful connections .

**Teaching strategy: Direct instruction + role play + simulation+ power point presentation**

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| **Concept introduced** : The aldehydes are more reactive than ketones because :   1. *Bulky alkyl groups present in ketones makes it difficult (hinder) the action of nucleophiles* 2. *Alkyl substituents are also weakly electron donating thus they make the carbon in the carbonyl less electrophilic ( or electron loving - philic : love ;phobic : hate ,decreased electropositivity )* |

# Minds on: “Steric Hindrance is Like a Fat Goalie”

# Quiet reading time : Students read the following article

# <http://masterorganicchemistry.com/2011/07/18/steric-hindrance-is-like-a-fat-goalie/>

“Sportswriter Todd Gallagher asked a question that every hockey fan has probably asked at one point. “*Could a morbidly obese goaltender succeed in the NHL?”As he relates in “*[*Andy Roddick Beat Me With a Frying Pan*](http://www.amazon.com/Andy-Roddick-Beat-Frying-Pan/dp/0307352803)*“, he talked Washington Capitals owner Ted Leonisis into letting him run an experiment. He hired Trevor, a local college goaltender, to wear a 1000 pound fat suit, and then let NHL players take target practice. Quote: Trevor’s goalie crouch was itself unnerving: butt on the ice and legs splayed out in front of him—really the only way someone that large could be situated. There were certainly places to score around his head and shoulders, but he filled most of the net and made it difficult to see the goal line.”*

# Role play : Students role play steric hindrance

# A group of volunteers (alkyl groups) surround a parcel (carbon atom) and try to block a lone student (reactant) trying to approach or open the parcel.

# The reactant will be trying to react (open/recover) with the carbon atom (parcel) .But the group of volunteers acting like alkyl groups(like the ones in ketones) will try to hinder(block) the reaction

“**Steric hindrance is the big barrier for chemical reactions.\* Remove it, and speed up the reaction.** “

**Tollens reagent test to distinguish aldehydes & ketones :**

Silver mirror test: **Minds ON + Hands on lab**

Students **watch a u tube clip on tollen’s (silver mirror) test** and perform the corresponding lab.

<http://www.youtube.com/watch?v=zFMsqcGdZCc&feature=related>

<http://www.youtube.com/watch?v=GkyxNpitgeE>

**Simple addition reactions : Aldehydes vs ketones**

Aldehydes and ketones can be prepared by the **controlledoxidation reaction** of alcohols.

In producing aldehydes and ketones with alcohols it is very important to remember the type of alcohol (**primary alcohols- produces aldehydes, secondary alcohols –ketones and tertiary alcohols-no available hydrogen –no reaction**) Students learn the reactions and the concept by cooperative jigsaw or using mind maps.

**APPLICATION /Assessment**

**Suggested projects**

1. “The smell of formaldehyde was once common in the hallways of high schools, as it was used a preservative of biological specimens. This use has largely been discontinued.” Choose an aldehyde or ketone and do an extensive investigation to study the properties, benefits, environmental effects etc.

(Students will work in small groups of 2-3 and do an extensive study on the properties/advantaged/disadvantages of a carbonyl compound of their choice. They will be allowed to present the study in differentiated ways .A molecular model should be also included. )

Some questions to guide your investigation :

* *Why did you choose this particular compound?*
* *Is your molecule an aldehyde or ketone? Give reason why?*
* *Does your molecule contain any other functional groups? List and show where they are in the molecule.*
* *What are the main properties and important uses of the chosen compound?*
* *What are the environmental/social advantages & disadvantages of the compound?*
* *Are there any suggestions how you can use this compound in environmental friendly ways.*

(Suggested carbonyl compounds: acetone, formaldehyde , vanillin, acetophenone, cinnamaldehyde, camphor, muscone, formaldehyde, acetaldehyde, etc.)

1. *“In cases of severe diabetes, a patient’s tissues cannot break down glucose, and, instead, the body breaks down fat for its energy. The fats are broken down in the liver and muscles, producing several compounds called “ketone bodies,” one of which is acetone.  
    The acetone produced in this process is carried in the blood and urine.”*

*a. Explain why acetone is soluble in these aqueous solutions.  
b. When fats are the main source of energy production, there is an overproduction of ketone bodies, leading to a condition called ketosis. A patient with untreated diabetes may have a blood concentration of acetone of 20 mg/ 100 mL. Convert this concentration to mol/L.  
c. Acetone is volatile and is exhaled with the breath. Suggest a reason why, like untreated diabetic patients, people who are severely starved or dieting may have a smell of acetone on their breath – a diagnostic symptom of ketosis.   
d. Other ketone bodies lower blood pH, causing a condition called acidosis, which can lead to coma and death. Research the symptoms and effects of ketosis and acidosis and how these conditions may be avoided.*

Present your project to the class in the form of any differentiated activity , role play, PowerPoint presentation, Bristol board presentation, etc.

**Other applications of aldehydes & ketones**

Acetone is one of the few organic compounds that is infinitely soluble in water. it is one of the most important industrial solvents, being used in such products as paints, varnishes, resins, coatings, and nail-polish removers. Other aldehydes and ketones of industrial significance are mainly used as solvents ,perfumes, and flavoring agents or as intermediates in the manufacture of plastics, dyes, and pharmaceuticals.

**Differentiated learning, accommodation & integration**

*Resource: ”Start where they are” Karen Hume (1, 2, 3)*

1. *Pre-assess students one - two weeks before the beginning of the unit.*
2. *Teacher should use the observations from the hands-on activities as a form of individual pre-assessment. Teacher should regrouped students for the next activities based on these results to make students engage with the essential concepts of the unit.*
3. *Teacher should discuss the intended learning outcomes with the students at the beginning of the unit.*
4. *Tiered assignments will be given to make sure students get the big ideas and the essential skills involved and the assignments will be given at different levels of complexity and open-ended ness. For example students who already understood the concept of steric hindrance are given a virtual lab assignment in which they must develop and test hypotheses related to the topic, while other students are given more direct instruction on the concept. Students are given a choice that contains a list of possible activities they can complete to learn more about aldehydes & ketones. The activities include hands on activities to further explore carbonyl compounds like reading books, or watching a video .Students will be asked to research more on aldehydes/ketones from internet or u-tube to share with the class.*

*Accommodation: ELL-students: 1. Students use computer to type their exit tickets, quiz. 2. Teacher – student conference/ interview to assess the student learning and understanding of the concepts.*

**How to overcome obstacles while teaching major concepts ?**

* Use simulations ,animations ,molecular models for more concrete example
* Steric hindrance can be showed using animation or simple role play
* Students can build their own models using fruits like plums ,grapes ,marshmallow to create fun models.
* Differentiated teaching & learning
* Flexible & varied teaching strategies incorporating :

-Presentation /Direct instruction

-U tube clips/videos Inquiry method

-Role paly/ Simulations

-Open ended questions/ Demonstrations

**References**

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