



Sequence n° 4: chemical kinetics



Fiche de synthèse mobilisée (collection en français) :

- Fiche n°4 : cinétique d'une réaction chimique



Sommaire des activités ETLV :

- ACTIVITY 1: discovering catalysis
- ACTIVITY 2: homogenous catalysis and heterogenous catalysis
- ACTIVITY 3: Perseverance rover
- ACTIVITY 4: MOXIE

ACTIVITY 1 : Discovering catalysis

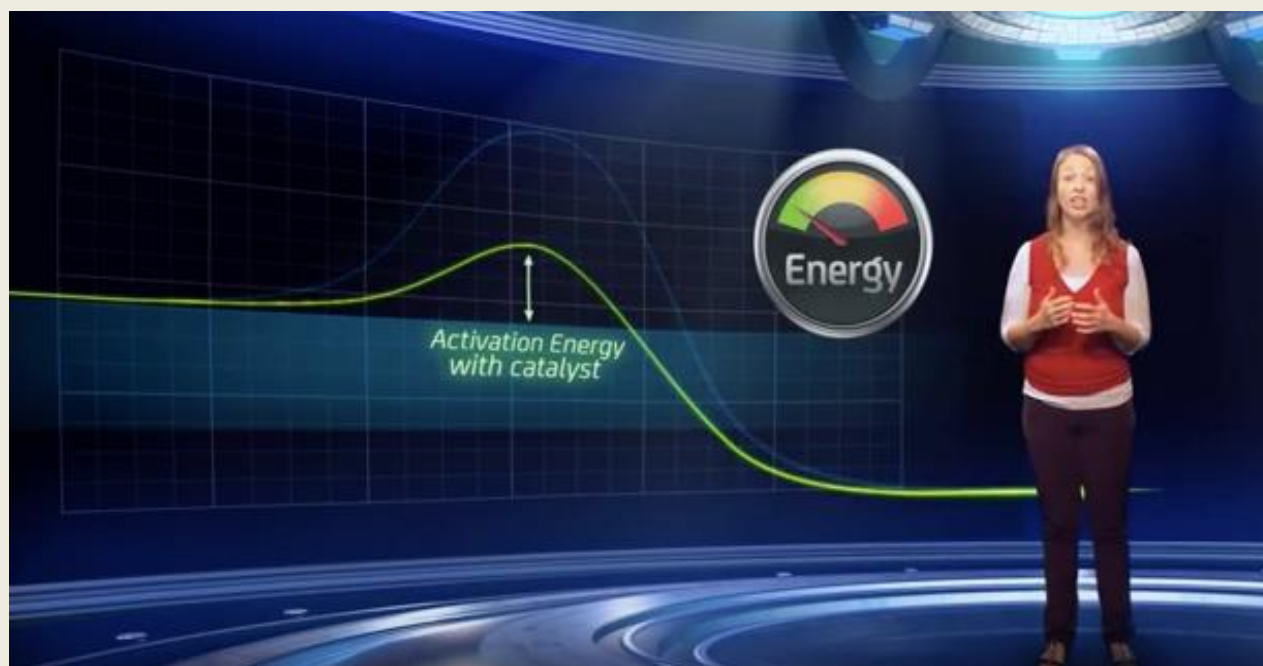
Objective: understanding catalysis

Part 1: Discovering catalysis

DOCUMENT 1: Catalysis video

Southampton University Open Course Ware: catalysis

https://www.youtube.com/watch?v=A_PhvlktMOW





■ **Understanding:**

Watch the “Catalysis” video from the Southampton online learning course. **(Start at 1:10s end 2:20s)**

What does the video deal with? _____

Give your definition of a catalyst:

List some advantages of using a catalyst:

Part 2: Using a homogeneous catalyst

■ **Understanding:**

Watch the “Catalysis” video: **(Start at 2:20s end 3:45s)**

Write the chemical reaction that needs to be sped up:

Which solution is added to speed up the reaction?

Which ion in your opinion acts as a catalyst of the reaction?

How does the catalyst work? Explain its mode of action.

ACTIVITY 2 : Homogeneous catalysis versus heterogeneous catalysis

Objective: distinguishing homogenous and heterogenous catalysis

Part 1 : Homogeneous versus heterogeneous catalysis

■ **Understanding:**

Watch the “Catalysis” video: **(Start at 3:45s end 5:30s)**

What is homogeneous catalysis? Give an example:

What is heterogeneous catalysis? Give two examples and write the chemical reactions involved.



Part 2: Summing up vocabulary

■ Acquiring vocabulary:

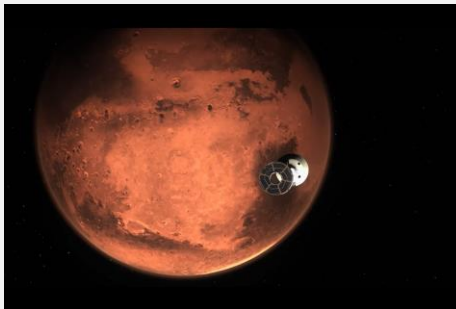
Using the previous activities, find an equivalent for:

English	French
a catalyst	
reaction rate	
to be sped up	
iron nitrate	
hydrogen peroxyde	
oxygen gas	
homogeneous catalysis	
activation energy	
a hill	
heterogeneous catalysis	
a catalytic converter	
a honeycomb structure	



ACTIVITY 3: Perseverance Rover

DOCUMENT 1: Mars Perseverance Overview



The Mars 2020 Perseverance Rover will search for signs of ancient microbial life, which will advance NASA's quest to explore the past habitability of Mars. The rover has a drill to collect core samples of Martian rock and soil, then store them in sealed tubes for pickup by a future mission that would ferry them back to Earth for detailed analysis. Perseverance will also test technologies to help pave the way for future human exploration of Mars.

Strapped to the rover's belly for the journey to Mars is a technology demonstration — the Mars Helicopter, Ingenuity, may achieve a "Wright Brothers moment " by testing the first powered flight on the Red Planet.

Searching for Ancient Life, Gathering Rocks and Soil

There are several ways that the mission helps pave the way for future human expeditions to Mars and demonstrates technologies that may be used in those endeavors. These include testing a method for producing oxygen from the Martian atmosphere, identifying other resources (such as subsurface water), improving landing techniques, and characterizing weather, dust, and other potential environmental conditions that could affect future astronauts living and working on Mars.

Sources : <https://mars.nasa.gov/mars2020/mission/overview/>

According to the Perseverance Rover overview and the video on the Nasa's website (watch <https://mars.nasa.gov/mars2020/mission/overview/>), answer the following questions:

- 1. What do scientists search for on Mars?

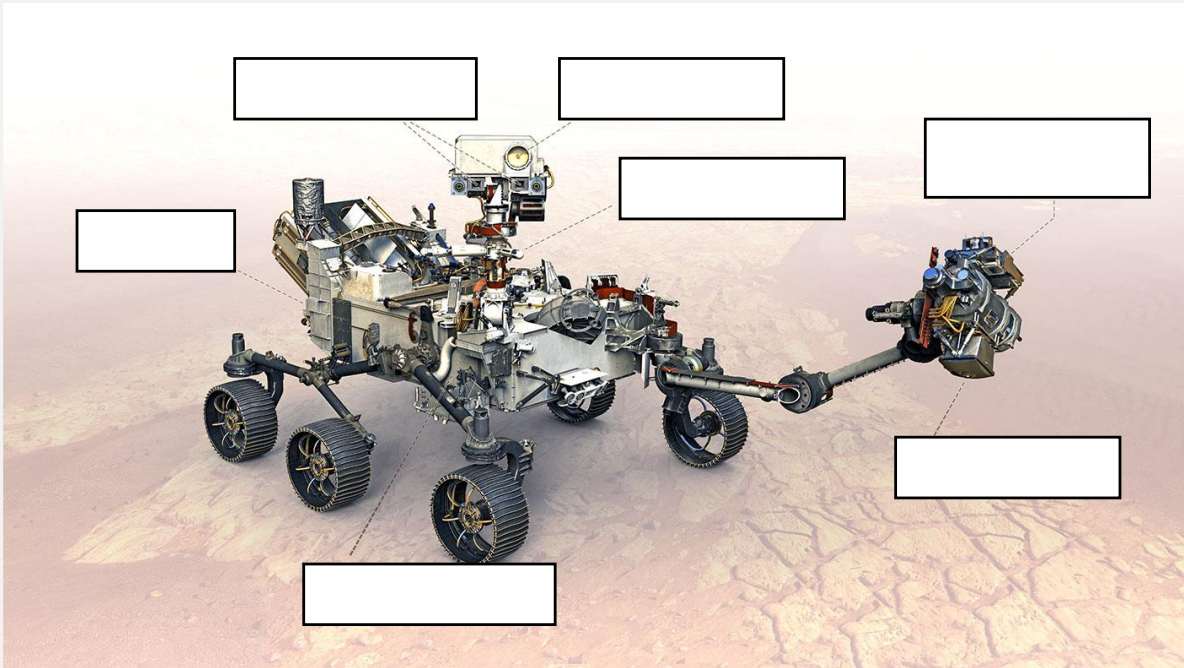
- 2. Why did scientists choose Jezero crater for the Perseverance Rover landing?

- 3. Fill the following tab with names and functions of science instruments equipped on Perseverance rover and use them to label document 2.

Name							
Function							



DOCUMENT 2: Mars Perseverance instruments



Sources : Nasa®

4. Which other special technology is the Perseverance Rover equipped with? What is its name?

5. What is the speed of Perseverance rover on the surface of Mars?

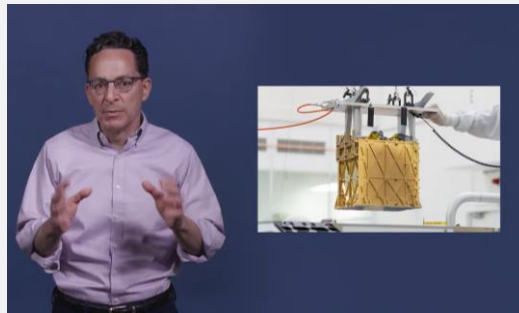
6. What do scientists want to do with samples picked up by the Perseverance Rover?

7. Why do scientists need to know Mars better?



ACTIVITY 4: MOXIE

DOCUMENT 3: MOXIE presentation



Sources : <https://www.mathworks.com/company/mathworks-stories/moxie-converts-mars-co2-to-oxygen.html>

A bit of help:

English	French
sample	échantillon
scientists	scientifiques
average	moyenne
amount of substance	quantité de matière
monitoring	suivi

English	French
rate	vitesse
landing	atterrissage
step	étape
supply	délivrer

8. What does MOXIE stand for?

9. How does MOXIE produce oxygen?

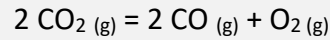
10. Which different components are part the MOXIE system?

11. What is the average oxygen production rate of MOXIE?

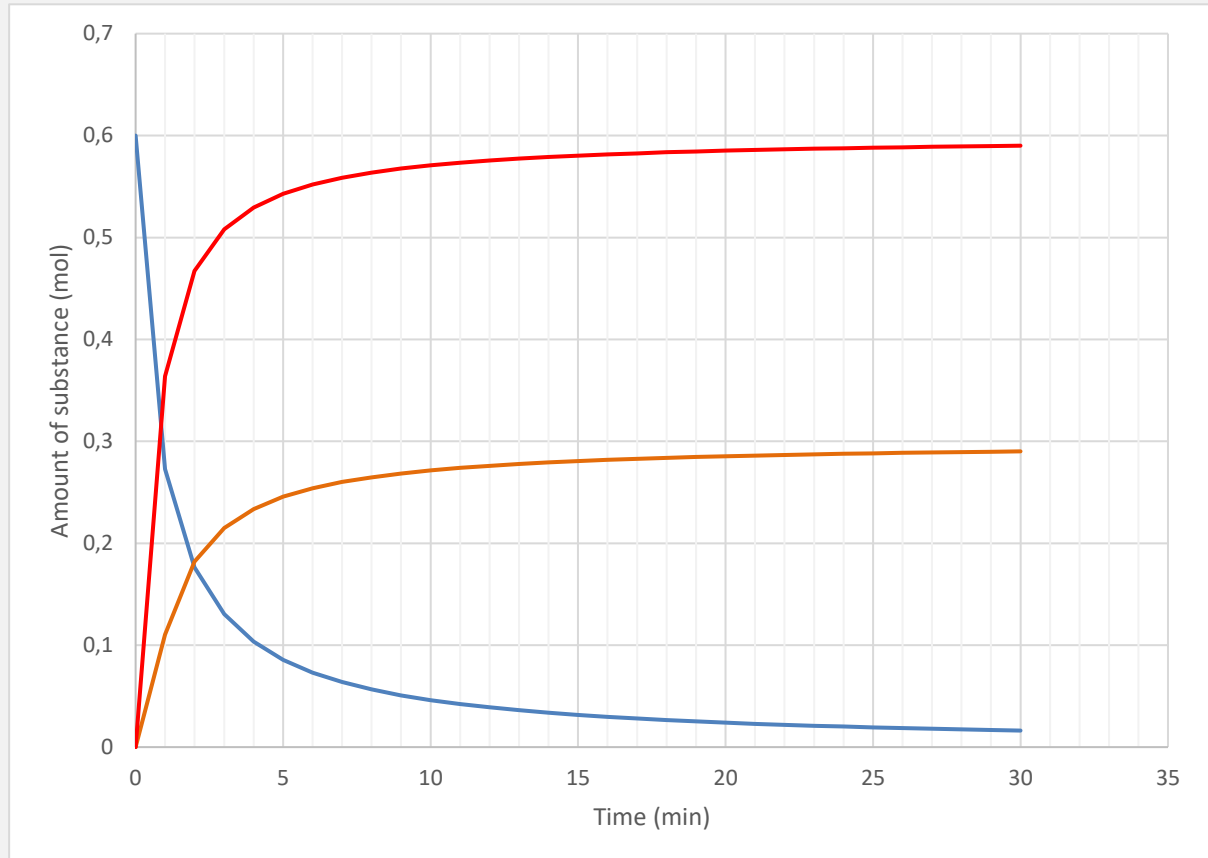
12. Give two reasons for producing oxygen on Mars:

**DOCUMENT 4: Chemical Kinetics of oxygen production**

Electrolysis takes place in a cell containing an electrolyte and two electrodes connected to the terminals of a direct current generator. The global equation of the chemical transformation is:



The graph of the kinetic monitoring of this reaction is given with the time in minutes and the amount of substance in mol.



Data: C (Z=6), M(C) = 12 g.mol⁻¹ ; O (Z=8), M(O) = 16 g.mol⁻¹ ; $\rho(\text{O}_2(\text{g})) = 1,2 \text{ kg.m}^{-3}$

13. On document 4, associate each curve with the corresponding species.

14. Graphically determine $t_{1/2}$ the reaction's half-life.

15. List two factors that can influence the kinetics of the reaction.



16. Determine the mass of oxygen m_{O_2} formed in 30 minutes.

17. How long could a 90 kg human being survive with this amount of dioxygen knowing that his average dioxygen consumption is $r=50 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$?



Activity summary

What you must remember:

- a catalyst enables to speed up a reaction rate
- a catalyst lowers the activation energy of the reaction
- catalysis can take place in homogeneous phase or heterogeneous phase
- how to use a graph of the kinetic monitoring of a chemical reaction

Skills linked to the curriculum:

Compétences	Capacités à maîtriser
<ul style="list-style-type: none">- APP- ANA	<ul style="list-style-type: none">- Utiliser le vocabulaire lié à la catalyse- Utiliser du vocabulaire spécifique- Lire, comprendre et identifier les informations scientifiques pertinentes dans des documents scientifiques- Mettre en lien des documents pour émettre des hypothèses en réponse à une question scientifique
<ul style="list-style-type: none">- APP- ANA	<ul style="list-style-type: none">- Définir un catalyseur et l'identifier dans une transformation chimique.
<ul style="list-style-type: none">- APP- COM	<ul style="list-style-type: none">- Qualifier la nature de la catalyse.- S'exprimer à l'écrit en utilisant le vocabulaire adapté