

Electricity Generated by Microorganisms

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Introduction

Wastewater in the drain



Introduction

What we discovered



Electricity

Introduction

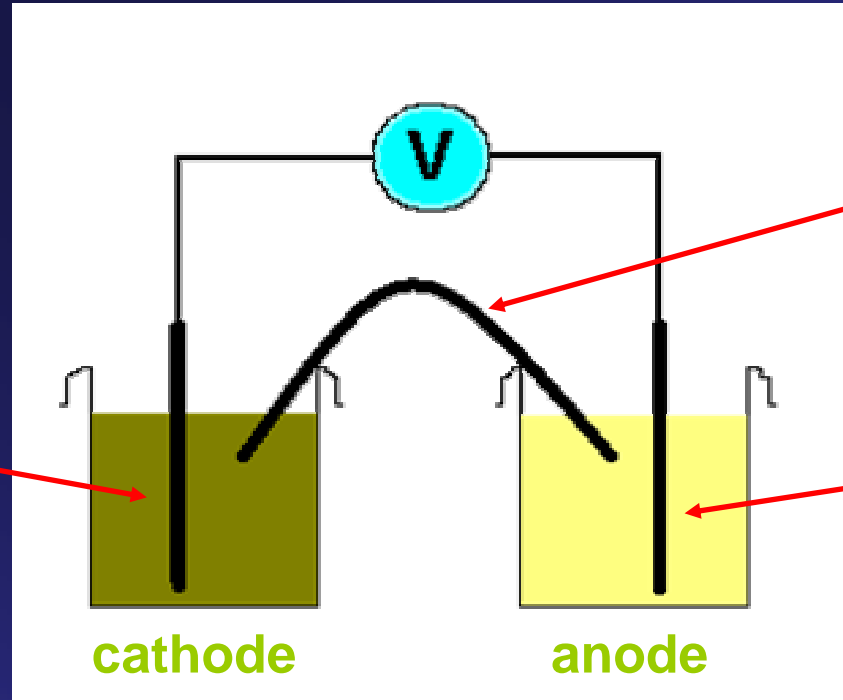
Wastewater we used



mildewed water
cress solution

mildewed glucose
solution

Our set-up,



salt bridge

wastewater

Potassium hexacyanoferrate(III) solution

Comparison of

Results

solution in anodic compartment	distilled water	mildewed water cress solution	glucose solution	mildewed glucose solution
Time taken to reach average electromotive force(s)	/	1150	/	2700
Average electromotive force (V)	0.12	0.161	0.11	0.139

Increases by 1.34 times

Increases by 1.26 times



Investigations

Part I : To investigate the factors affecting the

rate of respiration of yeast

Part II : To investigate the factors affecting

the rate of electrons transfer

Part III : To investigate the factors affecting

the real-life application of the fuel cell

Part I

1) To investigate the factors affecting the rate of respiration of yeast

A. To Find The Optimum Concentration Of Glucose Solution

B. To Find The Optimum pH Of The Anodic Compartment

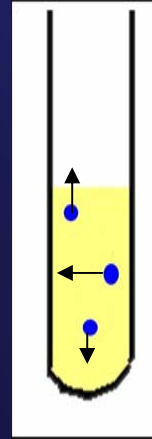
A. To Find The Optimum Concentration Of Glucose Solution

Concentration of glucose solution(M)	time taken(s)			
	1 st set	2 nd set	3 rd set	Mean
0.03	1/3 of the test tube is reached after 30min.			
0.3	241	226	236	234
0.4	197	203	197	199
0.5	218	228	247	231
0.6	240	228	229	233
0.7	231	228	228	227
0.8	239	228	228	233
0.9	252	246	227	242
2	1/3 of the test tube is reached after 45min.			

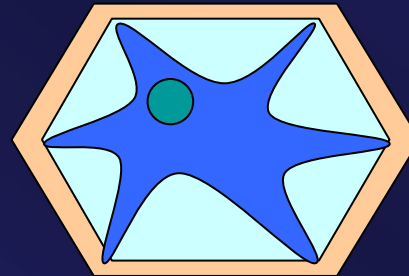
Shortest

optimum concentration: 0.4M

low concentration



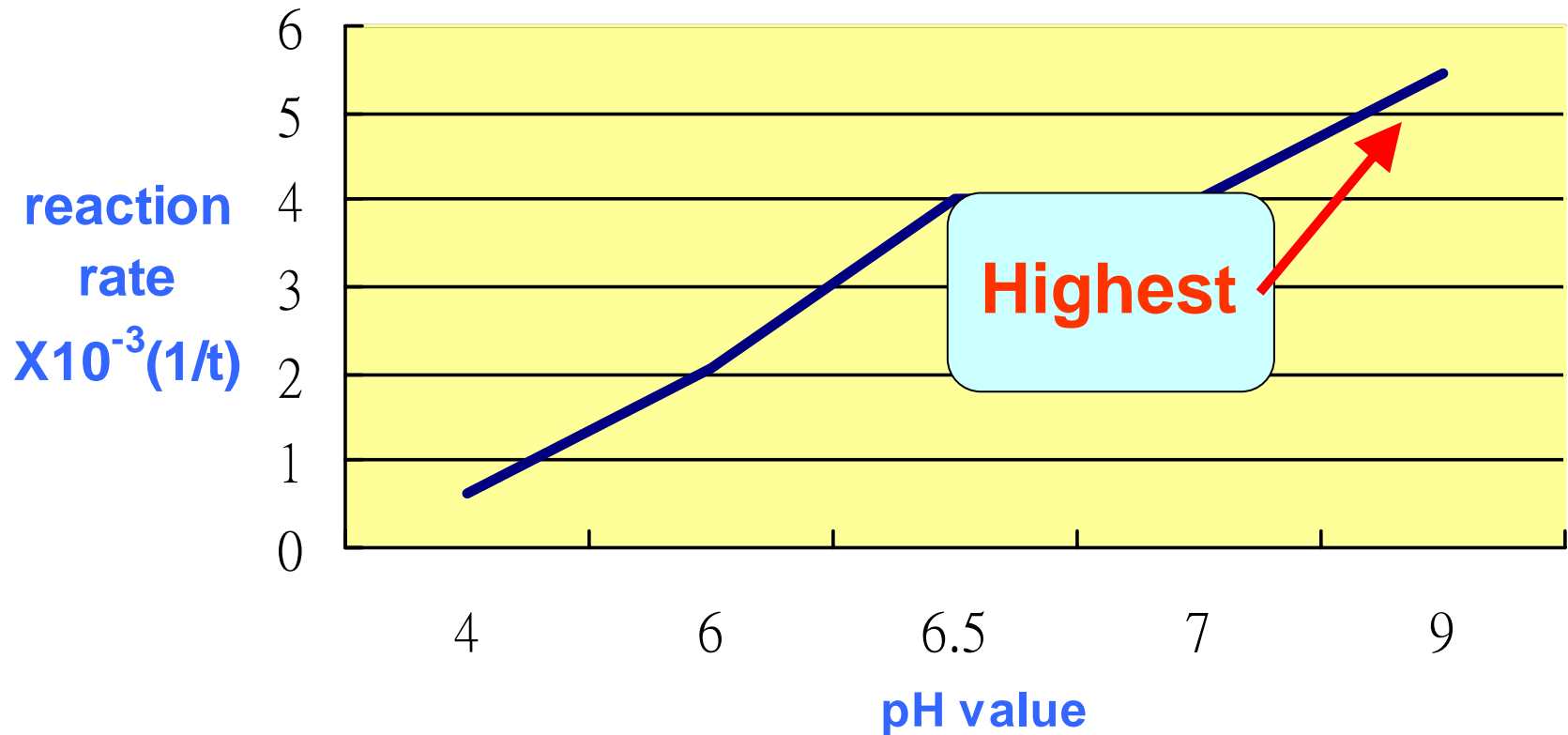
high concentration



plasmolysis

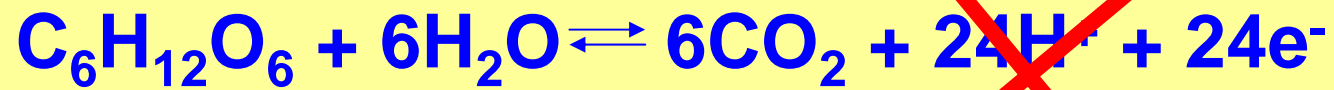
B. Determination Of The Optimum pH

The rate of respiration under different pH value



Why alkaline?

Equation for the first step of respiration is:



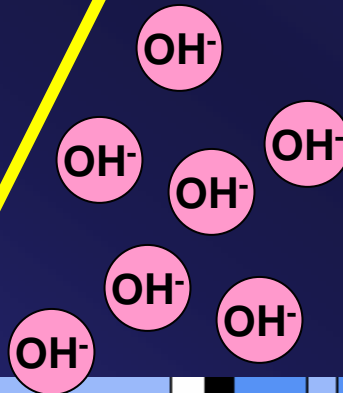
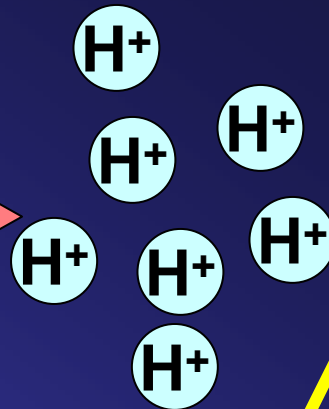
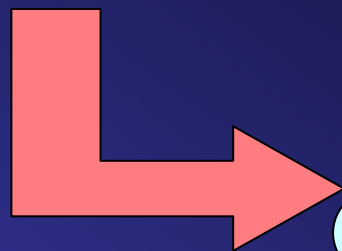
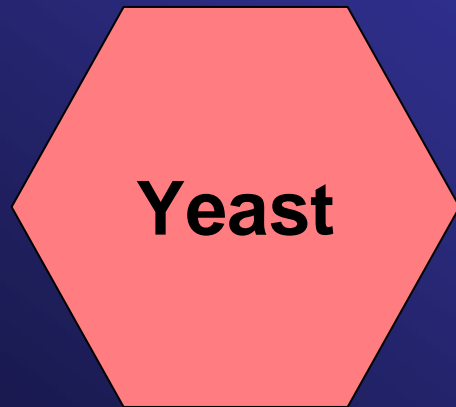
Equilibrium position shifts

Investigation

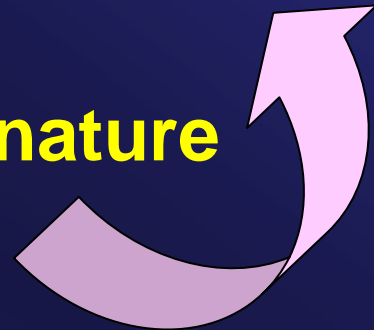
When pH value is too low or too high

Too low pH level

Too high pH level



denature



Part II

- A. To Find The Optimum Concentration Of Mediators
- B. To Find The Optimum Temperature Of The Setup

2) To investigate the factors affecting the rate of electrons transfer

A. To Find The Optimum Concentration Of Mediators

Results of thionine

Concentration	0.0005M	0.005M	0.01M	0.05M	0.1M
Time taken to reach steady electromotive force (s)	6280	4830	2180	1740	840
average electromotive force (V)	0.310	0.336	0.436	0.472	0.475

↓ time taken to reach steady e.m.f.

↑ average e.m.f.

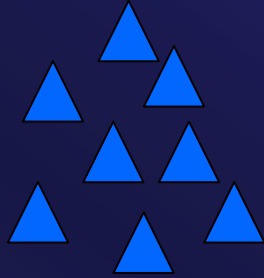
Results of methylene blue

Concentration	0.0005 M	0.005 M	0.01M	0.05M	0.1M
Time taken to reach steady electromotive force(s)	2760	1605	2700	2790	3305
average electromotive force (V)	0.281	0.448	0.465	0.460	0.298

fastest rate

When concentration is too high.....

too high conc.
methylene blue



↓ rate of e⁻
production

inhibit

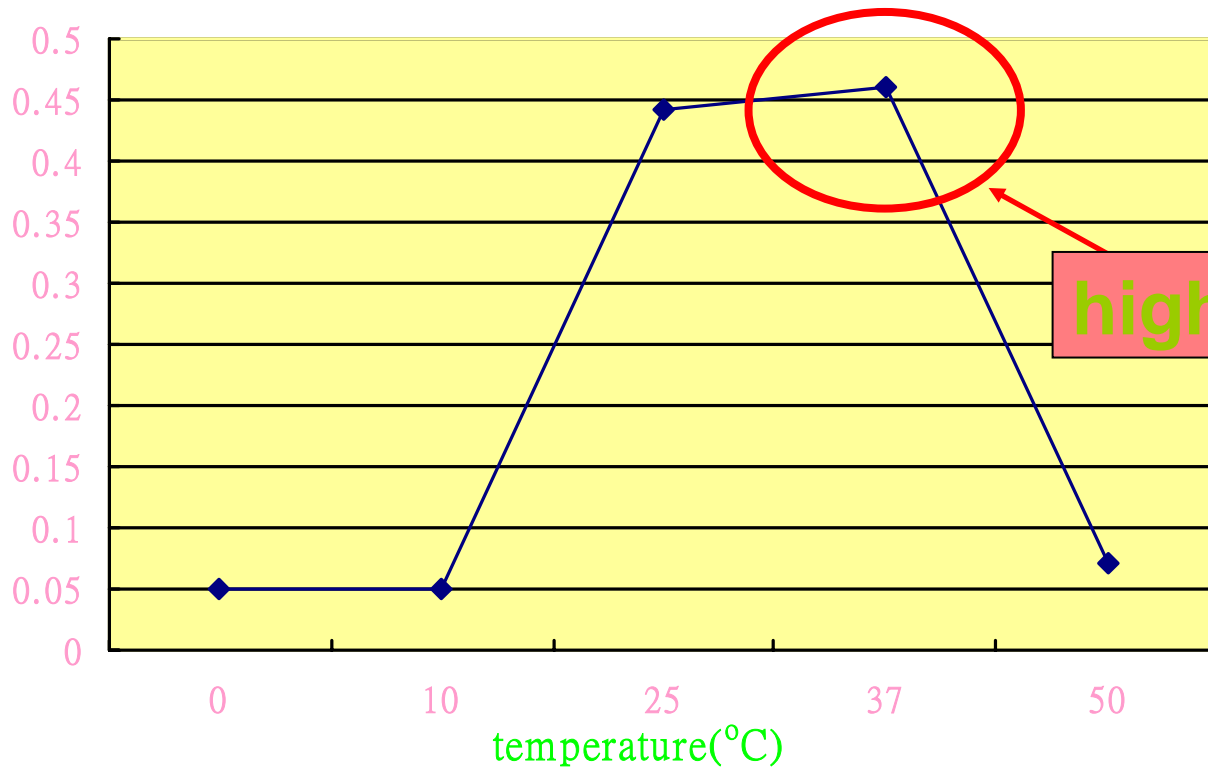
other reactions
in yeast

Investigation

B. To Find The Optimum Temperature Of The Setup

The average e.m.f. attained under different temperatures

average
e.m.f.(V)



highest rate

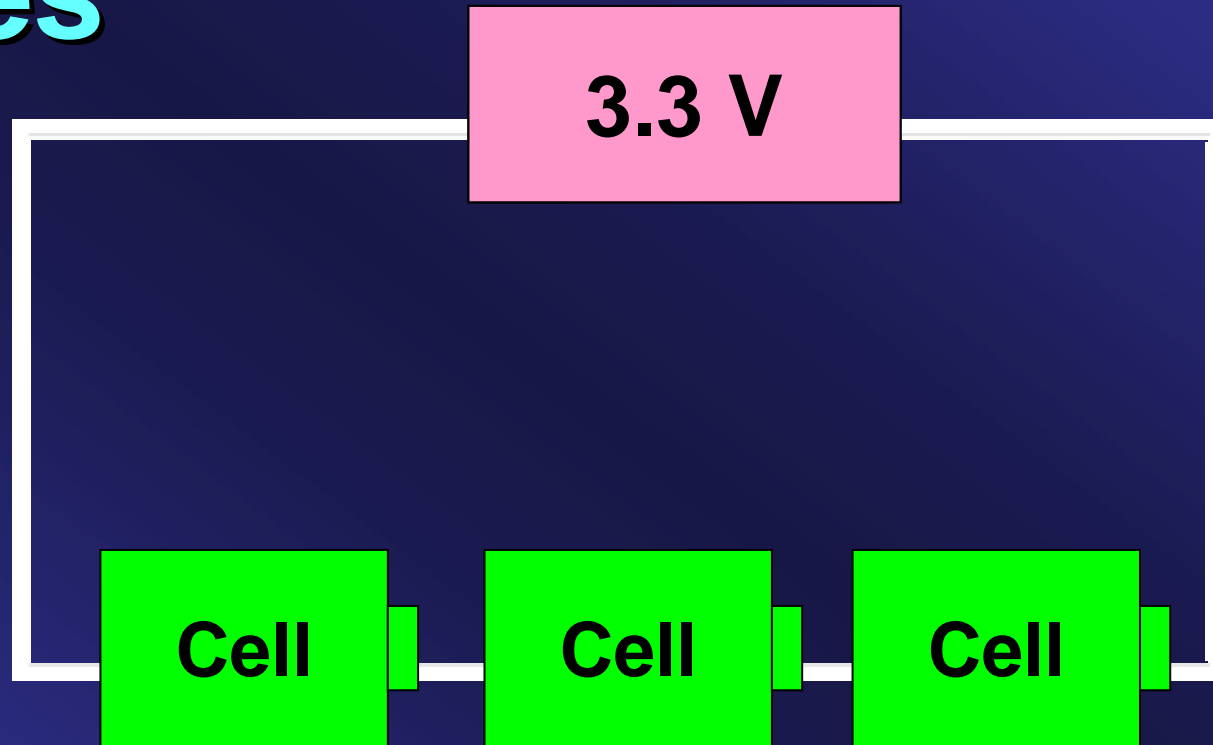
Part III

- 1
- A. Cells Connected In Series
- B. Relationship Between Current And Resistance

3) To investigate the factors affecting the real-life application of the fuel cell

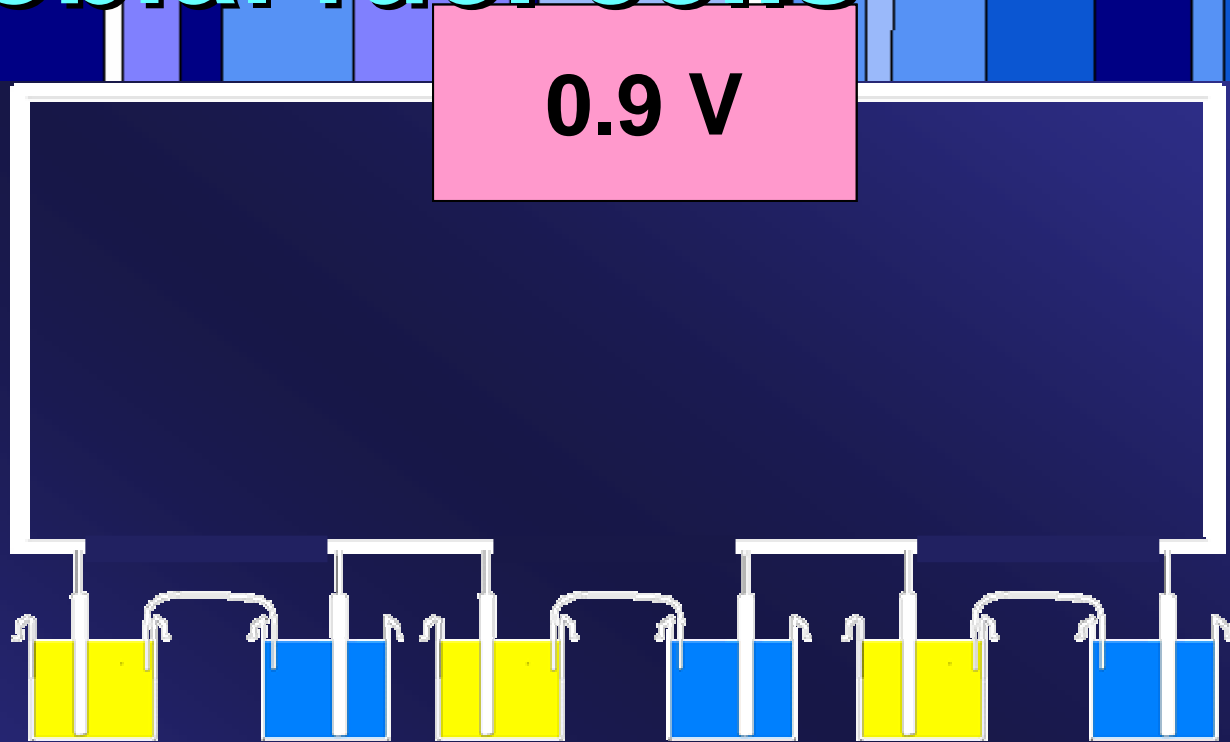
2) To investigate the factors affecting the rate of electrons transfer

A. Cells Connected In Series



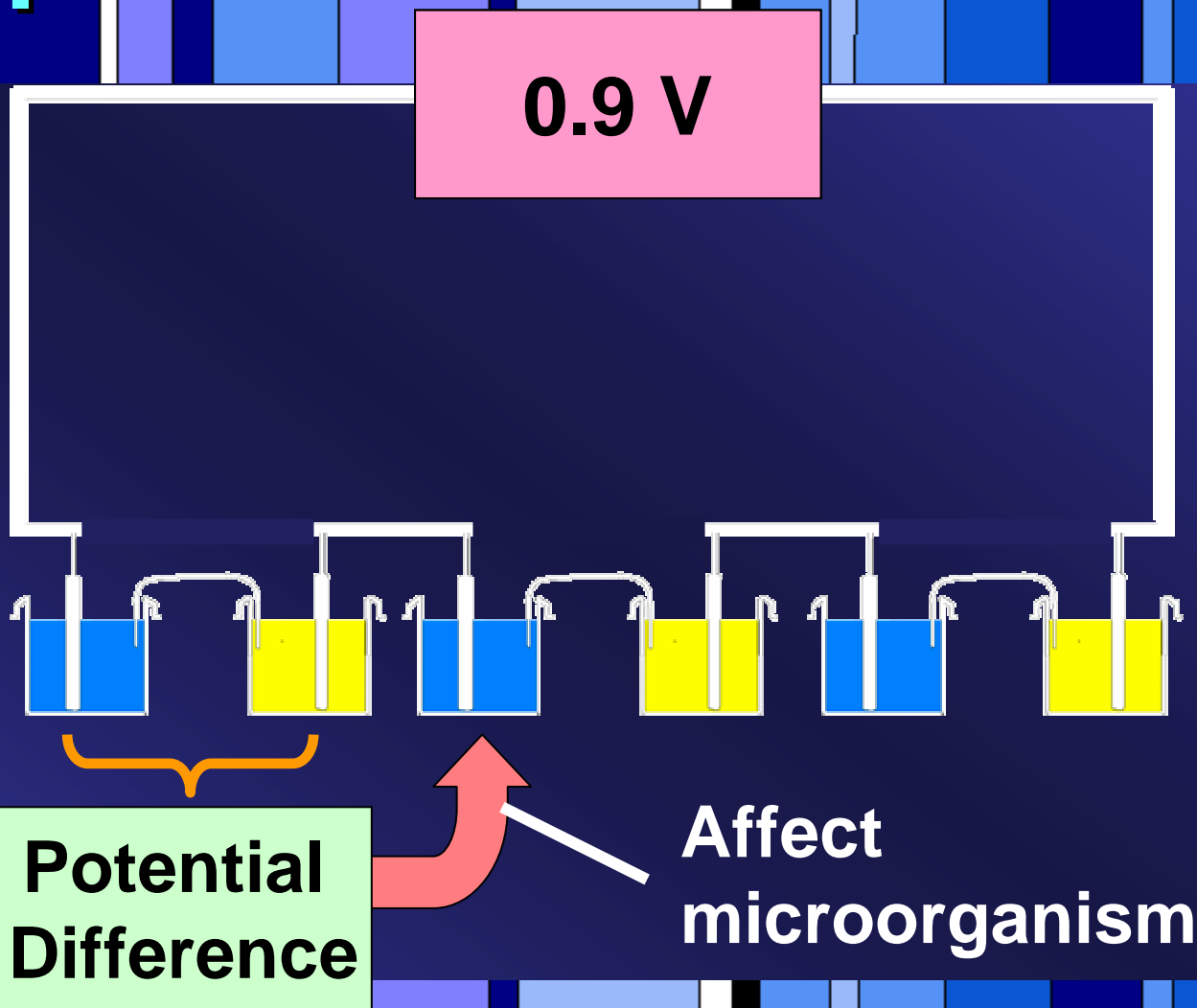
$$\text{Voltage} = 1.1 + 1.1 + 1.1 = 3.3\text{V}$$

Microbial fuel cells



Voltage = $0.5+0.2+0.2=0.9V \neq 0.5+0.5+0.5$

Why?



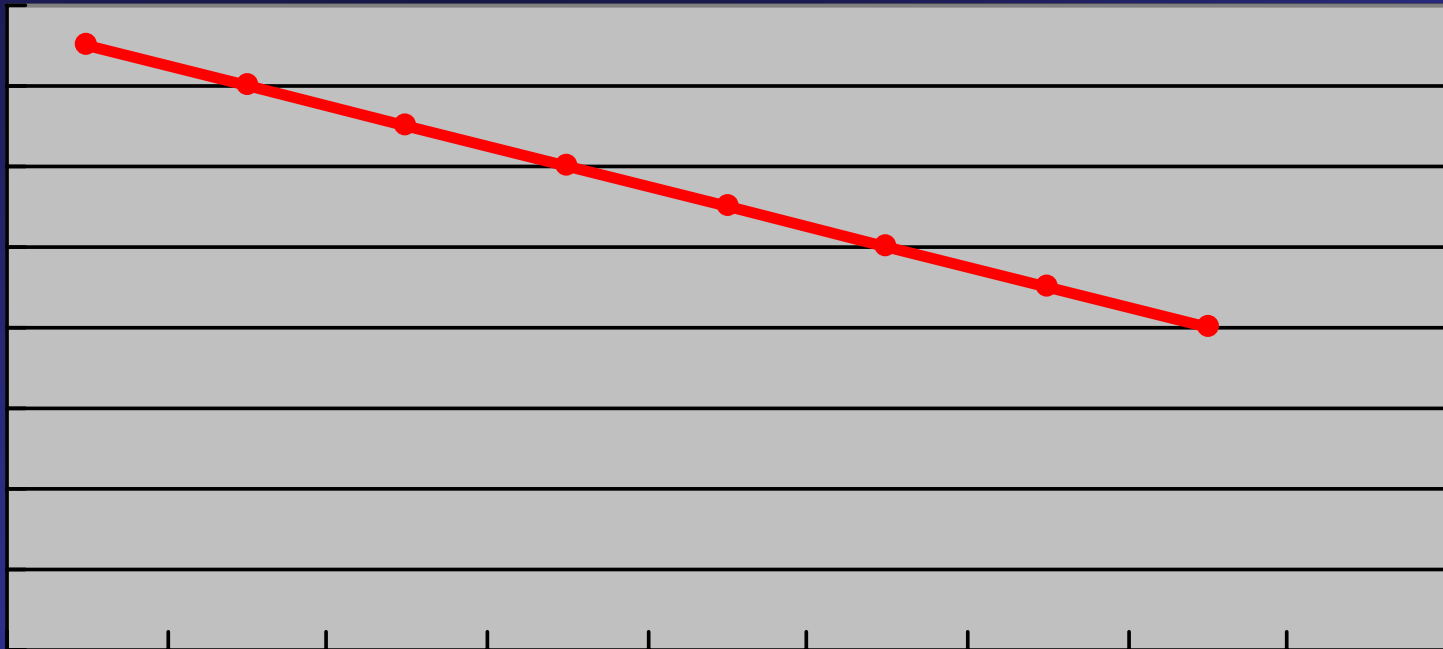
Investigation

B. Relationship Between Current And Resistance

The changes of current and e.m.f. of cell against time under low resistance

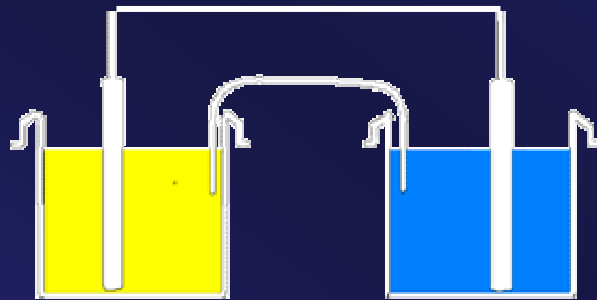
Current (mA)

0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0

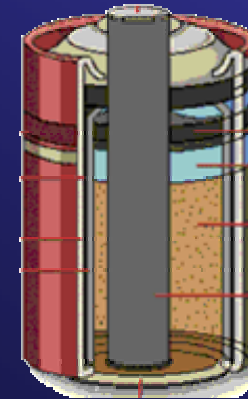


Time(s)

Investigation



Microbial Fuel Cell



Zinc-carbon cell

Both can recover later after a large current is drawn

Under high resistance...

Lower current: 0.01mA



**More than
24 hours**



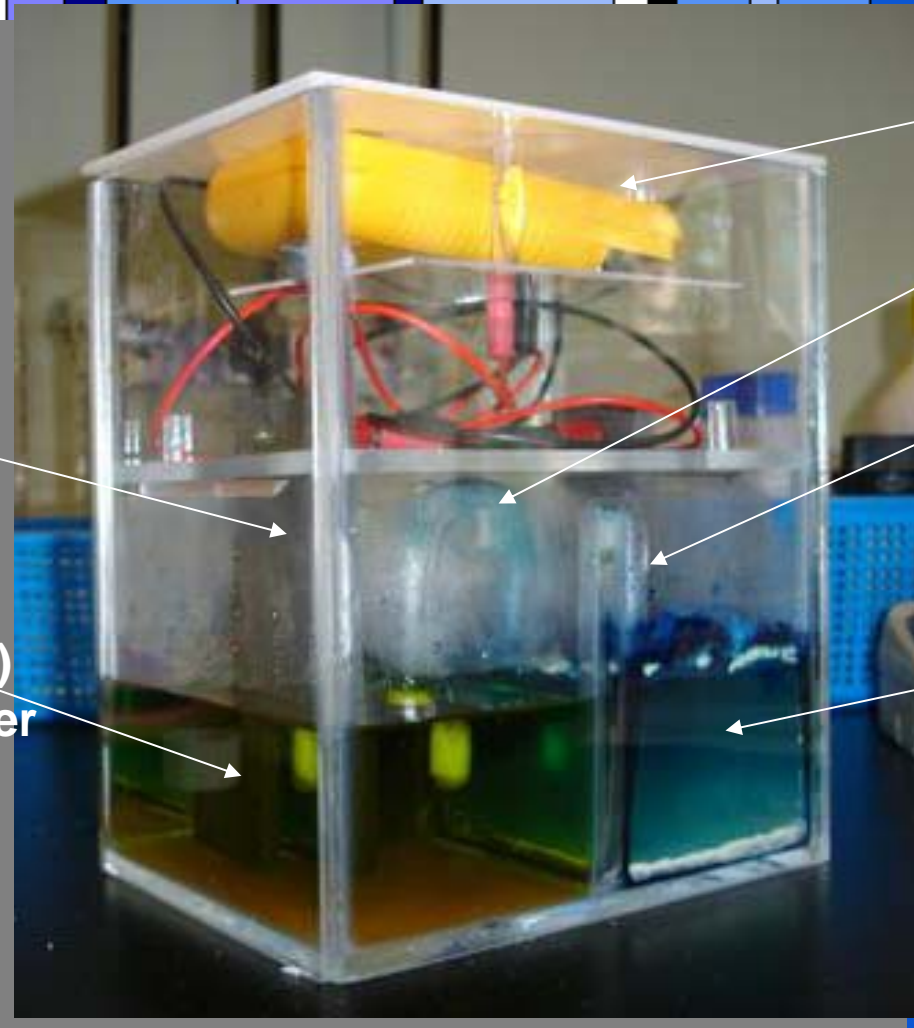
Conclusion

Construction of a simple mod



Conclusion

Our model



voltmeter

U-tube(KNO_3^- (aq))

carbon plate

0.005M methylene blue + 1g yeast + 0.4M glucose solution + pH 9 buffer

carbon plate

Potassium hexacyanoferrate(III) solution + pH 9 buffer

Conclusion

At optimum conditions,

e.m.f: 0.5V

current: 0.15mA

Conclusion

Major setback

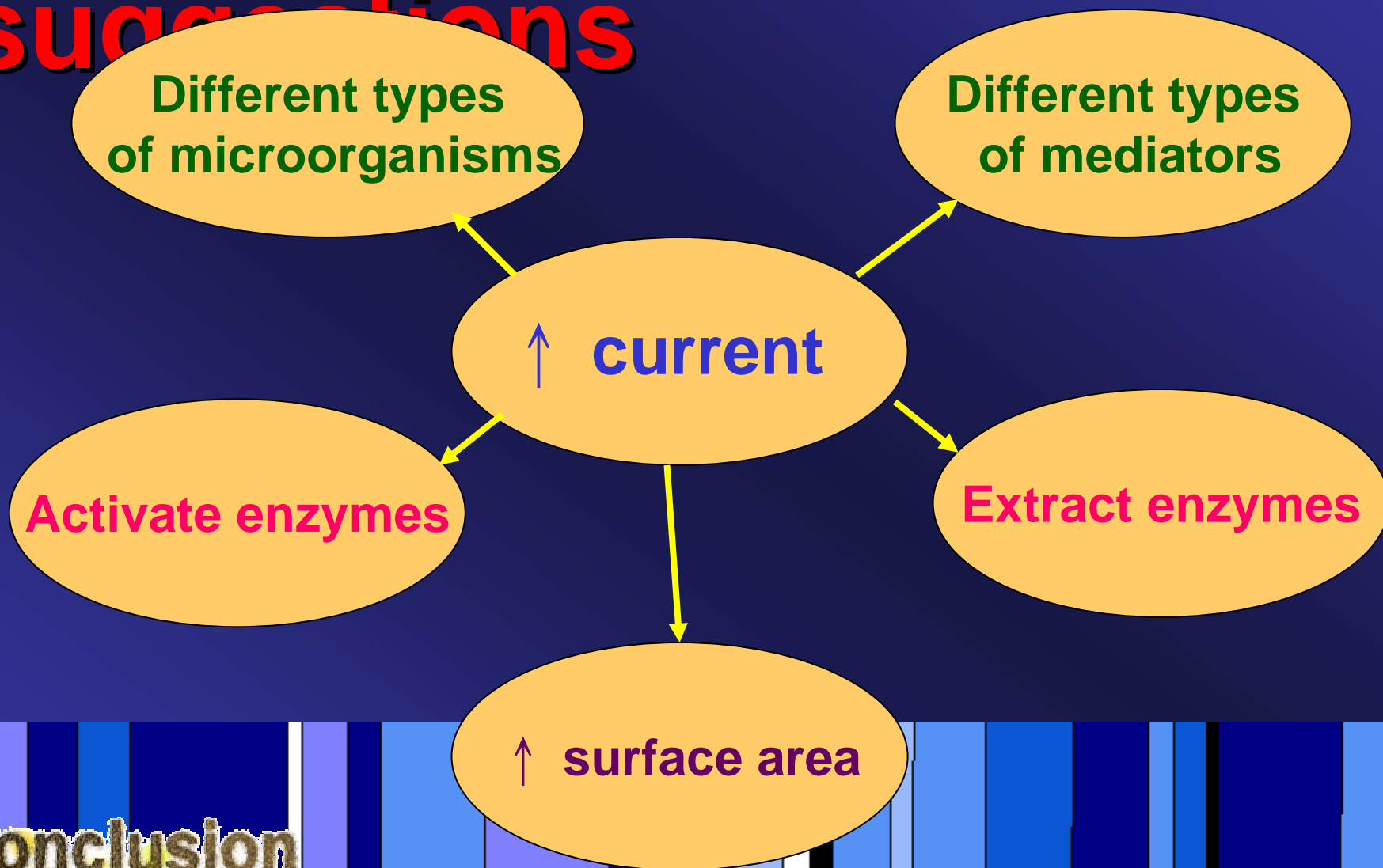
low current

unsustainable current

Conclusion

Our

suggestions



Conclusion

Prospective

application


useless materials



energy source

**biological
wastewater
treatment**

Conclusion



**‘One small step for
man, one giant
leap for mankind’**

by Neil Armstrong



**THANK
S!**