PART 1. INTRODUCTION

1. Reasons for topic selection

1.1. Due to requirements for current teaching method innovation: Coming from requirements of educational law of Socialist Republic of Vietnam in 2005 and Decree No 29-NQ/TW at the 8th meeting of Party's central committee at term XI (dated 04/11/2013) about basic and comprehensive innovation to the training and education.

1.2. Due to requirements for improving teaching quality in general, teaching on living functions – transformation of material and energy (TME) in particular: In teaching process**,** teachers should have a thorough grasp of movement and development of concept in general, concepts of material and energy transformation in particular in order to have the method in improving teaching quality to this concept.

1.3. Due to the weaknesses in teaching concept of material and energy transformation (MET) in the current biological programs***:*** in current state, biological teaching in high schools has not focused on movement logics of the concepts of MET.

From above reasons, we select the topic: **"Formation and development of the concept of material and energy transformation in high schools' biology program*".***

2. Purposes of researching

Find out development logics for the concept of MET in order to define ways to organize the suitable teaching with students' characters and concept development itinerary through studying levels and classes to enhance the effective of teaching biology.

3. Scientific theory

If find out development logics for the definition of concept of MET in high school biology program to organize the teaching suitably with students' characters and concept development itinerary through studying levels and classes, then it can not only form specialized biological concept but also development biological concept generally and theoretically about concept of MET as one important feature in all systems and develop studying capacity

4. Researching subject: develop concept of MET in biological teaching in high school.

5. Researching object: biological teaching process at school.

6. Researching task:

6.1. Systematize the theoretical base on concept, formation and development concept in general and biological concept in particular in high school biology program.

6.2. Identify current state of teaching MET concept for teachers with currently and results from student's awareness about content of this concept.

6.3. Identify structure of MET concept.

6.4. Identify development logics in MET concept in high schools' biology program.

6.5. Identify the process of teaching organization for the development of MET concept.

6.6. Experiment pedagogical to evaluate correctness of scientific theory proposed by the topic.

7. Researching method

Research theory; investigate the teaching*;* expert method, experiment pedagogical.

8. Limitations of the topic:

Experiment in topics: (*1) TME in cell level; (2) TME in body level; (3) TME in upper body level in high school*.

9. Contributions of the topic:

9.1. Identify structure of MET concept as the base for searching logics of movements in the concept.

9.2. Identify logics of movement and development of MET concept in basic organization level and TME in living organization levels: cell, body, population, community, and ecosystem - biosphere.

9.3. Propose effective pathways for guiding student in researching MET concept in high schools' biology program.

9.4. Propose the process and method for teaching MET concept effectively in teaching biology in high school.

PART 2. RESEARCHING RESULTS

Chapter 1: AGRUMENT AND ACTUAL BASE OF THE TOPIC

1.1. OVERVIEW OF RESEARCHES RELATED TO THE TOPIC

1.1.1. Research the formation and development of concept in the teaching in the world

1.1.1.1. Researches on concept formation and development

Researches on concept formation and development stay in almost philosophical theories such as: Democrat, Becon, Phobach, Hegel, Karl Marx and Angghen, M.M.Ro-den-tan...It showed that some opinions had limitations when they conisder that the concept is only subjective concept, not pay attentions to the relationship between sensibility and material properties, some contrary points of view when they said that the concept is the lowest form of the sensible awareness stage that means under judging and reasoning.

1.1.1.2. Researches on the concept formation and development in teaching in general and teaching biology in particular

Many authors researched the concept formation and development in teaching some specific subjects such as: Wolfgang Doran and Walter Jabn,A.Z.Rêtcô,Z.A.Mookeeva, O.V Cazaccova and N.M Veczilin,N.M Veczilin and V.N.Coocxunxcaia,B.V Vơxexviaxki,etc. Researchers only describe the development of scientific contents of each concept without showing out argument base and guiding analysis to the development of concept types. The method of forming concept has not paid attentions such as contents of concept, etc.

1.1.2. Researches on concept formation and development in the teaching in Vietnam

1.1.2.1 Researches on concept formation and development

Authors: Vuong Tat Dat, Bui Thanh Quat, Nguyen Ngoc Ha, Vu Van Vien, Tran Thi Ngoc Anh, etc showed out nature as well as rule characters of the concept formation and development process, considered as the guideline for argument base for concept formation and development in teaching.

1.1.2.2. Researches on concept formation and development in teaching in general and teaching biology in particular

The concept formation and development process in teaching biology has researches from authors: Vu Le, Tran Ba Hoanh, Dinh Quang Bao, Nguyen quang Vinh, Dang Thi Da Thuy, Nguyen Thi Nghia, Ha Van Dung, Nguyen Thi Dieu Phuong. Researchers solved some issues such as: Determine the route of forming biological concepts, systematize development of some basic concepts in high school's bioligical programs, analyze orientations of concept development, analyze formation and development of some concepts, including material and energy transformation concept, apply and approach system structure

in research of concepts, biological rules, using mind map in teaching MET concept at body level. Currently, there are not any fullfill research about the structure of MET concept as well as logics of movements and development of this concept in all living organization levels and life form as well.

1.2. AGRUMENT BASE OF FORMATION AND DEVELOPMENT OF MET CONCEPT IN TEACHING BIOLOGY IN HIGH SCHOOL

1.2.1. Nature of the concept

The concept has three properties: general, nature and development.

1.2.2. Logical structure of the concept

Each concept is one perfect whole including: comprehension of the division and external appearance of the definition.

The relationship between comprehension and outside appearance: Formal logic's considers comprehension as total symbols, the more symbol is the deeper the content is. Therefore, the deeper comprehension is, the narrower the outside appearance, the shallower the comprehension is and then the wider the outside appearance is. According to dialectical logics, comprehension of the concept does not depend on quantity of symbol, but depends on penetrating level into subject's nature. The more awareness develops in the route of phenomenon generalization in the subjective world then the more plentiful comprehension of concepts becomes.

1.2.3. Roles of the concept

Base for awareness: System of scientific concept helps us aware the nature of subject, phenomenon as well as relationship in subjective and current status. System of concepts and rules are built up basing on consistent viewpoints which creates up one scientific theory helping us have a thorough grasp of great issues in the scientific fields.

Main knowledge components in the subject contents: contents of subjects in the nature are system of concepts.

1.2.4. Concept formation and development

1.2.4.1. Formation of concept

According to Tran Ba Hoanh, the process of concept formation usually built through:

Firstly, identify awareness tasks.

Secondly, aware some symbols of researched subject.

Thirdly, analyze and find out some general symbols and nature.

Forthly, take new concepts into available concept system.

Fifthly, practise and apply concept.

1.2.4.2. Development of concept

Why do we need to develop the concept? The subject nature contains many factors, different aspects which individual is not able to aware fully and rightly in once, only possible to enter deeper and deeper, expand gradually awaring results as well as supplement and expand, the concept which reflects awareness results indispensably would be development.

Nature of concept development: Concept development is one concept. which is established and accurate with more available symbols, supplemented with new symbols, makes new smaller concepts rise up.

1.2.4.3. Concept development directions

According to Tran Ba Hoanh, Trinh Nguyen Giao, the concept is developed basing on directions: concretize concept contents, complete concept contents, formation new concepts.

1.2.5. Biological concepts

1.2.5.1. Defintion:

According to authors as Dinh Quang Bao, Nguyen Duc Thanh, Tran Ba Hoanh, etc, biological concepts reflect general symbols and properties, nature of living structures, phenomenon, process and relationships.

1.2.5.2. Types of biological concepts

According to reflecting scope of the concept is wide or narrow to divide the biological concept into: general and specialized biological concepts.

According to biological contents reflected by the concept, we would have: concepts on structure, form and living activities.

1.2.6. Material and energy transformation concept

Generally from different conceptions about MET, we can say that the concept of MET has general character and is created up by performing three activities following with the closed order which are: receive material, Energy→ transform material and energy → discard material and energy. When expanding each activity and connect between activities then specific. From general (material and energy transformation), transfer to nutrition activities in each level's of living subject's organizations, we would have specific MET activities – appear system of MET concept in specific cases.

Identify the structure of MET concept at general level as the orientation for identifying movement logic of the concept, concurrently the orientation for the formation and development process of MET concept.

For structure of MET concept, there are three symbols which are: receiving, transforming and discarding process. The process of MET happens out in all living organization levels. Despite performing in any living organization level, MET naturally consists of three factors as mentioned above. In each level, when expanding each symbol, we would have suitable new concept system.

1.3. CAPACITY AND STUDYING CAPACITY

1.3.1. Capacity

1.3.1.1.Concept of capacity

The capacity is the ability of effective performance in one specific case based on the knowledge base about the action.

1.3.1.2.Structure of the capacity

Structure of the capacity includes: knowledge and skills on operation field, situation happening in the activity, results of activity performance. This is base to orient for contents of forming capacity in the study of students. In other words, in order to forming capacity for students in any field, it is necessary to guide students to have knowledge and skills on the operation field, perform activities in different situations and activity brings results back. Activity's results reflect the knowledge about the activity, reflect correct performance of the activity, suitable with specific situation.

1.3.2. Studying capacity

Awareness capacity on content is: Identify nature, relationship of thenature, Identify movement logics of studying contents.

Capacity on awareness, the route of knowledge discovery such as: by inductive or deductive, analysis or generation, phenomenon generation, symatization, etc.

Scientific researching capacity to the subject is: discover researching issue, show out researching supposition, require for building researching plans, perform researching plans, inform researching results.

Evaluate studying capacity base on the satisfaction levels of each knowledge from three components as mentioned above.

1.4. CURRENT STATUS OF MET CONCEPT

In order to have actual base of the topic, we design survey notes, carry out survey teachers and students in some high schools through some main contents as follows: Identify teachers' point of view on comprehension of MET concept in teaching biology in high school, current teaching MET concept of teachers, awareness and knowledge of students on MET concept.

Analyze survey results, we would draw out some comments:

Some not-small components of teacher have not had a thorough grasp of the nature of MET concept; have not paid attentions to development logics of this concept through articles, chapters and classes, not yet identified suitable teaching methods to form and develop this concept during the teaching process, the formation of new concept onyx stops at symbol level, student have not distinguish accurately nature symbol and non-nature symbol of each concept.

Students have tendency of having no respect to the biology subject, investing little time for studying, weak passion, studying by dealing type.

On that base, we realize that the identification of development logics to MET concept in the biological programs in high school and teaching organization following with that logics can be effective solution in contributing and improving the quality of teaching the biology subjects.

Chapter 2. FORMATION AND DEVELOPMENT OF MET CONCEPT IN TEACHING STUDENTS IN HIGH SCHOOL

2.1. DEVELOPMENT OF MET CONCEPT IN HIGH SCHOOL'S BIOLOGY PROGRAM

2.1.1. Concept on MET concept in the living nature

The metabolism concept is the explanation of appearing form to activities of MET and concept of MET explains the nature of activities, there are three continuous activities: receive, transform and discard material and energy.

Each character will be presented specifically in each different living types and in different living organization level. When expand each symbol in each living form or in each living organization level, we would have system of new deficitions under the MET concept in living nature, we call that as the development of MET concept. Hence, development of MET concept is gradual appearance of new concepts whenever we expand each symbol in

to each specific living form, into each specific living organization level following with different deep levels.

2.1.2. Development of MET concept in living organizations level

*2.1.2.1. **Material*** and energy transformation in cell

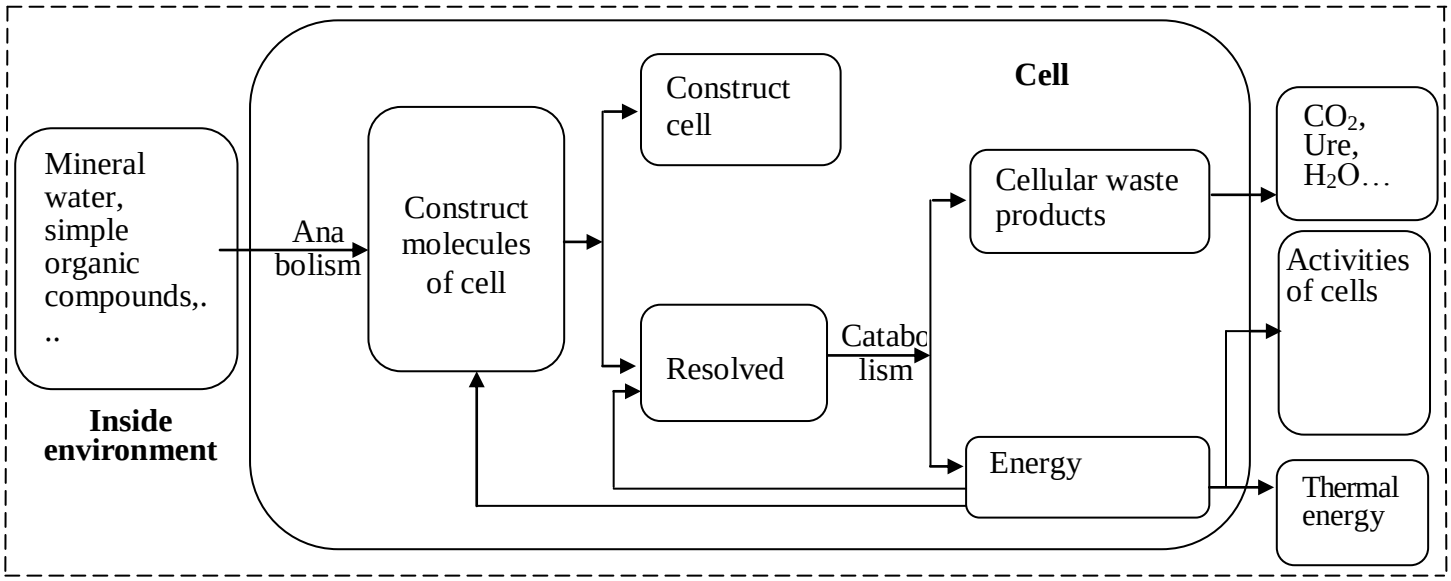


Diagram 2.1. The process of MET in cell.

2.1.2.2. Material and energy transformation in body

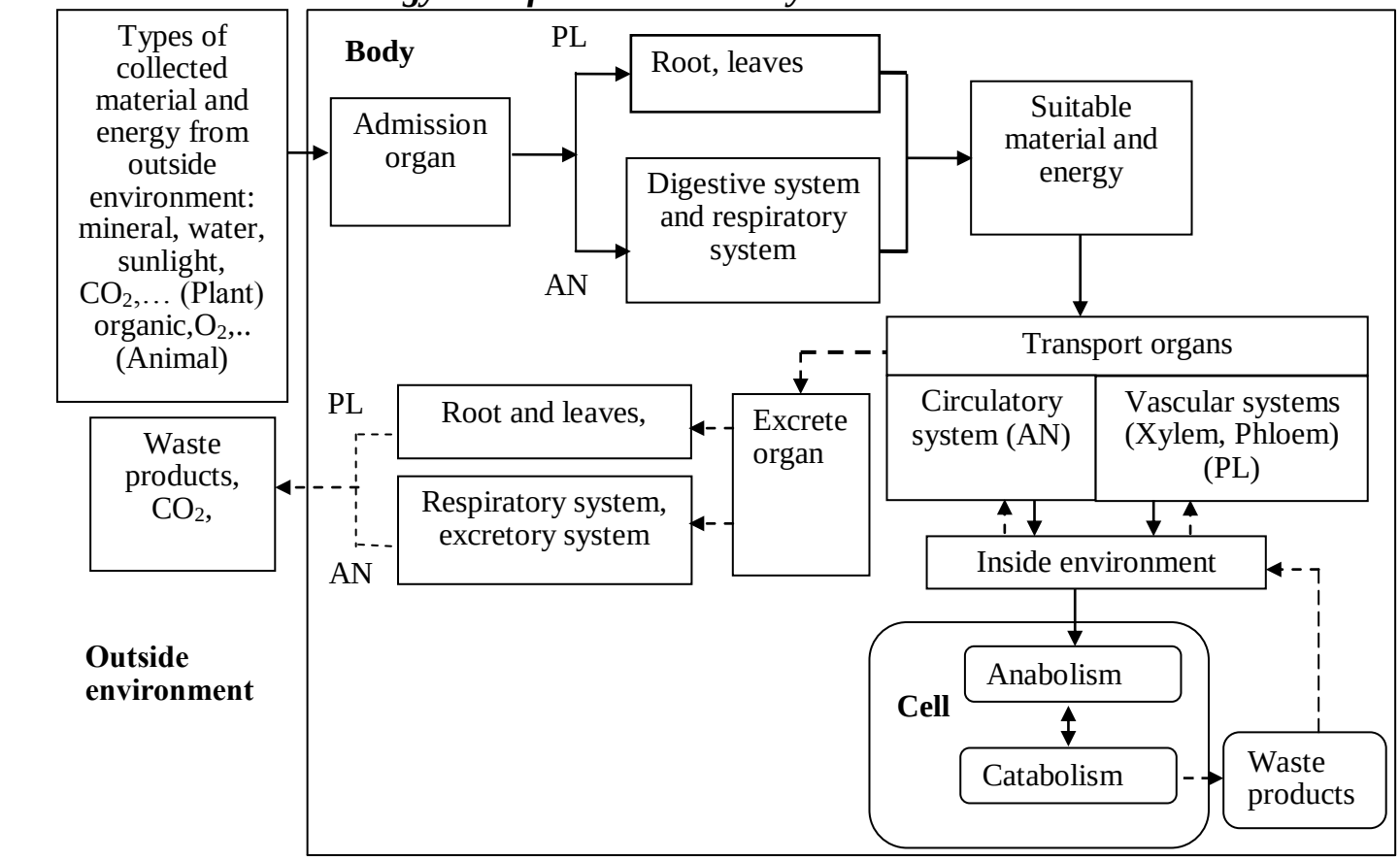


Diagram 2.2. The process of MET in body

2.1.2.3. Material and energy transformation in population

The process of MET in each body mainly is the same to each other, then we should consider MET at the population level happening following with the diagram *2.2*. Difference

from the body level is that subjects in the population concurrently perform the process of MET.

2.1.2.4. Material and energy transformation in community

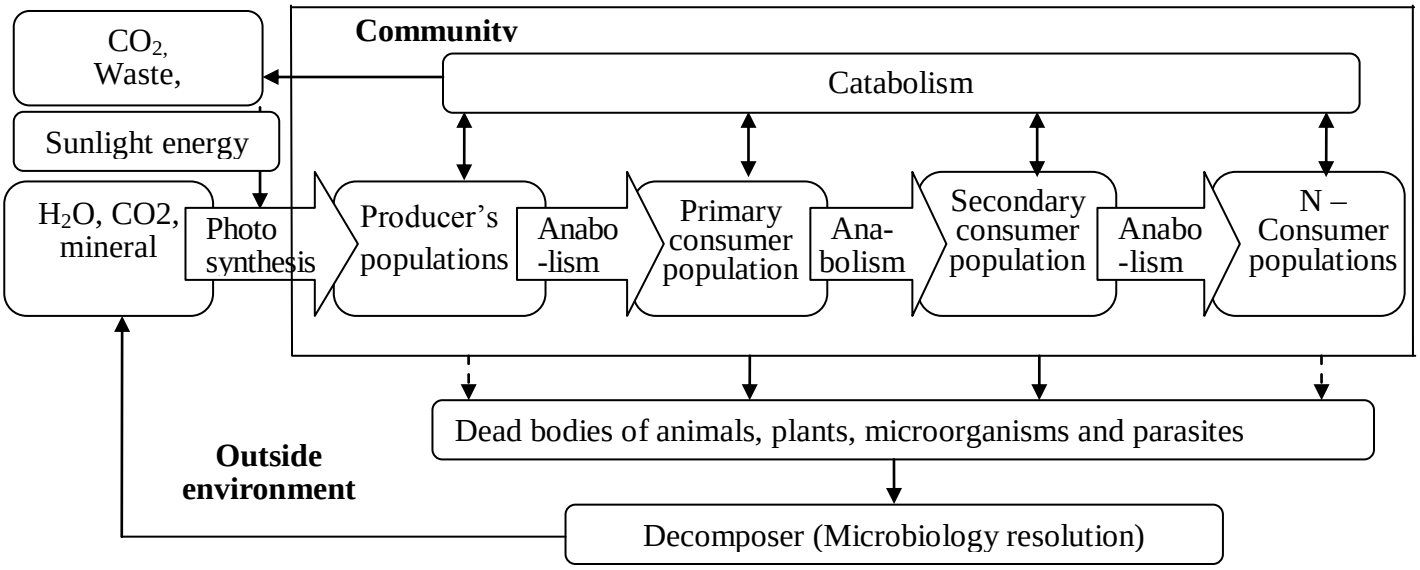


Diagram 2.3. The process of MET in Community

2.1.2.5. Material and energy transformation in ecosystem – biosphere

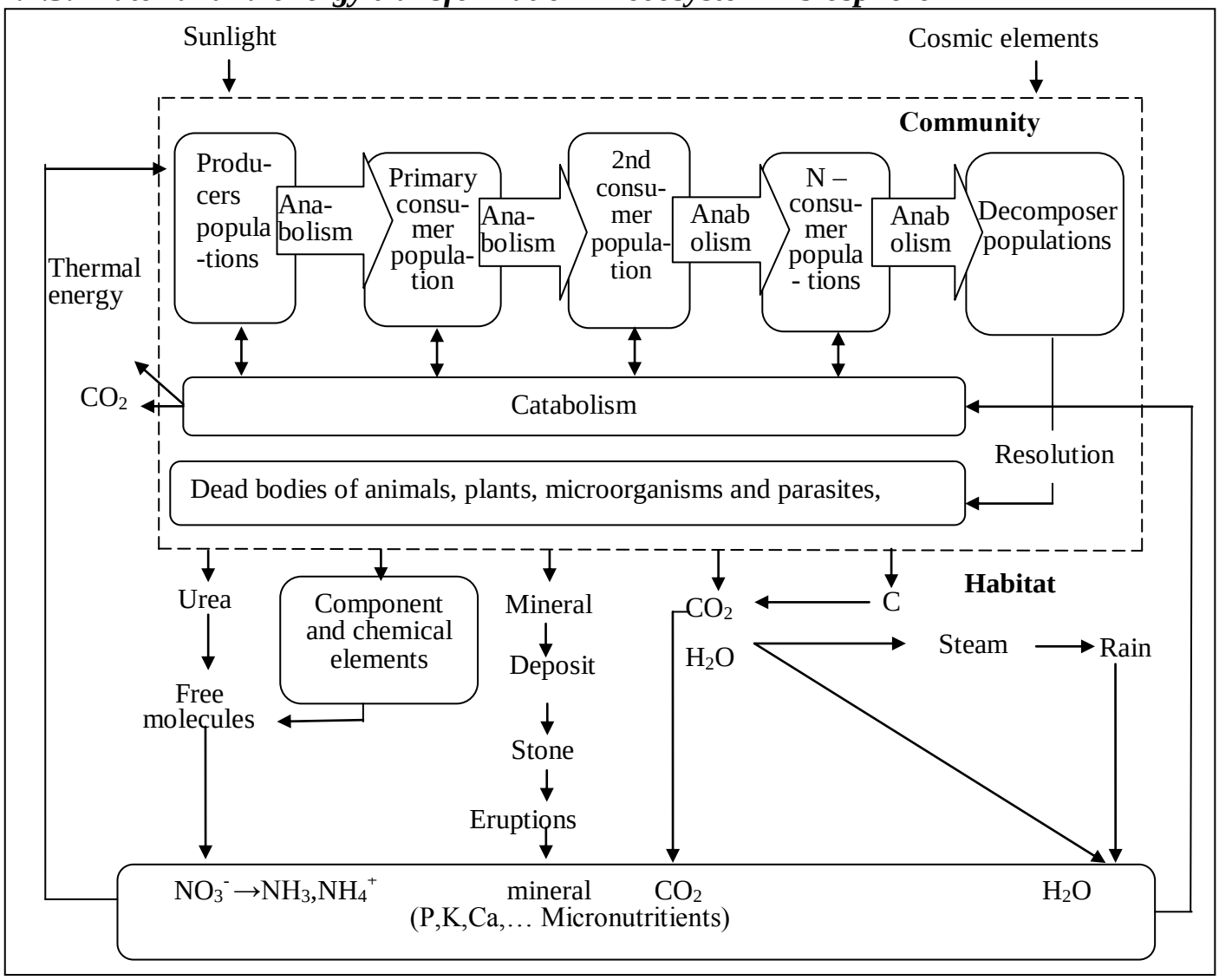


Diagram 2.4. The process of MET in ecosystem - biosphere

2.1.3. MET concept is developed through classes in biological programs in high school

2.1.3.1. Development of MET concept in the Biology 6

Table 2.1. Development of MET concept in Biology 6

Nutrition organ		**Nutritional functions for MET**		
		Admission material and energy	Material and energy are transformed	Discarded material and energy
Root → root hairs		Water and minerals from the soil solution, oxygen from the air.		
Stem	Xylem	Water and minerals from the roots to the leaves through the roots repulsion, attractive force water of leaf and binding affinity of stem.		
	Phloem	Organic compounds from the leaves to the organ by the concentration difference in leaves and place of inclusion.		
Leaves	Palisade meso-phyll cell	Light from the sun	Photosynthesis. Sunlight energy → chemical energy. $CO_2+H_2O \xrightarrow[\text{Chloro-phyll}]{\text{Light}}$ Glucose + O_2 Glucose + minerals → organic compounds. - Respiratory - Chemical energy → used energy. - Glucose → CO_2+ H_2O + thermal energy	H_2O O_2 Thermal energy, CO_2.
	Air reservoir chamber	CO_2,O_2 from air		
	Stomata	Water, mineral from stem.		

2.1.3.2. The development of MET concept in Biology 7

Table 2.2. The development of MET concept in biology class 7

Nutrition organ	**Nutritional functions for MET**		
	Admission material and energy	Material and energy are transformed	Discarded material and energy
Digestive	Organic substances contain chemical energy, water,		

	minerals		
	Collection and mechanical digestion, chemical digestion with digestive.		
Respiratory	Absorb oxygen from the alveoli into the pulmonary capillaries		CO_2, steam, heat
Circulation	Admission of nutrients, oxygen from the capillaries → intracellular environment → in cell.	- Anabolism and accumulated energy - Catabolism and release energy for activities of life.	
Excrete	Skin: water, salt. Urology: urea, water, salt		Toxic residues

2.1.3.3. The development of MET concept in Biology 8

Table 2.3. The development of MET concept in Biology 8

Nutrition organ	**Nutritional functions for MET**		
	Admission material and energy	Material and energy are transformed	Discarded material and energy
Digestive	Organic substances contain chemical energy, water, minerals		
	Collection and mechanical digestion, chemical digestion with digestive.		
Respiratory	Absorb oxygen from the alveoli into the pulmonary capillaries		CO_2, steam, heat
Circulation	Admission of nutrients, oxygen from the capillaries → intracellular environment → in cell.	Anabolism and accumulated energy Catabolism and release energy for activities of life.	
Excrete	Skin: water, salt. Urology: urea, water, salt		Toxic residues

2.1.3.4. The development of MET concept in Biology 9

Under the aspect of MET, it has just mentioned through food chain and food web, that is MET among populations. In the ecosystem – biosphere, it has just mentioned the biogeochemical cycle of some substance in the nature.

2.1.3.5. The development of MET concept in biology class 10

Table 2.4. The development of MET concept at cell level.

Expand comprehension / Type of cell	Nutritional functions for MET							
	Admission of material and energy			MET		Discard of material and energy		
	Types of material and energy	Admission organ	Admission mechanism	Anabolism	Catabolism	Type of material and energy	Discard organ	Discard mechanism
Plant cells	Sunlight Mineral Water	Chloroplasts Membrane	Photophosphorylation Redox chain Passive and active.	Photosynthesis and synthesis needed by the cell	Respiratory: degradation of molecules and release ATP energy for life activities	Thermal energy. Toxic substances and excess.	Membrane	Passive and active.
Animal cells	Organics contains chemical energy in chemical bonds. Mineral, water.	Membrane	Passive and active.	Synthesis needed by the cell, accumulate energy in chemical bonds.	Respiratory: Resolution of organic, release ATP for activities of life	Thermal energy. Toxic and excessive substances	Membrane Passive and active	Passive and active.

2.1.3.6. The development of MET concept in Biology 11

Table 2.5. Development of MET concept at body level.

Expand comprehension / Type Of body	Nutritional functions for MET							
	Admission of material and energy			Material and energy transformation		Discard of material and energy		
	Types of material and energy	Collection organ	Collection mechanism	Anabolism	Catabolism	Type of material and energy	Discard organ	Discard mechanism

Plant	Sunlight, CO_2, O_2, minerals, H_2O	Chlorophyll in leaves. Root hairs. Xylem in stem.	Diffusion	Photo-synthesis and synthesis organics needed by body	Respi-ratory	Residues, toxic	Leaves root	Passive and active
Animal	Chemical energy in organics, H2O, O2.	-Digestive organ: Mechanical digestion. Chemical digestion. Biological digestion. -Circulatory system. -Respira-tory organ	Diffusion	Synthesis organics needed by body.	Respir atory	Residues, toxic	Excre-tion organ. Respir-atory organ.	Passive and active.

2.1.3.7. Development of MET concept in Biology 12

Table 2.6. Development of MET concept at group organization level.

Expansion of compre-hension / Com-ponents of community	**Nutritional functions for MET**							
	Admission of material and energy			Material and energy transformation		Discard of material and energy		
	Types of material and energy	Collection organ	Admission mechanism	Assimilation	catabolism	Type of material and energy	Discard organ	Discard mecha-nism
Producing organisms (mostly plants (Ecosystem on land)	As in the plant body	As in the plant body	As in the plant body	Inorganic, solar energy → Organics of producing organisms, chemical energy accumulation. ↓	Respir-atory	As in the plant body	Cell membrane	Passive and active.
Consuming organisms	As in the animal body	As in the animal body	As in the animal body	Organics of consuming, accumulating chemical energy. ↓	Respir atory	As in the body of each animal	As in the body of each animal	As in the body of each animal

						species	species	species
Organisms resolution	As in micro orga-nism body.	As in micro orga-nism body.	As in micro orga-nism body.	From dead body of consuming organisms ↓ Organics in accumulated energy microorganisms	Respir atory	As in the body of each of microo rganis ms species	As in the body of each of microo rganis ms species	As in the body of each of microo rganis ms species

From the presentation on the development of MET concept in high schools' biology program, we can summarize development logics through the following diagram:

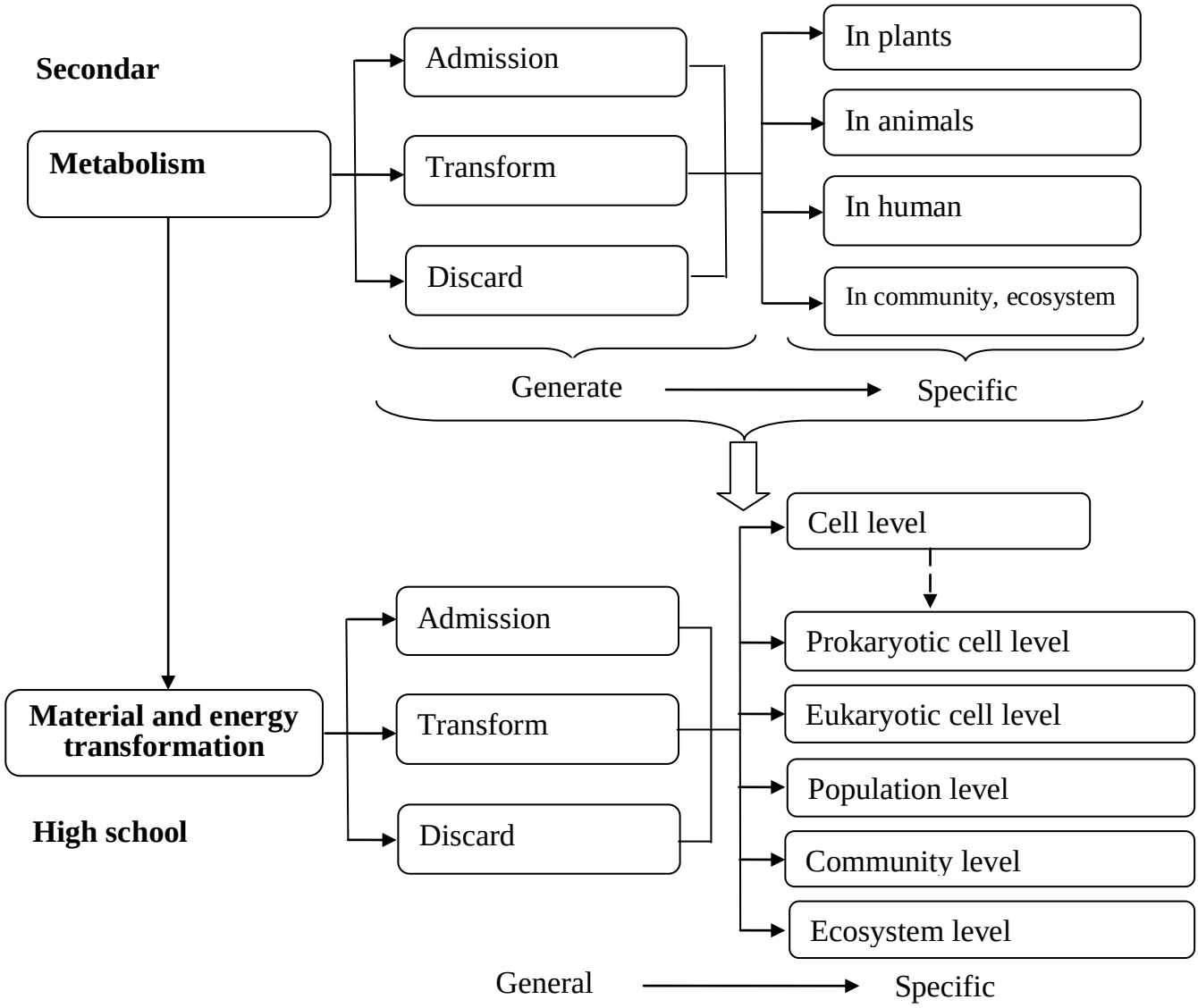


Diagram 2.5. The diagram on development logics of MET concept in high schools' biology program

2.2. TEACHING PROCESS FOR DEVELOPING MET CONCEPT IN THE LIVING NATURE

2.2.1. General regulations

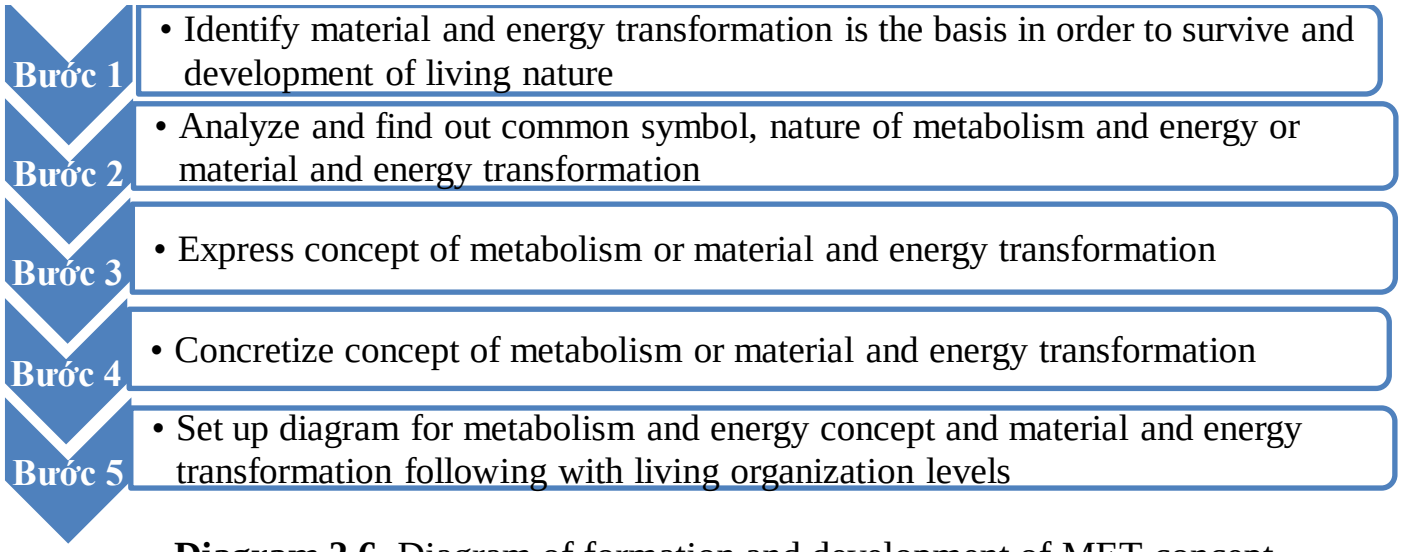


Diagram 2.6. Diagram of formation and development of MET concept

2.2.2. Process explanation

The process of MET concept development from general to special pathways:

Used effectively and creatively and logically contents of high schools' biology program. The appearance of MET concept presented in high schools' biology program by "metabolism" (general) and is developed to MET concept. Rightly from the introduction lesson (biology 6), in the item of distinguishing living subjects and non-living subjects as mentioned: living body has metabolism with environment (admission necessary substances and discard waste products to outside) then able to survive; grow and reproduction".

Coming to biology 8, there is chapter VI. The metabolism and energy. Begin from metabolism, then analyze particular symbol in which comes from admission material from environment, transforming to particular organic component needed by the body, concurrently accumulate energy. Material and energy are degradated to release energy to use for living activities, concurrently excessive, toxic thermal energy material will be discharged to the environment. This transformation process is called MET process.

At the beginning of biological program 10, particular feature of living organization levels state that: living organization is opening system, is always the source of admission material and energy from environment and returning discharge waste products and thermal energy to the environment. In the cell biology part, there is one chapter "MET". In each study stage, everything begins from general concept then coming to specialization about metabolism or MET in each organization of each living type or living organization level that is one of the bases which we use to set up above process.

The second base which we select is the viewpoint of teaching and development by V.V.Da Vu Dop concluded by Le Van Hong and partners: "Clearly the concept formation must implemented through two stages: *i) The stage of getting general relationship and ii) The stage of using general relationship into occupying different appearance form of the concept"*.

During the process, steps from step 1 to step 4 are identified for general ones; step 5 is to apply the general one, identify specific one in the system (with the same nature); Step 6 naturally uses diagram to express concept system following with rising original that means by following with movements of concept contents

Step 1: contents of this step should be presented:

- Show out researching purpose of the topic of metabolism or MET.

- By arguments to confirm that living is metabolism and difference from non-living subjects is by metabolism from the living body, organism are able to grow, develop, reproduction, then survive.

- Content of step 1 should identify that the metabolism activities is the basis in order to survive and development of living subjects.

- The way to identify: from the beginning lesion of the biology class 6, through contents in differing living subjects and non-living subjects, should guide students to mention living proof on metabolism and the metabolism is living condition of the living subjects.

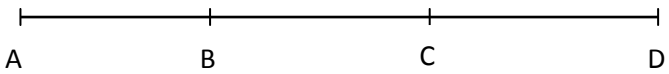
Step 2: Objectives of this step is that students should base on the term "exchange" to identify activities (admission and discard), through guidelines for students to state out that there should have activity between admission and discard activities of the body (transform to the substances which form living body).

Contents in step 2 is to state three characters which are: admission material and energy from environment, transform material and energy to take into as particular material and energy, build up the living body, concurrently conciliate to release energy to use for living activities, discard substances in excess, toxic ones from living body to the environment.

Teachers suggest students to draw out the conclusion of three basic characters of the metabolism.

Step 3: The purpose of this step is beginning orientation steps, there is also other way to state the "metabolism" but coming into the nature, that is second activity – MET between activities of admission and discard. Teachers guide initially students to know that: if only impress on beginning and ending activities (Admission and discard), that is called as metabolism; if impress on activities between admission and discard as "transformation" which is called as MET

Purpose of this step is to orient students to state contents of metabolism concept, MET by words or diagram. The formation method is that teachers should state matter: if we express metabolism activity by line into three sections as follows:



Then which section express admission material and energy? Which section is discard material and energy? How you conclude about metabolism? Which section for transformation? How you conclude about MET?

It is impossible to carry out in one time in any content. Should have orientation to perform and improve gradually through contents and each class from under to upper ones.

Step *4:* Purpose of this step is to applying the general concept about "metabolism or MET" to identify particular expressions of MET in specific cases.

Contents of this step are to guide students to apply each student of MET in each living organization level or in each living type, how particular concepts are expressed.

Step *5:* the purpose of this step is to practice students to know how to use systematization language of different concepts but having the same nature of performing MET in living nature. Step 5 is next one which specializes and develops contents as

studying in step 4. Results of step 5 are set up statement diagram for specific development of concept in MET or metabolism in living type or living organization level.

This process is the orientation and guidelines for development in concept system on MET in living nature that means to identify operational procedures to develop solidly the system of MET concept. This viewpoint of above process is logical expression from general to particular ones and thus it is suitable when study specific living subjects. Students have general and natural viewpoints overcome at the beginning stages (class 6, 7). Students can be overloaded about knowledge of phenomenon, unconnected events which are not able to connect to form nature concept of living subject.

2.3. STUDYING ORGANIZATION FOR DEVELOPING MET CONCEPT

2.3.1. Organize to form the concept of "metabolism" or "MET concept" by logical method

In secondary school, biology is researched closely with functions of this organ or organ system under each living type but researched under the viewpoint of metabolism which is determinants factor for existing and development of living body. Thus, firstly we should organize students to form the metabolism concept, this is considered as general concept, from such general concept, and it will be specialized to have specific concepts in different situations. To the middle of biology 8, the metabolism concept is developed to be MET concept. From biological 10 to 12, MET is considered as one topic and MET is general concept which should be engraved and developed. Thus, we can come deeply into activities of MET in the living nature by general concept which is "MET", then we can specialized by particular symbols in each different living levels.

From the above analysis, it shows that MET concept is founded and developed into two stages: forming MET concept at general level; forming MET concept at other specific symbols, thus we can use similar studying activities to each level.

2.3.1.1. Analysis method of concept comprehension

Analysis is important studying activity, through analysis, it could discover origin of the concept as well as logic structure of that concept, for example: when we say that the living nature always exchange with environment to exist and develop, thus "what is metabolism? From the metabolism, we can analyze that there are components for admission and discard. If only how much admission equally to volume of discard then the body is not able to survive and develop. The development is increasing more volume due to receiving and then accumulating, waste products then comes out. Such analysis can show that the first living activities include three basic activities, they are material and energy admission from environment, material and energy alternation collects material and energy of the living body, discard substances in excess to outside environment. From three symbols, form general concept and common one about metabolism of living world.

Concept of this metabolism mainly express on admission activity and discard activity that has not expressed the symbol that nature is transformation process. How collected material and energy from environment to become particular material and energy of the body happen out? After holding solidly nature of transformation process (anabolism and catabolism), we can change that concept of metabolism by concept have similar meanings which is MET. Thank for analysis activities, human can understand structure and origin of each symbol in the concept.

In teaching, when identify symbol of the concept, we can use analysis activity from phenomenon or events, to find out common characters, the most nature of event groups. Thus, in this thesis, we form and development concept system on MET in the living nature, firstly form the general concept “metabolism”, then “MET” by analysis activities, small concept system only is particular symbols of general concepts as mentioned above.

2.3.1.2. The method for using concretization activity

Concretization activity is the action from general level to new and particular level. Thank for concretization activities, it helps for performing the concept development from general relationship to particular and plentiful case. Thus, general relationship is used such as efficient tools and facilities to classify different phenomenon. For example, from general concept of metabolism or “MET”, in order to identify small concept system in them, we only need to concretize the symbol “material collection”, we can admission material in plant, in which there are: absorb water and mineral, root is the organ for water and mineral absorption, root hairs are cells for water and mineral absorption from soil solution, water and mineral mechanism, etc.

Concretize symbol “material collection”, we can have admission material in animal, in which: admission material type in animal is organic type. The admission organ is mouth, the way of admission food into mouth is snatching or gnawing. Thus, with the concept of metabolism concept in the stage of food collection, if it is concretized in other living types or in each different living organization level, we can have system of concepts which have relationship in origin with different ranks.

Conclude, general and concretization action in the formation and development of MET concept system in living nature is the suitable and effective method and pathways.

2.3.2. Form MET concept by technical method

Logical method helps teachers guide students to follow with corresponding logics discovered by human. In teaching, each method which can bring high or low efficiency depends on performance technique such as using questions, exercise, matter, how to guide – performance technique, we can call it as technical method.

For example: after students of class 6 have general conclusion: basic characters of living subjects which is “metabolism”. In order for students to understand how metabolism is? The metabolism in the plant is performed specifically in which stage? Teacher must use questions: base on which characters we can conclude that living subject has metabolism? To guide students that how the concretization of “metabolism” in the plant is expressed, we must use questions for suggestion such as: You can see what material substances plants take from environment? By organ the plant can take material substances into?, Thank for suggestion questions, teachers can guide students to analyze, find out common symbols, form concept of metabolism, or similarly by these questions, students can realize that how metabolism in the plant is expressed specifically? Similarly, we can use exercises or suggestion.

By this question or exercise, guidelines for helping students form concept in general, MET concept in particular through the general to specific route or in contrary (can see this example through experiment handbook – appendix).

2.3.3. Form MET concept by organizational method

Despite of using technical method to generate or specialize, it is necessary for student to perform in house or exchange in team by themselves. Guide students to study in house or discuss in team during class time, etc. we can call it as organizational method.

As mentioned above, in order to research the formation and development process of MET concept in living nature, we base on movement logics of the concept as well as development route through study classes and levels, because through study class and levels, it not only depends on objective development logics of MET concept but also important that it depends on awareness levels and rules of students. Thus, when form the general concept of metabolism, we use questions to guide students from observation phenomenon to draw out general concept: "metabolism" at classes through discussion or from the concept of metabolism, should identify particular expressions in plants, animals, we can use organization in class. However, when end the research of metabolism in each subject of plant, animal, human body, etc. should form general diagram about "metabolism", we offer home works to help students set up diagram or system table by themselves to generate from specifically concepts.

When end the biology and environment, in class 9, we should generate higher about MET concept during the biological process in secondary school, also should research in home, then come to class for discussion and modification. Similarly to generate about MET in each living organization level, it is also necessary to use exercises to prepare for self-study in home and coming to class for discussion.

Conclusion, it is necessary to use organization method to form and develop MET concept suitably and effectively.

2.4. CRITERIA FOR EVALUATING STUDYING CAPACITY DEVELOPMENT

(See table 3.11. Results of evaluating the development studying capacity through the topics in the study years 2012-2013 and 2013-2014**)**

Chapter 3. TEACHING EXPERIMENT

3.1. PURPOSE OF TEACHING EXPERIMENT

Check correctness of supposition of proposed topic.

3.2. CONTENTS OF EXPERIMENT

3.2.1. Topics for experiment teaching

MET at the cell level (biology 10); MET at body level (biology 11); MET at community level (biology 12).

3.2.2. Indicators should be measured in the experiment

- Studying results through marks;
- Hold solidly development nature of MET concept;
- Studying capacity in general and studying capacity of MET concept in particular.

3.3. PERFORMANCE METHOD

3.3.1. Select school and class for experiment

The teaching experiment development is carried out by us in three high schools in two years 2012-2013 and 2013 – 2014, specifically as follows:

Viet Duc high school – Ha Noi (Capital region);

Que Vo 3 high school – Bac Ninh province (midland and plant region);

Thanh Son high school – Phu Tho province (mountainous region);

Each school selects three classes for experiment and three classes in each class 10, 11 and 12.

3.3.2. Select teachers for experiment

Select three teachers in one school who have working years from 5 years and more, their qualification is good and upper, in which: teachers teach class 10 in the study year 2012-2013, concurrently they are teachers who teach class 11 in the study year 2013-2014; teachers teach class 11 in study year 2012-2013, concurrently are teachers who teach class 12 in the study year 2013-2014.

Before teaching, we can agree for experiment targets, the method for carrying out: agree for teaching contents, teaching method, specifically the agree on comprehension of concepts for formation, development logics of concepts, guiding method for students to follow with movement logics of concepts.

3.3.3. Arrange experiment classes and control

Arrange experiments in type of parallel (3 layers/ each metric) on results of concept studying competency practice. In experiment classes, students are organized to follow with the formation and development method for MET proposed by the thesis. In control class, students are organized to study following with guidelines of teachers in order to form and develop MET concept. In experiment and control classes, use similar facilities, at the ending of each teaching class, check through same questions.

3.4. EXPERIMENT RESULTS

3.4.1. Studying results

3.4.1.1. Quantitative results

**** Evaluate studying results in the year 2012-2013***

Table 3.2. Summary of studying results through topics

Topic	**Formula**	**Less-ons**	$\bar{X}$ **± m**	**S**	**CV (%)**	$d_{TN-ĐC}$	t_d
Cell level	Experiment	465	6,65±0,054	1,16	17,41	1,14	12,621
	Control	469	5,61±0,062	1,35	24,13		
Body level	Experiment	465	6,99±0,059	1,28	18,31	1,19	14,510
	Control	469	5,80±0,057	1,23	21,13		
Community - Ecosystem level	Experiment	460	7,12±0,065	1,39	19,47	1,31	13,896
	Control	467	5,81±0,069	1,48	25,53		
Total	Experiment	**463,3**	**6,92**	**-**	**-**	**1,213**	-
	Control	**468,3**	**5,74**	**-**	**-**		

From data in table 3.2, we can see that:

- Total average point of exams of experiment classes is higher in comparison with control classes (difference about 1,213 points).

- Total average point of experiment class is higher than control class: 6,65 > 5,61; 6,99 > 5,80; 7,21 > 5,81.

- Difference ($d_{TN-ĐC}$) of total average point between experiment and control classes of exams is positive and increasing in turn: 1,14; 1,19 and 1,31.

- Variable degree (CV%) in experiment classes through exams is always lower in comparison with control classes and relatively stable at levels: 17,41<24,13; 18,31<21,13; 19,47<25,53 which proof that results in experiment classes are solid and stable.

- Check reliability on difference between two total average values of experiment and control by testing value t_d that shows collected values are greater than 0,05 (in turn are: 16,21; 14,510;13,896) proofing that the difference between experiment and control is meaningful.

Table 3.4: Increasing converge frequency (fi↑ %)- Number % of students satisfies with Xi and upper

Topic	**Formula**	**Less-ons**	**Number of student satisfies with Xi**							
			3	4	5	6	7	8	9	10
Cell level	**Control**	1847	100	95,1	83,7	60,4	24,8	4,1	0,9	0
	Experiment	1847	100	100	99,1	85,0	56,9	20,8	9,3	1,5
Body level	Control	1847	98,3	94,9	89,2	66,2	29,2	4,9	0,9	0
	Experiment	1847	98,8	98,8	97,3	88,5	61,9	30,6	15,6	1,9
Community - Ecosystem level	Control	1837	100	99,2	94,9	74,0	35,7	9,7	4,2	0,6
	Experiment	1844	100	100	98,7	90,8	69,1	44,2	17,4	6,7

From data in table 3.4, build up diagram of converge frequency line of experiment and control classes as follows:

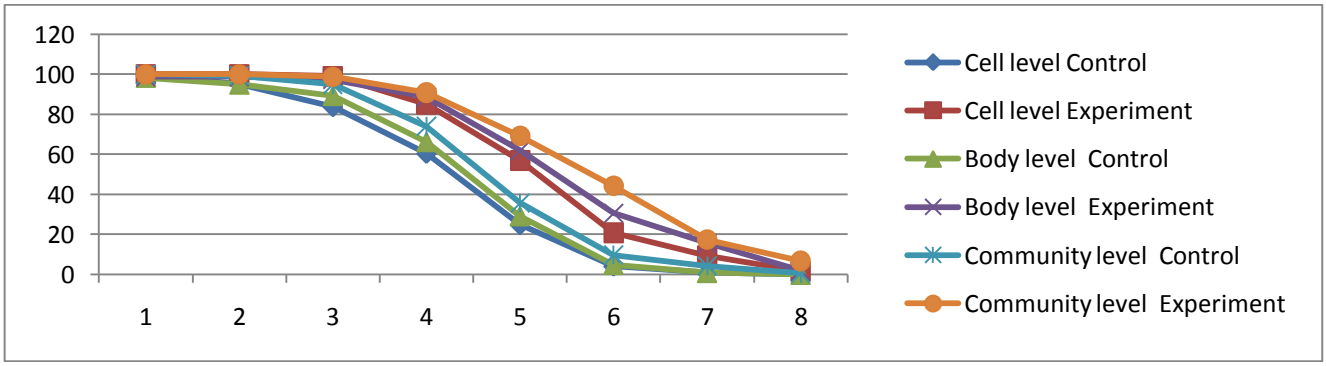


Figure 3.2. Diagram of increasing converge frequency about results of checking topic.

From diagram 3.2, we realize that in classes, experiment line is distributed nearly with symmetrically to the value mod=7; the experiment class is distributed nearly symmetrically around the value mod=7. Quantity of students satisfying with points under value mod ≥7 of experiment classes more than experiment type. Increasing converge line of experiment class always stays in the right and higher with experiment class.

**** Evaluate studying values in the year 2013-2014***

Table 3.6. Summary of studying results through topics

Topic	**Formula**	**lessons**	$\bar{X} \pm$ **m**	**S**	**CV (%)**	$d_{TN-ĐC}$	**Td**
Cell level	Experiment	465	6,55±0,061	1,3	19,84	1,0	11,524
	Control	469	5,55±0,062	1,34	24,08		
Body level	Experiment	465	6,93±0,061	1,32	19,11	1,14	13,720
	Control	469	5,79±0,056	1,22	21,04		
Community - Ecosystem level	Experiment	460	7,14±0,066	1,42	20,12	1,25	13,181
	Control	467	5,79±0,069	1,49	25,66		
Total	Experiment	**463,3**	**6,87**		-	**1,13**	-
	Control	**468,3**	**5,71**	-	-		

Data in table 3.6 show that:

- Total average point of exams of experiment classes is higher in comparison with control class about 1,13 points

- Total average point of exams of experiment classes is higher in comparison with control class: 6,65 > 5,55; 6,93 > 5,79; 7,04 > 5,79.

- Difference ($d_{TN-ĐC}$) of total average point between experiment and control classes of exams is positive and increasing in turn: 1,0; 1,14; 1,25.

- Variable degree (CV%) in experiment classes through exams is always lower in comparison with control classes and relatively stable at levels: 19,84<24,08; 19,11<21,04; 20,12<25,66 which proof that results in experiment classes are solid and stable.

- Check reliability on difference between two total average values of experiment and control by testing value t_d that shows collected values are greater than 0,05, in turn: 11,524; 13,720; 13,181 proofing that the difference between experiment and control is meaningful..

Table 3.8. Increasing converge frequency (fi↑ %)- Number % of students satisfies with Xi and upper

Topic	**Formula**	**Lessons**	**Number of student satisfies with Xi**							
			3	4	5	6	7	8	9	10
Cell level	Control	1847	99,9	94,7	83,3	60	24,8	4,1	0,9	0
	Experiment	1847	100	100	98,9	84,8	56,9	20,8	9,3	1,5
Body level	Control	1847	100	98,1	92,4	68,1	29,4	6,6	3	0,2
	Experiment	1847	100	100	99,4	90,8	68,3	31,4	10,8	2,4
Community - Ecosystem level	Control	1847	100	98,9	94,9	74,7	35,8	9,8	4,3	1,3
	Experiment	1847	99,9	99,9	98,2	90,7	69,5	44,2	18,2	8,8

From data in table 3.8, build up diagram of converge frequency line of experiment and control classes as follows:

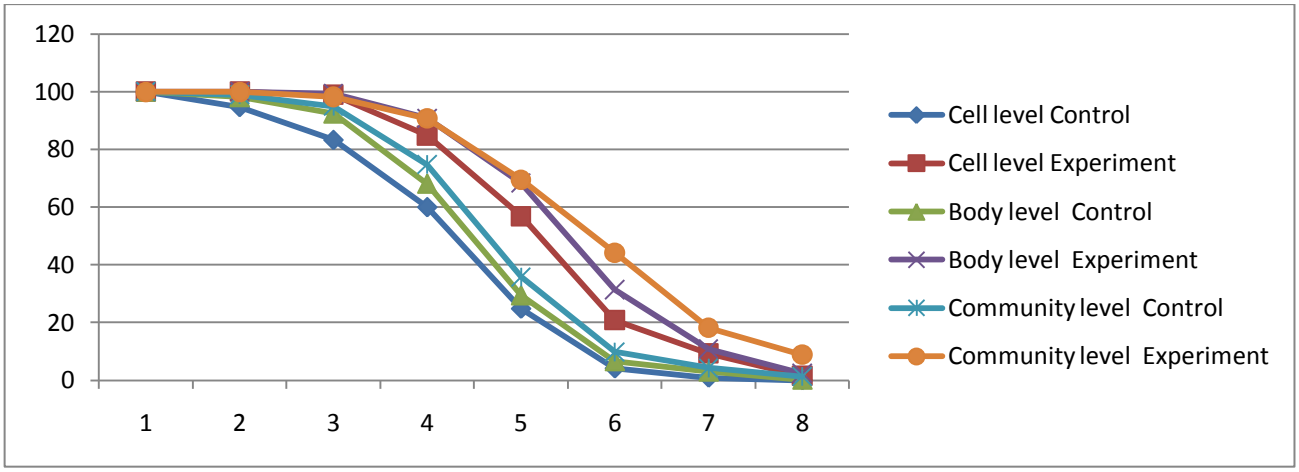


Figure 3.4. Diagram of increasing converge frequency about results of checking topic

From diagram 3.4, we realize that in classes, experiment line is distributed nearly with symmetrically to the value mod=6; the experiment class is distributed nearly symmetrically around the value mod=6. Quantity of students satisfying with points under value mod =6 of experiment classes more than experiment type. Increasing converge line of experiment class always stays in the right and higher with experiment class.

**** Compare studying results of topics of classes in the study class 2012-2013 and the year 2013-2014:***

Table 3.10. Particular parameters among experiment classes through years

Class	Formula	$\bar{X} \pm m$	S	CV (%)	Td
Year 2012-2013	Control	5,865±0,044	1,87	27,14	5,489
	Experiment	6,670±0,044	1,78	24,62	
Year 2013-2014	Control	5,8425±0,044	1,78	24,62	5,263
	Experiment	7,030±0,043	1,85	26,32	

It is possible to express studying results in comparison among three classes through two years 2012-2013 and year 2013-2014 by following diagram:

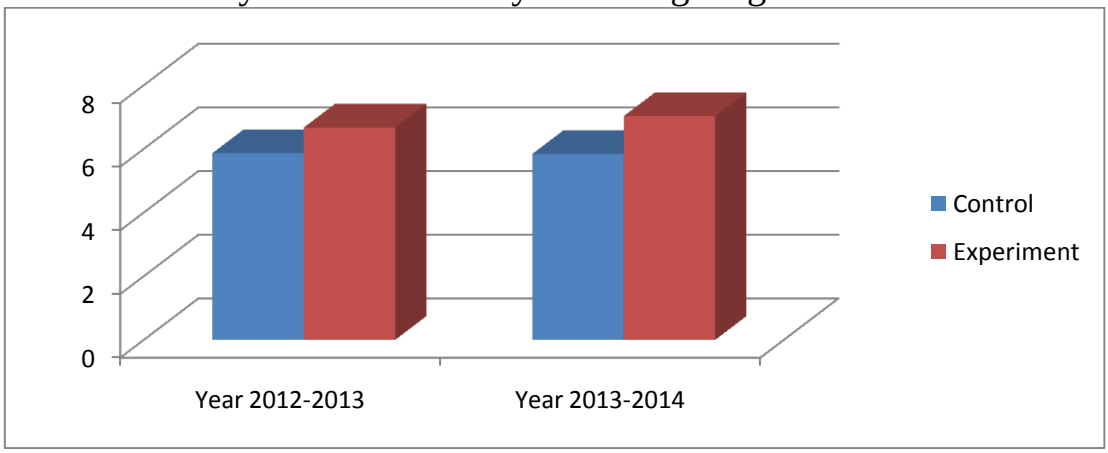


Figure 3.5. Expression of studying results in comparison with classes through two study years 2012-2013 and study year 2013-2014

From data in table 3.10 and diagram of diagram 3.5, we can see:

- Total average point of exams has gradual increasing among classes through two years. Difference ($d_{TN-ĐC}$) between total average point between experiment classes is always positive, increasing by 0,33.

- Variable degree (CV%) in experiment classes through exams is always lower in comparison with control classes and relatively stable at levels: 27,14,24,62 and 26,32.

- Check reliability on difference between two total average values of classes in the year 2012-2013 and the year 2013-2014 by inspection quantity t_d which shows collected value is bigger than 0,05(5,489 and 5,623), proofing that the difference between experiment and control is meaningful..

Thus, from above results, we can confirm that concept formation and development proposed by the thesis is effective.

3.4.1.2. Evaluate qualitative results

**** Spirit, attitude and positive and active study of students***

Students in experiments class have high studying attitude, they are always active in doing home works in home and participate in building up lesions in experiment classes. Quality for answering to questions from students in experiment classes is also higher than ones in control class. Students in experiment class is more interesting in biology, not consider biology as auxiliary subject.

**** The ability to generalize knowledge through tests results in essay questions***

Students in experiment group is better than students in control group about generation skills, they know how to determine comparison criteria when generate, explain similar and different reasons, draw out conclusion, generate to general symbols, natures of MET concept.

3.4.2. Development for studying capacity

Table 3.11. Results of evaluating the development studying capacity through the topics in the study years 2012-2013 and 2013-2014

Studying capacity MET concept			Students rate achieved studying capacity (%)					
			Level 1		Level 2		Level 3	
Criteria	**Indicator**		***Test 1***	***Test 2***	***Test 1***	***Test 2***	***Test 1***	***Test 2***
Realize expression of metabolism activities	Realize activities belonging to metabolism in physiological activities	E	13,48	7,06	26,24	25,14	60,28	67,8
		C	15,11	15,97	43,96	51,98	40,93	32,05
	Show out common characters of metabolism	E	11,23	7,99	24,93	22,44	63,84	69,57
		C	13,86	15,11	45,3	54,79	40,84	30,1
	Analyze and show out basic characters in each stage of metabolism	E	10,14	8,31	27,81	20,24	62,05	71,45
		C	14,4	12,07	42,94	52,41	42,66	35,52
Identify nature expression of metabolism activities	Identify nature of metabolism	E	12,36	8,66	29,39	25,97	58,25	65,37
		C	15,33	17,32	45,8	47,16	38,87	35,52
	Identify the relationship of nature expressions in metabolism	E	12,69	8,21	34,77	28,44	52,54	63,35
		C	19,9	9,53	45,7	51,49	34,4	38,98
	Identify expression contents of metabolism concept	E	20,48	9,7	27,07	21,53	52,45	68,77
		C	23,12	27,89	46,51	41,74	30,37	30,37
Identify nature expression of MET from expressions of metabolism	Show out one of three expressions in metabolism which is transformation	E	20,48	8,71	26,31	18,52	53,21	72,77
		C	22,74	25,55	41,64	52,57	35,62	21,88
	Identify nature characters of transformation	E	16,57	14,58	25,36	21,47	58,07	63,95
		C	26,10	21,49	45,43	52,9	28,47	25,61
	Identify cell – transformation unit	E	19,27	21,98	23,64	15,96	57,09	62,06
		C	24,36	19,65	27,67	51,49	47,97	28,86
	Identify expression content of MET	E	16,27	12,57	23,64	23,43	60,09	64,0
		C	33,68	20,3	41,96	50,84	24,36	28,86
Express MET concept in living nature	Express by listing symbols	E	20,9	10,9	27,97	27,27	51,13	61,83
		C	32,05	17,82	44,72	49,21	23,23	32,97
	Express by clauses	E	14,13	11,44	26,63	28,02	59,24	60,54
		C	19,8	12,18	42,19	51,87	38,01	35,95
Concretize MET concept through expression in the stage of collection in living type	Identify specific expression in MET concept in micro-organism	E	20,3	12,24	25,66	18,44	54,04	69,32
		C	19,8	12,18	38,01	51,87	42,19	35,95
	Identify specific expression in MET concept in plant	E	14,6	12,27	250,	19,58	60,4	68,15
		C	14,83	14,46	57,99	53,44	27,18	32,1
	Identify specific expression in MET concept in animal	E	20,47	16,06	27,92	29,25	51,61	54,69
		C	13,37	17,6	51,11	51,92	35,52	30,48
Concretize MET concept through transformation in living type	Concretize MET concept through transformation micro-organism	E	16,73	9,78	30,14	32,83	53,13	57,39
		C	12,83	17,6	45,02	51,92	42,15	30,48
	Concretize MET concept through expression in the stage of plant	E	16,57	14,8	26,78	26,94	56,65	58,26
		C	26,1	21,49	45,43	52,9	28,47	25,61
	Concretize MET concept through expression in the stage of animal	E	15,48	12,36	26,24	29,39	58,28	58,25
		C	17,18	15,33	41,9	45,8	40,92	38,87
Concretize MET concept through expression in the stage of	Concretize MET concept through expression in the stage of discard in micro-organism	E	18,23	12,69	25,93	34,77	55,84	52,54
		C	12,86	19,9	50,3	45,7	36,84	34,4
	Concretize MET concept through expression in the stage of discard in plant	E	8,14	9,48	29,81	28,07	62,05	62,45
		C	13,4	23,12	43,94	46,51	42,66	30,37

discard in living types	Concretize MET concept through expression in the stage of discard in animal	E	17,56	16,48	29,2	26,31	53,24	57,21
		C	15,38	22,74	45,8	41,64	38,82	35,62
Concretize MET concept through expression in the stage of collecting in living organization levels	Concretize MET concept through expression in the stage of collecting in cell	E	21,69	16,57	27,8	25,36	50,51	58,07
		C	19,9	20,9	44,7	27,97	35,4	51,13
	Concretize MET concept through expression in the stage of collecting in body level	E	18,18	18,57	29,07	21,43	52,75	60,0
		C	23,12	27,05	46,51	44,72	30,37	28,23
	Concretize MET concept through expression in the stage of collecting in community	E	19,48	14,13	27,31	26,63	53,21	59,24
		C	22,14	16,8	41,24	42,19	36,62	38,01
	Concretize MET concept through expression in the stage of collecting in group	E	16,57	14,3	21,36	25,66	62,07	60,04
		C	26,1	19,8	45,43	38,01	28,47	42,19
	Concretize MET concept through expression in the stage of collecting in ecological system	E	11,27	4,6	33,64	35	55,09	60,4
		C	22,36	14,83	29,67	57,99	47,97	27,18
Concretize MET concept through expression in the stage of transformation in living organization levels	Concretize MET concept through expression in the stage of transformation in cell.	E	16,27	10,47	23,64	27,92	60,09	61,61
		C	30,68	13,37	41,96	51,11	27,36	35,52
	Concretize MET concept through expression in the stage of transformation in body	E	24,9	16,73	23,97	30,14	51,13	53,13
		C	28,05	16,67	44,72	43,22	27,23	40,11
	Concretize MET concept through expression in the stage of transformation in community.	E	17,13	11,51	26,63	26,88	56,24	61,61
		C	15,8	13,4	42,19	43,94	42,01	42,66
	Concretize MET concept through expression in the stage of transformation in group.	E	13,28	9,56	26,24	29,2	60,48	61,24
		C	17,11	15,38	41,96	45,8	40,93	38,82
	Concretize MET concept through expression in the stage of transformation in ecological system	E	17,23	11,69	22,03	22,8	60,74	65,51
		C	13,86	19,9	50,3	44,7	35,84	35,4
Concretize MET concept through expression in the stage of discard in living organization levels	Concretize MET concept through expression in the stage of discard in cell	E	16,14	13,18	26,81	29,07	57,05	57,75
		C	10,4	23,12	46,94	46,51	42,66	30,37
	Concretize MET concept through expression in the stage of discard in body	E	12,36	9,48	27,39	27,31	60,25	63,21
		C	15,33	22,14	45,8	41,24	38,87	36,62
	Concretize MET concept through expression in the stage of discard in community	E	12,69	16,57	32,77	21,36	54,54	62,07
		C	19,9	26,1	45,7	45,43	34,4	28,47
	Concretize MET concept through expression in the stage of discard in group	E	20,48	11,27	27,07	33,64	52,45	55,09
		C	23,12	22,36	46,51	29,67	30,37	47,97
Concretize MET concept through expression between two connecting stages of living types	Concretize MET concept through expression between two connecting stages of plant	E	20,48	16,27	28,31	23,64	51,21	60,09
		C	32,74	30,68	31,64	41,96	35,62	27,36
	Concretize MET concept through expression between two connecting stages of animal	E	16,57	4,9	21,36	23,97	62,07	71,13
		C	26,1	28,05	45,43	44,72	28,47	27,23
Identify general symbol, nature of each new specific concept	Analyst phenomenon to identify symbols	E	9,27	14,13	33,64	26,63	57,09	59,24
		C	25,36	15,8	27,67	42,19	46,97	42,01
	Identify general symbol, nature of realized symbols	E	16,27	13,28	23,64	26,24	60,09	60,48
		C	27,68	15,11	42,96	41,96	29,36	42,93
	Mention name of concept	E	20,9	17,23	27,97	22,63	51,13	60,14
		C	32,05	19,9	44,72	45,7	23,23	34,4
Concept systemization	Express suitable concept systematization	E	16,16	10,48	26,63	30,07	57,21	59,45
		C	19,8	23,12	42,19	46,51	38,01	30,37

	Expressions show out expansion of each nature symbol of MET concept in living nature	E	14,13	15,9	26,73	25,97	59,14	58,13
		C	11,8	32,05	45,19	44,72	43,01	23,23

Note: Level 1: incorrect; Level 2: Correct but not sufficient; Level 3: Correct and sufficient.

From results, we can draw out some conclusions: in evaluation criteria group, the rate of student satisfying at level 1 in experiment and control groups mainly has big change in two study years, however, for the level 3, there is clear difference, the rate of students satisfying with level 3 in some criteria does not have big change such as in groups of criteria 4, criteria 7 but in remaining control groups, there is big change, therefore the rate of students satisfying with level 3 in study year 2013-2014 has clear increasing in comparison with study year 2012-2013. Thus, we can confirm that organizational methods for forming MET concept for students as proposed in the thesis is effective and positive.

PART 3. CONCLUSION AND SUGGESTION

3.1.CONCLUSION

3.1.1.Basic contents of high schools' biology program is concept system, thus, the teaching is actually concept system, having a thorough grasp of nature of concept, concurrently holding solidly systematization of those concepts, thus identify logics and the development of concepts through study stage, classes and living organization level is the target need to be improved.

3.1.2. Knowledge on MET concept is basic living activity knowledge in students, is expressed at all living organization levels, each level is expressed following with different types. The thesis is determined as comprehension direction of MET concept by movement logics and development through living organization levels to understand the nature and objective movement of MET

3.1.3. The perception the development logics for the concept of MET, writer has construct justifications, as follow: concept, biology concept, MET concept, the basis to identify the development of MET concept and indicated concept system which belong to MET concept from Biology 6 to Biology 12.

3.1.4. In order to organize studying activities to help students have thorough grasp of concept system, the thesis propose principle, process and methods for studying following with the analysis of MET concept development from cell level, Prokaryotic cell, Eukaryote cell, population and community and ecosystem – biosphere.

3.1.5. The thesis shows out clearly the way for experiment performance, measurement criteria in the experiment, tools in experiment and data system as the base and proofs that the supposition is correct, means that students in experiment classes can hold solidly concept system, understand thoroughly development process of concept system, with knowledge then studying competency of students is formed and developed.

3.2. SUGGESTION

Determine development logics of contents which are basic teaching capacity, actually many teachers are still embarrassed. Particularly for identifying the development of MET concept, almost of them are too embarrassed, thus should have documents to improve or training classes for capable teachers that helps for improving teaching method in general and biological concept teaching in particular.