

# Teaching Design of “Cytoplasm” (the First Class)

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**Abstract:** Taking the "synthesis and secretion processes of secreted proteins" as the main chain and with the teaching method of "identifying graphs-discussion-drawing-display-evaluation", this class is designed to guide students to understand the organelles related to the formation of secreted proteins. This helps students to understand that the organelles in the cytoplasm are not independent and incoherent, but a coordinated unity with the division of labor.

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## 1 Design Concept

The constructivist view of learning holds that learning is not simply transfer knowledge from teachers to students, but is formed and constructed by students based on the repeated and bidirectional effects between the old and new experiences. The constructivist view of teaching also believes that based on the original experience of students, teachers should adjust their roles. Through creating vivid situations, teachers should guide students to think and reflect to achieve the meaning of construction, and should focus on cooperative learning methods.

Based on these two theories of constructivism, this lesson will use multimedia and other visual aids, provide graphs, slides and other advance organizers, take the learning case as a carrier, use the teaching method of "identifying graphs-discussion-drawing-display-evaluation" to guide students to understand the structures and functions of organelles. Through

the exchange between teachers and students as well as between students, students' viewpoints will be fully paid attention to and the study of generated problems will be carried out to guide students to experience that cell is a coordinated unity with a clear internal division of labor, finally reaching the two-way construction of original experience and new experience.

## 2 Teaching Objectives

### 2.1 Knowledge Objectives

Give examples about the structures and functions of ribosome, endoplasmic reticulum, Golgi apparatus and mitochondria; briefly describe the synthesis and secretion process of secreted proteins; discuss the unity of structures and functions in cells, and the unity of parts and the whole.

### 2.2 Ability Objectives

Try to describe the observed organelles images and draw a schematic diagram of organelles; learn to solve practical problems with the knowledge students have learned.

### 2.3 Emotional Attitudes and Value Goals

Through the synthesis and secretion process of secreted proteins, understand the unity of organism structures and functions and form the scientific world outlook; recognize the importance of technological progress in scientific research.

## 3 Teaching Processes

Pre-class Preparation: multimedia courseware, learning case in the class

### 3.1 Situations introduction to stimulate interest

When playing the video of "food in the factory production lines", the teacher guides students to watch the video and at the same time, guides them with their own knowledge and experience to think about: how delicious food is produced. Students discuss, think and answer. Then, the teacher makes a metaphor: liken the cell to the basic unit of the life system and there are similar factories departments or workshops within the cell. The cell is like a busy factory and busy workshops in the factory are organelles. Then the teacher uses PPT to show the microscopic structure of the cell and three basic structures of the cell: cell membrane, cytoplasm and nucleus. After that, the teacher uses PPT to show the submicroscopic structure of the cell and guides students to carefully observe the microscopic structure and the submicroscopic structure of the cell. Question: where are the organelles? Students observe, think and answer. The teacher adds: organelles exist in the cytoplasm and in addition to organelles in the cytoplasm, the transparent liquid is called cellular sol, which is the site of a variety of metabolic activities.

Design Intent: For the delicious food, students are naturally unable to resist. Accordingly, by playing the video of "food in the factory production line" and comparing macro-food with micro-cell before the class, students can intuitively understand the existence of organelles to introduce the new course, greatly stimulating the interest of students.

### 3.2 Cooperation and exchange to explore new knowledge

#### 3.2.1 "You say, I draw"—structures and functions of organelles

Distribute the learning cases designed in advance to students in the class. The teacher assigns the task: Now, you have a once-in-a-lifetime opportunity. Please bring your books and pens to the cytoplasm for a lifetime unforgettable trip. Record the forms of ribosome, endoplasmic reticulum, Golgi apparatus and mitochondria that you see along the way and combined with the relevant knowledge in the book, use personification sentences to describe organelles. Students draw the schematic diagrams of organelles according to the description.

Students read the relevant contents of four organelles of endoplasmic reticulum, ribosome, Golgi apparatus, and mitochondrial in the book and the results of the trip are recorded in the learning case in a group of four people (see table 1). Then two students in each group show their discussion and exchange results to the whole class. One of the students uses personification sentences to describe the organelles, while another student paints a schematic diagram of organelles on the blackboard. The teacher guides the whole class to discuss and revise together and independently build the structures and functions of the four kinds of organelles.

Names	Structure Sketches	Forms	Membrane Structures	Chemical Composition	Functions	Distribution and Characteristics
Ribosome		____-shaped granular corpuscle	____ membrane	consisting of ____ and ____	it's ____ place	one part_____, another part_____
Endoplasmic Reticulum		a reticular structure consisting of a cystic cavity and a thin tube. it is divided into ____endoplasmic reticulum(with ribosome on it) and ____endoplasmic reticulum	membrane of ____ layer		place of processing for__, can transport ____to Golgi apparatus and other parts of the cell.	commonly exist in animal and plant cells

Golgi Apparatus		consisting of a flattened pouch and vesicles produced by this pouch.	membrane of ___ layer.		processing, sorting and packaging proteins which come from ___ plant: _____ animal: _____	commonly exist in animal and plant cells
Mitochondria		under the optical microscope, _____ outer membrane _____, inner membrane _____	membrane of ___ layer.	_____	it's the center of _____	commonly exist in animal and plant cells; distribution is related to _____

**Table 1 Organelles (Part)**

The teaching of ribosomes. The teacher asks student 1 in the group to describe the ribosome they recorded during the trip using personification sentences, and guides student 2 in the group to draw a schematic diagram of the ribosome on the blackboard. Students evaluate it and the teacher evaluates and supplements the distribution of ribosomes.

For example: student 1: I'm a ribosome. Although I'm relatively small, my distribution is not small. Some of them are in the cytoplasm and some of them depend on the endoplasmic reticulum. My composition is simple and RNA and protein is OK. But my function is not small. All the proteins in the cell must be synthesized here. Let me tell you a little secret: my only drawback is that I have no coat and I'm naked. Student 2 draws a sketch of the ribosome according to the student 1's description.

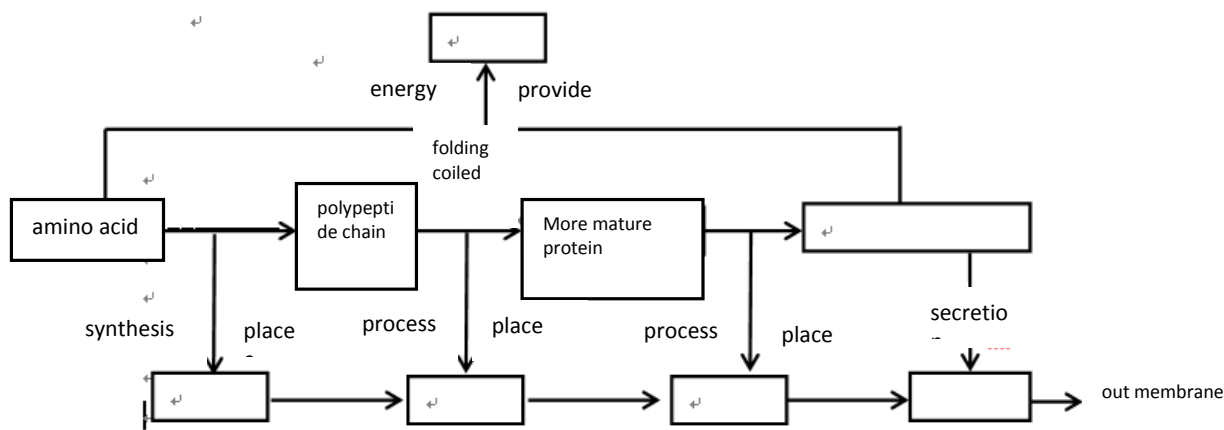
Design intent: by guiding students to swim in the ocean of "cytoplasm" and describe and draw a structural sketch of organelles they see along the way using personification sentences, the teacher gives full play to the students' imagination. At the same time, through the evaluation between students as well as between teachers and students, the class atmosphere is greatly active. While learning structures and functions of organelles, students can enjoy the pleasure of learning. So this kind of enjoyable and educational teaching method is very popular with students.

### 3.2.2 "I see, I draw"—the synthesis and secretion

#### processes of proteins.

Functionally, these organelles are closely linked to proteins, and in the history of science, a scientist has experimentally proved the connection. Data shows that scientists have done such an experiment in studying the synthesis and secretion of secreted proteins. They injected leucine labeled 3H in the pancreas acinar cells of guinea pigs. One minute later, the marked amino acid appears on the ribosome. After 3 minutes, it appears in the endoplasmic reticulum which is attached to the ribosome. After 17 minutes, it appears in the Golgi apparatus. After 117 minutes, it appears in a small bubble transporting proteins near the inside of the cytomembrane and releases into the extracellular secretions. After students read the material, play the slides: the synthesis and secretion processes of secreted proteins. Then assign the task: take 4 people as a group, and on the basis of 4 kinds of structural sketches of organelles, paint synthesis and secretion processes of secreted proteins. Each group forms a result and displays it with the slides in the class.

Evaluation is carried out between students and the teacher provides a complement and makes a summary. Then, students are required to complete the conceptual logic diagram of the "secreted proteins formation processes" in the learning case (see table 2).



**Table 2 Synthesis and secretion of secreted proteins**

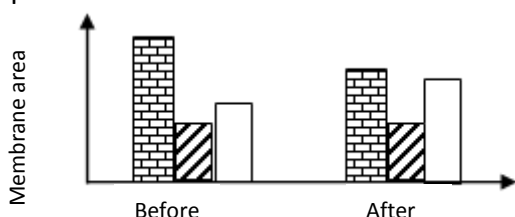
### 3.2.3 “See my change”—Membrane area changes of related cell structure during the formation processes of secreted proteins.

Analyze and discuss through examples: the regularity of membrane area changes of each cell structure during the formation processes of secreted proteins. Then explore through interaction: use the form of a line chart to represent the above rules. Student's results are displayed with slides, and students evaluate them. The teacher comments and makes a summary.

Discuss and analyze: the changes in the area of the biofilm in a few seconds before and after the secreted proteins formation of a cell are shown below. What kind of cell structure do these pictures

represent?

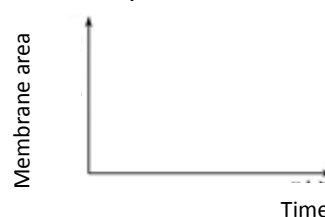
- A. Ribosome, Endoplasmic reticulum, Golgi apparatus
- B. Endoplasmic reticulum, Golgi apparatus, Cytomembrane
- C. Ribosome, Golgi apparatus, Endoplasmic reticulum
- D. Endoplasmic reticulum, Cytomembrane, Golgi apparatus



Interact and explore: according to the synthesis

process of secreted proteins, draw the change tendency of endoplasmic reticulum (A), cell membrane (B) and Golgi apparatus membrane (C) in the following picture (expressed in line chart).

Design Intent: in this section of the content, students always feel it difficult to discuss the membrane area changes of each cell structure in the secreted proteins processes. Judging from the scoring rate of each test, the score of this knowledge point is relatively low. Therefore, it is necessary to arrive at the changes rules of cytomembrane area of each cell structure through students' own analysis and discussion, and try to draw the line graph to express it. Through this activity, students' ability of graphic conversion can be improved to a certain extent.



### 3.3 Summarize, internalize and promote

Through this lesson, students must have a further understanding on the organelles associated with synthesis and secretion of secreted proteins. Finally, students are required to summarize from the three aspects of knowledge, ability and emotion. Students summarize and supplement and the teacher evaluate it.

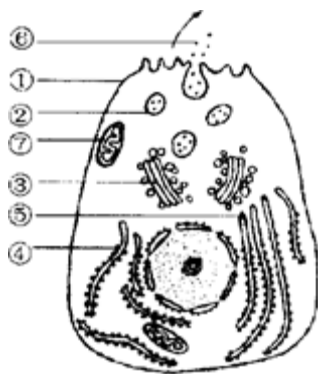
### 3.4 Check and feedback, consolidate and expand

For example: the right picture is a secreted cell of an

animal. Inject amino acid labeled with radioisotope  $^3\text{H}$  into the cell. After a period of time, the secreted proteins containing radioactivity are detected outside the cell. Please answer the following questions (fill the serial number in []):

(1) The radioisotope will appear in turn in the site of the picture is \_\_\_\_\_. (fill in the serial number)

(2) ⑥ secreted proteins are synthesized first by [] on [].



#### 4 Reflection on teaching

This section is one of the important contents of this chapter, which is the third section of the second chapter of "Biology (Compulsory-) molecule and cell" which is Experimental textbook of curriculum standard in Zhejiang General High School. The textbook first shows that the cytoplasm mainly consists of organelles and cell Sol, and then highlights the structures and functions of organelles. Students also know little about micro-organelles. If the structures and functions of each organelle are introduced in turn according to the order in the book, it will appear to be somewhat dull. The constructivist view of teaching believes that only by creating vivid situations and guiding students to think and reflect repeatedly can the construction of meaning be achieved. Therefore, if a situation is not created to connect the learning between various organelles, it will not be conducive for students to construct new knowledge. With the situation of the "synthesis and secretion process of secreted proteins" and taking pictures as the advance organizers, this lesson focuses on the teaching of relevant various types of organelles around this core issue, which is helpful for

students to increase their perceptual awareness and overcome the difficulties of understanding the micro-structures. At the same time, through the communication and evaluation between teachers and students as well as between students, the schematic diagram of secreted proteins formation is to be improved. In this way, students' original experience and new experience will be constructed in two directions.

This lesson can well implement the requirements of "biology curriculum standards" and fully explain the relationship between the structures and functions of the cell to establish a complete cellular concept. Taking the "synthesis and secretion processes of secreted proteins" as the main line, the structures and functions of each organelle are strung out by the learning case in the class as the carrier. Through the activity of "You say, I draw", the knowledge goal of "structures and functions of ribosome, endoplasmic reticulum, Golgi apparatus, mitochondria" is to be completed. At the same time, students' ability to draw is also cultivated. With scientific data presentation, slides, "I see, I draw" and other activities, the knowledge goal of the "synthesis and secretion processes of secreted proteins" is to be completed. In this process, students gradually identify the importance of technological progress in scientific research and recognize the unity of organism structures and functions, and gradually form a scientific world outlook. Through the activity of "See my change", the column diagram of the membrane area changes of the cell structure in the process of secreted proteins formation is transformed into a line chart. Students' ability of graphic transformation is also to be developed. This lesson combines the visible clue of "knowledge teaching" with "ability teaching", "emotion, attitude, and values teaching" to truly achieve the students in the mind and give fully play to the main role of students. This kind of teaching model can be used as a model for knowledge teaching of memory learning and for reference.