Biology experiments in English

（ALTによる英語での生物実験）

Worksheet1

生物実験[Biology experiments] (in class2-4/5, 2-7,2-8)　**酵素(カタラーゼ)の性質**

(教科書 P25,図表 P32～33)

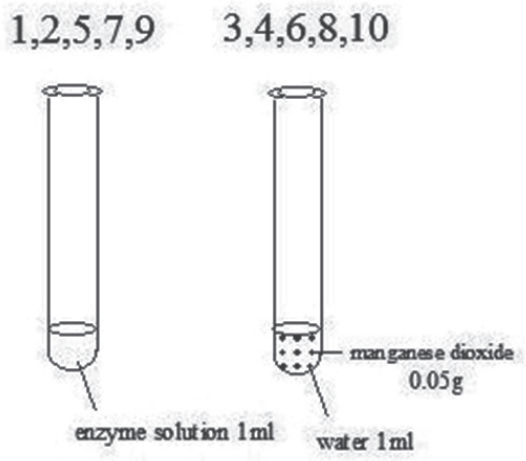
【 Goal 】

To understand the nature of enzymes, using Catalase

【Procedure】

<< Operation A>>
To make enzyme solution
1) Grind 1.5g chicken liver with a mortar
2) Add 20ml water

<< Operation B>>
[Test tube 1,2,5,7,9]
: Add 1ml enzyme solution with a pipette
[Test tube 3,4,6,8,10]
: Add 1 spatula of manganese dioxide (about 0.05g) and 1ml water with a pipette



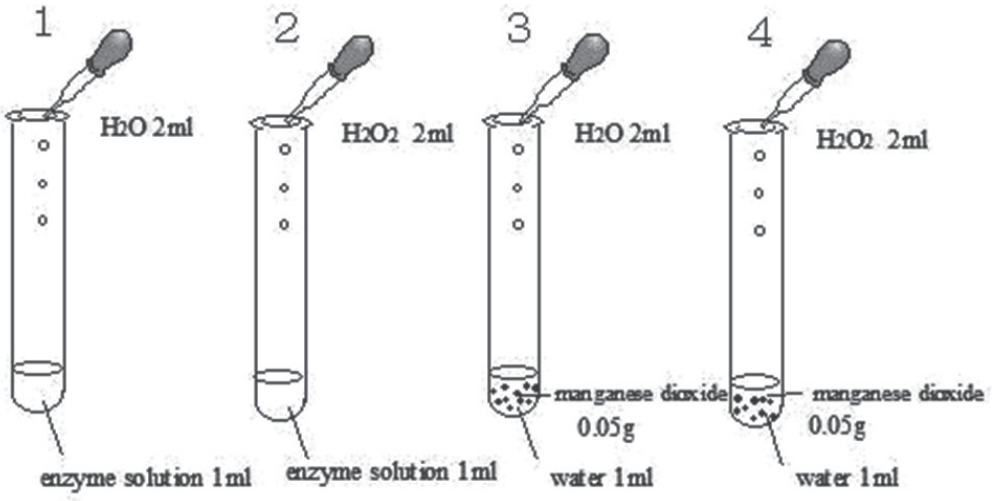
<< Operation C>>
[Test tube 5,6] : Heat the test tube by putting it in boiled water for about 1minute and then remove and let it cool
[Test tube 7,8] : Add 1ml of 10% HCl with a pipette and then mix well
[Test tube 9,10] : Add 1ml of 20% NaOH with a pipette and then mix well

<< Operation D >>
[Test tube 1,3] : Add 2ml water with a pipette
[Test tube 2,4] : Add 2ml of 3% H_2O_2 with a pipette

→ write observation

<< Operation E >>
[Test tube 2,4] : After the reaction of << Operation D>> :
1) Light an incense stick
2) Blow out the incense stick
3) Put the burning end of the incense stick inside the test tube 2,4

→ write observation



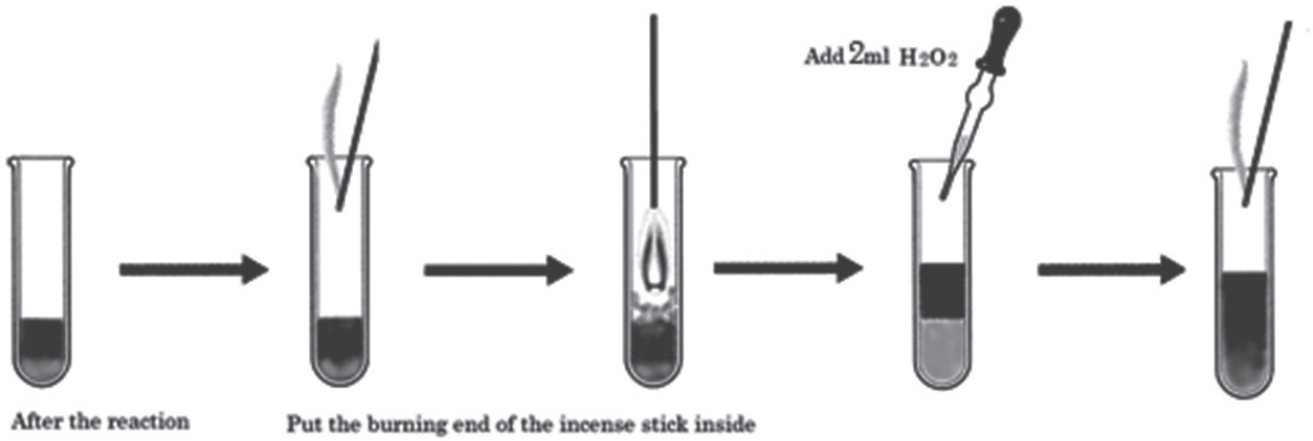
<< Operation F >>

[Test tube 2,4] : After the reaction of << Operation E>>:

Add 2ml of 3% H_2O_2 with a pipette

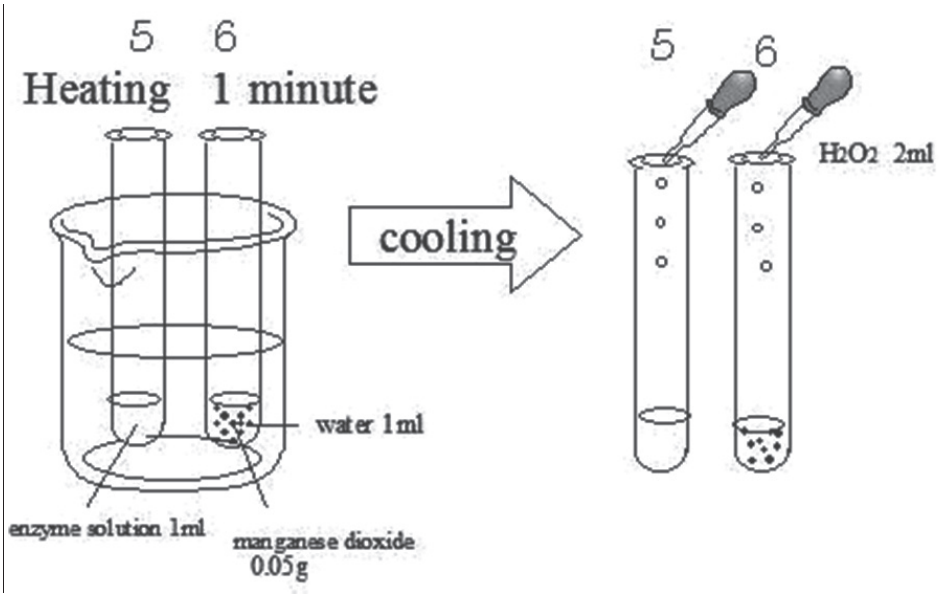
After the reaction , put the burning end of the incense stick inside the test tube 2,4

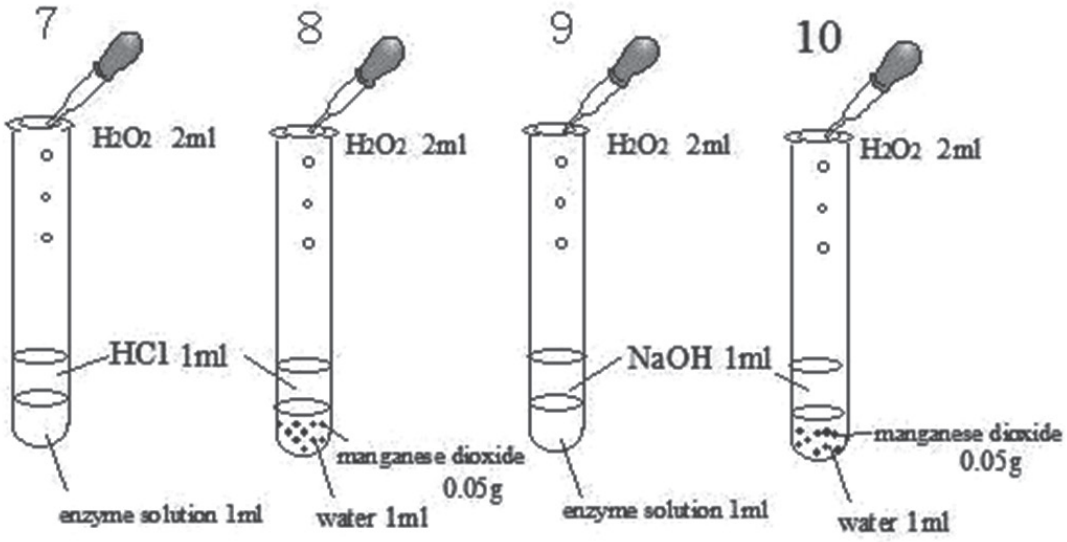
→ write observation



<< Operation G >>

[Test tube 5,6,7,8,9,10]: Add 2ml of 3% H_2O_2 with a pipette → write observation





Worksheet2

2－　　No.　　Name

Describe the reaction

<< Operation D >>

Test tube 1

Test tube 2

Test tube 3

Test tube 4

<< Operation E >>

Test tube 2

Test tube 4

<< Operation F >>

Test tube 2

Test tube 4

<< Operation G >>

Test tube 5

Test tube 6

Test tube 7

Test tube 8

Test tube 9

Test tube 10

【words】 Catalase カタラーゼ　enzyme 酵素　hydrogen peroxide 過酸化水素　liver 肝臓
manganese dioxide 二酸化マンガン　spatula 薬さじ（小）　pipette ピペット　mortar 乳鉢
test tube 試験管　inorganic catalyst 無機触媒　incense stick 線香　gas 気体
reaction 反応　evolve(他動詞)〈熱・光・ガスなどを〉放出する　decompose(他動詞)〈…を〉分解する
heated（形）加熱した　Chemical reaction formula 化学式　enzyme solution 酵素液　catalysis 触媒作用
denature 変性する　protein タンパク質　acid 酸　base 塩基　substrate specificity 基質特異性

Questions

1 What does Catalase decompose?

2 What kind of gas was evolved in test tubes?

3 Write chemical reaction formula for the Catalase reaction.

4 After the reaction, does Catalase have the ability to decompose H_2O_2?

Answer following questions. **(You can use Japanese)**

5 test tube 1 and 2 の結果から何がわかりますか。

6 test tube 3 and 4 の結果から何がわかりますか。

7 test tube 5 and 6 の結果から何がわかりますか。

8 test tube 7 and 8 の結果から何がわかりますか。

9 test tube 9 and 10 の結果から何がわかりますか。

10 test tube 1 and 3 のような実験を何と呼ぶのか。

Write down what you think or understand through this experiment. **(You can use Japanese)**

Questions の こたえ これは配布しない

1 What does Catalase decompose?

【H_2O_2】

2 What kind of gas was evolved in the test tube?

【O_2】

3 Write chemical reaction formula for the Catalase reaction.

【 $2H_2O_2 \rightarrow 2H_2O + O_2$ 】

4 After reaction, does Catalase have the ability to decompose H_2O_2?

【 Yes, it does. 能力はもっている。 】

Explain following questions. (You can use Japanese)

1 test tube 1 and 2 の結果から何がわかりますか。

【酵素液は過酸化水素を分解できるが水は分解できない。】

2 test tube 3 and 4 の結果から何がわかりますか。

【酸化マンガン(Ⅳ)は過酸化水素を分解できるが水は分解できない。】

3 test tube 5 and 6 の結果から何がわかりますか。

【加熱した酵素液ははたらきを失うが、酸化マンガン(Ⅳ)は失わない。】

4 test tube 7 and 8 の結果から何がわかりますか。

【酸によって酵素液ははたらきを失うが、酸化マンガン(Ⅳ)は失わない。】

5 test tube 9 and 10 の結果から何がわかりますか。

【アルカリ（NaOH）によって酵素液ははたらきを失うが、酸化マンガン(Ⅳ)は失わない。】

6 test tube 1 and 3 のような実験を何と呼ぶのか。

【対照実験 control experiment】

Write down what you think or understand through this experiment. (You can use Japanese)

生物実験
[Biology Experiment]
酵素（カタラーゼ）の性質

【 Goal 】
To understand the nature of enzymes, using Catalase

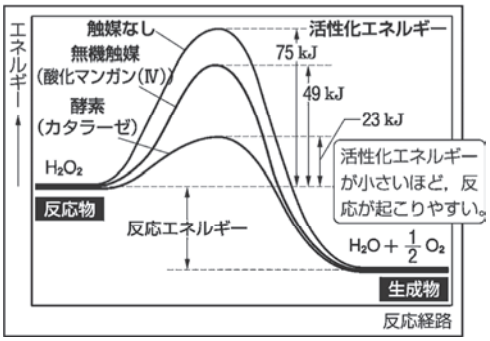
【 Main Idea】

Compare Enzymes and Inorganic Catalysts

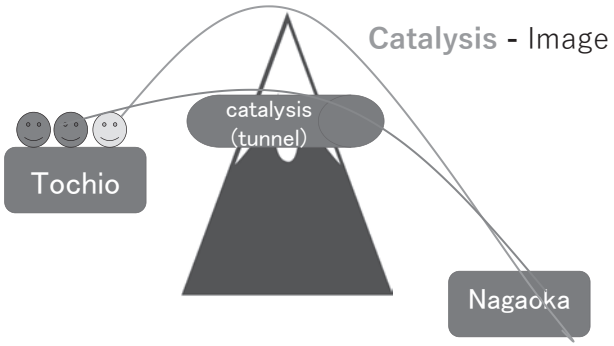
Catalase — Same effect — Manganese Dioxide (MnO_2)

But there are some differences
Let's find the differences in our experiment

Catalysis Review

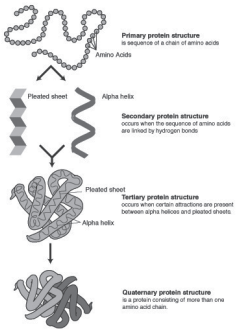


Catalysis - Image



Enzyme Properties Review

Protein Structure

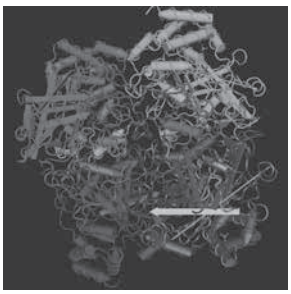


Key points:

- **2nd, 3rd, 4th are weak hydrogen bonds**
- **Enzyme shape creates catalysis ability**

No shape = No catalysis

http://www.ncbi.nlm.nih.gov/Class/MLACourse/Original8Hour/Genetics/protein.gif



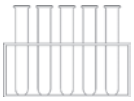
https://www.ncbi.nlm.nih.gov/Structure/mmdb/mmdbimage.fcgi?type=1&unm=1&uid=1SI8

【 Today's Procedure】

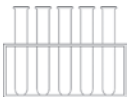
Catalase set

Look for differences

Manganese Dioxide set



1, 2, 5, 7, 9



3, 4, 6, 8, 10

Five Conditions

⊖ control (Water)
⊕ control (H_2O_2)
Heated
Acid
Base

Extra
Flame test
2nd Flame test

① Prepare Catalyst Solutions

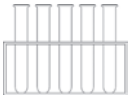
Catalase

[A] – Make enzyme sol.
[B] – Add 1ml solution to tubes

1, 2, 5, 7, 9

Manganese Dioxide (MnO_2)

[B] – small spoon of metal + 1ml water to tubes



3, 4, 6, 8, 10

② Prepare Acid, Base···Heated tests

Catalase
[C] – One tube each condition

Manganese Dioxide (MnO_2)
[C] – One tube each condition

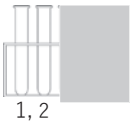
5, 7, 9

6, 8, 10

③ Test ⊖ , ⊕ controls
Flame test

Catalase
[D] – ⊖ , ⊕ control

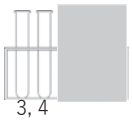
Right after D
[E] – Flame test
[F] – Second Flame test



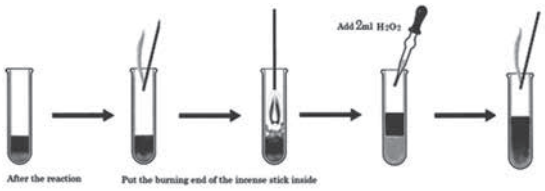
1, 2

Manganese Dioxide (MnO_2)
[D] – ⊖ , ⊕ control

Right after D
[E] – Flame Test
[F] – 2nd Flame test



3, 4



④ Test Heated, Acid, Base conditions

Catalase
[F] – Add H_2O_2 to each tube

5, 7, 9

Manganese Dioxide (MnO_2)
[F] – Add H_2O_2 to each tube

6, 8, 10

Hints

- Always write your observations after
  H_2O_2 → Reaction, no reaction
- Divide the work, share your observations

Catalase Prep Controls + Flame test	Manganese Prep Acid, Base Prep Heating prep

Team 1:

Prepare E n z y m e Solution + set [A, B]

Test ⊖ , ⊕ controls, Flame test [D, E, F]

Catalase
1, 2, 5, 7, 9 ➡ ⊖ , ⊕、 flame
1, 2, 3, 4

Team 2:

Prepare M a n g a n e s e set [B]

Prepare Acid, Base···Heated tests [C]

Test Acid, Base, Heated conditions [G]

Manganese Dioxide
3, 4, 6, 8, 10
⬇
Acid, base, heat
5, 6, 7, 8, 9, 10