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Research on the Application of Osmotic Physics History in Junior Middle School Physics Teaching

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Abstract: *As an important achievement in the development of physics, the history of physics needs teachers to pay attention to the educational significance in the teaching process. This paper studies the educational significance of osmotic physics history in junior middle school physics teaching. Teaching science edition junior middle school physics textbooks present the history of physics content is sorted out and summarized. The teaching principles and cases of penetrating physics history in teaching are put forward.*

Key words: *Junior high school physics; Penetration; History of physics; Application*

Introduction

Physics is a basic science with a long history. Many scientists have made great efforts to explore the composition and motion rules of the material world, and to study the fields of heat, optics, electromagnetism, relativity, quantum mechanics, nuclear physics, condensed matter physics and so on. They pushed physics further and further to build the great buildings of physics.

In the preface to Guo Yiling and Shen Huijun's history of Physics, Mr. Qian Sanqiang mentioned as follows: "The history of physics is a treasure land containing great spiritual wealth. It's worth exploring and it's worth discovering." In the middle school physics teaching process, it is necessary to permeate the content of physics history. As a physics teacher, we should think about how to infiltrate the history of physics into the teaching process.

The Educational Significance of Osmotic Physics History in Junior Middle School Physics Teaching

The history of physics is to study the history of human cognition of various physical phenomena in natural science, including the basic laws of the occurrence and development of physics, the process of the development and transformation of physical concepts and thinking, how physics becomes an independent science and how to open up new fields. In the research process and content of the history of physics, it embodies the research connotation of the construction of "physical concept", the analysis of "scientific thinking", the development of "scientific inquiry ability" and the promotion of "scientific attitude and responsibility" . This plays an important role in the cultivation of students' physical core accomplishment.

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(1) Permeating Physics History in Junior Middle School Physics Teaching Helps Students to Construct a Complete "Physics Concept" .

The history of physics is permeated in the middle school physics teaching process, which means that the history of physics should be taught to students with its historical development as a clue when they learn basic physical concepts and physical laws. It enables students to understand the process of cognition, formation and development based on a complete historical background when learning theoretical knowledge. By constructing the cognition, formation and expansion of the complete "physical concept", it helps them to understand the physical knowledge.

(2) Permeating Physics History in Junior Middle School Physics Teaching is Beneficial to Enrich Students' Rigorous "Scientific Thinking".

The history of physics is permeated in the middle school physics teaching process, which is to enrich students' complete thinking process of producing, researching and summarizing physics problems with the history of physics as the carrier in teaching. This enables students to master the unique thinking process and method of physics from the nature of thinking, so as to rigorously "scientific thinking".

(3) Permeating Physics History in Junior Middle School Physics Teaching Helps Students to Develop Good "Scientific Inquiry Ability"

Permeating the history of physics in the middle school physics teaching process enables students to become "scientists" and repeat scientific inquiry experiments. According to the complete process of scientific inquiry, it studies the formation process of some scientific knowledge and cultivates students' good "scientific inquiry ability" through the historical development of scientific research.

(4) The Infiltration of Physics History in Junior Middle School Physics Teaching Helps Students to Improve Their Positive "Scientific Attitude and Responsibility".

Permeating the history of physics in the middle school physics teaching process is to let students understand the scientists and physicists of different times for a certain kind or a physical problem made hard dedication. It lets the student know in the physics development history past dynasties scientist in the pursuit truth road hard pay, even some scientist sacrificed precious life. It enables students to realize the position of physics in different times in the process of social development and cultivate their high sense of social responsibility.

The Presentation and Analysis of the History of Physics in the Middle School Physics Teaching Materials

(1) Statistics of Physics History in Junior High School Physics Textbook of Teaching Science Edition.

In order to make the infiltration education of the history of physics more closely combined with the actual teaching, the present form of the history of physics in the physics textbook of the educational science edition

is understood and counted in detail. Different categories are classified according to the following basis for subsequent research:

First, in terms of presentation content, it is divided into four categories: introduction to physicists (classification symbol: A), introduction to the history of scientific research (classification symbol: B), introduction to scientific research methods (classification symbol: C) and scientific research achievements (classification symbol: D).

Second, from the form of presentation, divided into pictures, text and text combination of three categories.
Third, from the position of the presentation of the textbook, it can be divided into ten categories: text, observation, activities, hands-on, experimental exploration, discussion and exchange, my design, family laboratory, towards society, physics online.

Fourthly, in terms of presentation quality, it can be divided into detailed (more than 1/2 of the page), medium (between 1/2 and 1/3 of the page), slightly (less than 1/3 of the page).

Table 1. Statistical Table of Presentation form of History of Physics in the First Volume of Eighth Grade Teaching Science Edition

Chapter	Content	Page	Content	Form	Position	Quality
Introduction	Understanding physics	1	A	Pictures	Article (information)	brief
	Understanding physics	2	A	Pictures	Article (information)	brief
	Understanding physics	3	D	Pictures and text	Article	brief
Chapter one: Into the lab	From carpentry ruler to rice original	11	D	Pictures and text	Article	detail
Chapter two: Motion and energy	From the hourglass to the atomic clock	15	B	Pictures and text	Physical online	medium
Chapter three: Sound	Man's exploration of the microscopic material world	22	B+D	Pictures and text	Physical online	detail
Chapter one: Into the lab	Chime bells by Zeng Houyi	45	D	Pictures and text	Physical online	medium
	Sound phenomena in ancient architecture	53	D	Pictures and text	Physical online	detail

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Chapter four: In the World of Light	camera	57	D	Pictures	Article (information)	brief
	Fantastic optical fiber	64	D	Pictures and text	Physical online	brief
	Space mirror	68	B	Pictures and text	Moves towards the society	medium
	The history of the camera	77	D	Pictures and text	Moves towards the society	medium
	Galilean telescope	82	D	Pictures	Article (information)	brief
	Appreciation: Looking into the distant universe	83	D	Pictures	Article	detail
	The microscope	84	D	Pictures	Article	brief
	Dispersion of light	85	A+B+D	Pictures and text	Article	detail
Chapter five: The change of state of matter	Gas thermometer	92	D	Pictures	Article (information)	detail
	Discovery and utilization of materials	101	D	Pictures and text	Article	medium
	liquefied	104	A+D	Pictures	Article (information)	brief
	Heat pipe	106	B+D	Pictures and text	Physical online	detail
Chapter six: Mass and density	Balance	113	B+D	Pictures	Article (information)	brief
	Argon is found from 0.0067	119	A+B+D	Pictures and text	Physical online	detail

Table2. Statistics of the form of Physics History Presented in the Second Volume of Eighth Grade Teaching Science Edition

Chapter	Content	Page	Content	Form	Position	Quality
Chapter seven: Force	The description of the force	6	B	Pictures and text	Article (information)	brief
	Newton	9	A	Pictures and text	Physical online	detail
	Explore the relationship between the forces of interaction	12	C+D	Pictures and text	Home laboratory	medium
	Newton and the Apple	13	C	text	article (information)	brief
	Ancient people used logs to roll large stones	20	C	Pictures	article	brief

Chapter 8: Force and Motion	Force and motion	23	A+B+D	text	Introduction	detail
	Galileo and the inclined plane experiment	25	A+B+C+D	Pictures and text	article	medium
	Investigation and research on “Bridge”	32	B+C+D	text	Physical online	brief
Chapter nine: Pressure	Blastomere experiment	44	B+C	Pictures and text	Home laboratory	medium
	Marine survey	44	C	text	Physical online	medium
	The ship’s brake	46	A	Pictures	article(information)	brief
	Three Gorges Lock and hydraulic technology	47	C+D	Pictures and text	Physical online	brief
	The Madburg hemisphere experiment	48	C+D	Pictures	article	medium
	torricelli	50	A+D	Pictures	article(information)	brief
	Glick’s experiment	51	C+D	Pictures	Discuss communication	medium
Chapter 10: Fluid force phenomena	Bernoulli	55	A	Pictures	article(information)	brief
	Wind tunnel	57	D	Pictures and text	Physical online	medium
	Cause of buoyancy	60	C	Pictures and text	Home laboratory	brief
	The legend of Archimedes	61	A+C+D	Pictures	article(information)	medium
	Archimedes’	63	A+D	Pictures	article(information)	brief
	Floating boat fishing	69	C+D	Pictures and text	article	medium
Chapter 11: Machinery and work	The ancient lever	76	C+D	Pictures and text	article	detail
	Investigate pulley applications	81	D	text	move into the society	medium
	Container crane	89	D	Pictures and text	Physical online	detail
	Study the construction of a bicycle	95	C+D	Pictures and text	Home laboratory	detail
	Ingenious automatic mechanism	95	C+D	Pictures and text	move into the society	detail

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Chapter 12: Mechanical energy	water	104	D	Pictures and text	article(information)	brief
	The principle of hydroelectric power	104	C+D	Pictures and text	article	detail
	wind	105	B+D	Pictures and text	article	detail
	Three Gorges Hydropower station	106	D	Pictures and text	Physical online	medium

Table3. Statistical Table of Presentation form of History of Physics in the First Volume of Grade 9 Teaching Science Edition

Chapter	Content	Page	Content	Form	Position	Quality
Chapter one: Molecular kinetic theory and internal energy	Dialogue about the composition of matter	2	B+C	Pictures and text	article(information)	medium
	Human cognition of the structure of matter	2	A+B+C	Pictures and text	article	medium
	Molecular motion	3	D	Pictures	article(information)	brief
	Brownian motion,	6	B+D	Pictures and text	Physical online	medium
Chapter two: The Engine that changed the world	Steam locomotive	19	D	Pictures	Introduction	brief
	Watt's steam engine	20	D	Pictures and text	article(information)	brief
	The steam engine	21	B +D	text	article	medium
	Ancient Chinese rockets	26	D	Pictures and text	article	brief
	The rockets	27	B+C	Pictures and text	article	detail
	The diesel engine	28	D	Pictures and text	Physical online	detail
	The engine that changed the world	30	B+D	Pictures and text	article	detail
Chapter three: Understanding circuits	What is lightning in the sky	34	C	Pictures	article(information)	brief
	Volta invented the battery	36	D	Pictures	article(information)	brief
	Explore the direction of current in the circuit	41	C+D	Pictures and text	Home laboratory	medium
	Combined circuits and integrated circuits	45	B+C+D	Pictures and text	article	detail
	Printed circuit board	46	D	Pictures and text	Physical online	medium

Chapter four: Exploring electric currents	The resistor	66	D	Pictures and text	article	detail
	Know the potentiometer	68	B+D	Pictures and text	Home laboratory	brief
	A superconductor	69	B+D	Pictures and text	Physical online	brief
Chapter five: Ohm's Law	Ohm's obsession	74	A+B	Pictures and text	article (information)	brief
	A special method of measuring electrical resistance	78	C	Pictures and text	Home laboratory	brief
	Know how to use an electric meter	78	D	Pictures and text	Home laboratory	brief
Chapter six: Electric power	Energy efficiency labeling of household appliances	89	D	Pictures and text	move into the society	detail
	Use an electricity meter to measure electric power	93	C	Pictures and text	Home laboratory	detail
	Joule's law	95	C	text	article	brief
	Joule	96	A	Pictures	article (information)	brief
	blackout	97	B	Pictures and text	Physical online	medium
	"One Yuan Energy Saving Lamp" campaign	101	B	Pictures and text	discussion and communication	medium
Chapter seven: Magnetism and electricity	Alpha magnetic spectrometer	104	D	Pictures	article (information)	brief
	Einstein	104	A	text	article	brief
	Magnetic material around you	108	D	Pictures	article (information)	medium
	Magnetic shielding	109	B	Pictures and text	Physical online	medium
	Oster demonstrates electromagnetic contact	111	A+B	Pictures	article (information)	brief
	Ampere experiment	112	B	Pictures	article (information)	brief
	Application of electromagnet	117	D	Pictures and text	article	detail
	Superconducting magnets	118	D	Pictures and text	Physical online	medium
	Simple transmitter and receiver	118	D	Pictures and text	Home laboratory	medium
	Circuit diagram of automatic alarm	121	B+D	Pictures	article	detail

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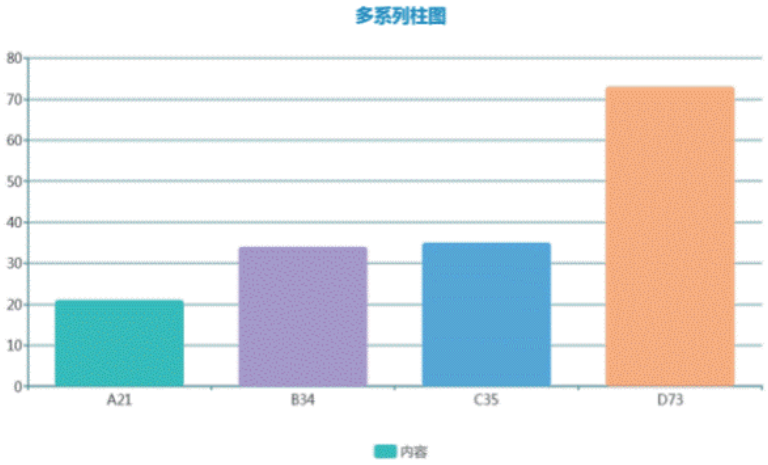
Chapter eight: Electromagnetic interactions and applications	Faraday	124	A+C	Pictures and text	article	medium
	The future of babies	127	A+D	Pictures and text	discussion and communication	brief
	A generator drives another generator	130	C+D	Pictures and text	article	medium
	Electric motors and human civilization	133	D	Pictures and text	article	detail
	Bell and the Telephone	135	D	Pictures and text	article	brief
	History of the Telephone	137	C+D	Pictures	article (information)	detail
	Sensors in Life	138	D	Pictures	article (information)	detail

Table 4. Statistical table of presentation form of history of Physics in the second volume of Grade 9 teaching Science Edition

Chapter	Content	Page	Content	Form	Position	Quality
Chapter nine: Household electricity	Practice using the home switchboard	9	B+C	Pictures and text	article	detail
	Intelligent family life	17	B+D	text	article	medium
	Household electricity	18	C+D	Pictures and text	Physical online	medium
Chapter ten: Electromagnetic waves and information technology	Spirit's image of Mars	20	D	Pictures	article (information)	brief
	How are electromagnetic waves generated	24	C	Pictures and text	Physical online	detail
	Electromagnetic shielding	24	C	Pictures and text	Home laboratory	medium
	The application of electromagnetic wave in information	25	D	Pictures and text	article	detail
	Application of electromagnetic wave in hospital media	29	D	Pictures and text	Physical online	detail
	Information Revolution and human civilization	33	B	Pictures and text	article	detail
Chapter eleven: Physics and energy technology	Da Vinci's vision	42	A+C	Pictures	article (information)	brief
	Alpha particle scattering experiment	54	B+C	Pictures and text	Physical online	detail
	Man's use of energy	59	B	Pictures and text	Physical online	detail

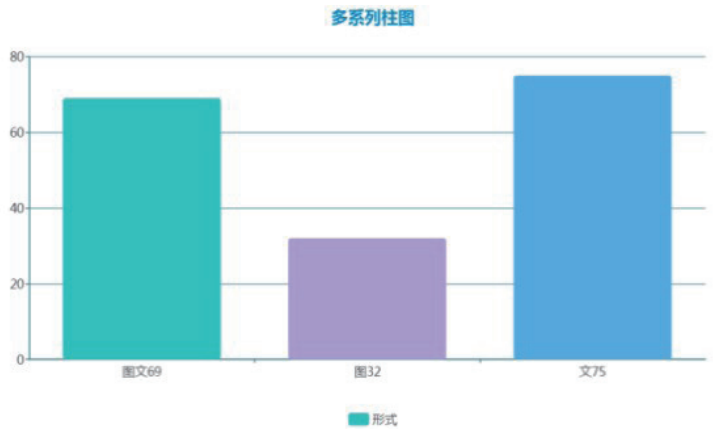
(2) Data analysis and summary of physics history in teaching science Edition junior high school physics textbook

It is based on the statistical data analysis of the content, form, position and quality of the history of physics in the junior middle school physics textbook of teaching Science Edition (see figure 2-1, 2-2, 2-3, 2-4). It can be found that when presenting the history of physics content in the textbooks, the results of scientific research are mostly introduced in the form of pictures, texts or words. This shows that in the teaching process, we should fully explore the above information. Through classroom teaching and extracurricular development, students' interest in independent learning is mobilized to enhance the role of physics history in teaching and education.



Render content	Data
Introduction to physicists	21
An introduction to the history of scientific research	34
Introduction to scientific research methods	35
Scientific Research Achievements	73

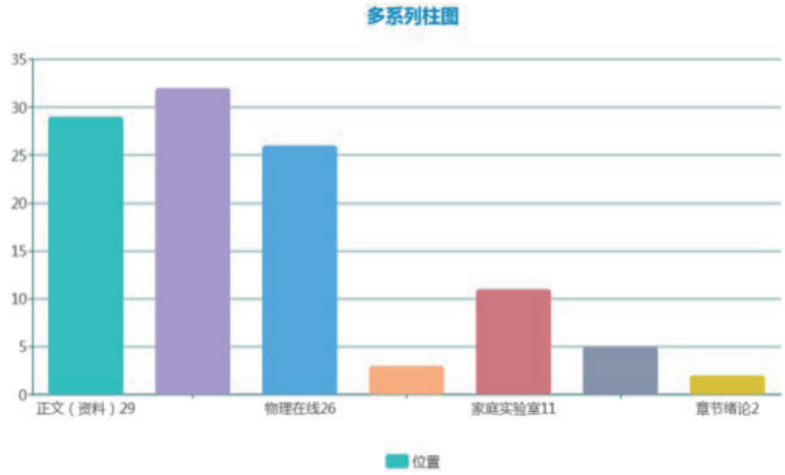
Figure 1. Data analysis table of physics history content presentation in teaching Science Edition of junior high school physics textbook



Present form	Data
Picture and text	69
Picture	32
Text	75

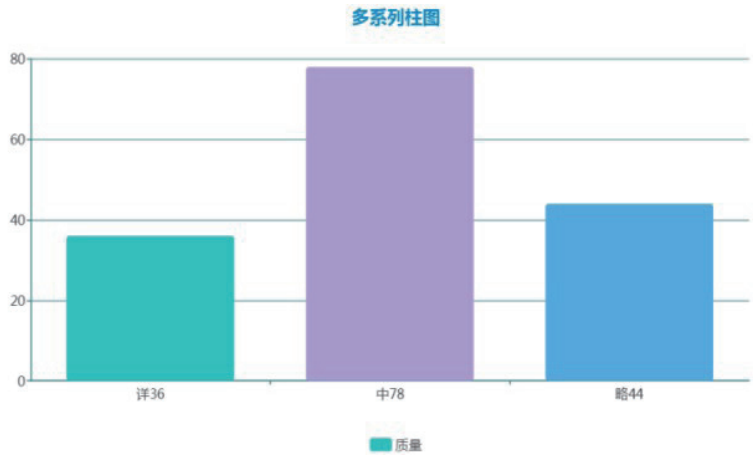
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Figure 2. Data analysis table of physics history form of junior high school physics textbook in Teaching Science Edition



Present position	Data	Present position	Data
article	32	Move into society	5
article(information)	29	Discussion and communication	3
Physical online	26	Chapter introduction	2
Home laboratory	11		

Figure 3. Data analysis table of position presentation of physics history in junior high school physics textbook of Teaching Science Edition



Rendering quality	Data
detail	36
medium	78
brief	44

Figure 4. Data analysis table of physics history quality presentation of junior middle school physics textbook in Teaching Science Edition

The Strategy Research of Osmotic Physics History in Junior Middle School Physics Teaching

(1) Basic Teaching Principles of the History of Osmosis Physics.

Through the presentation and analysis of the history of physics in textbooks, we can find that the history of physics plays an important role in teaching. It has many forms and contents. It appears and is scattered as supporting material or reading material for a particular physical content. If it is to be used in teaching, practical teaching is no small challenge. Therefore, when we are teaching, we should grasp the principle of scientific, enlightening, appropriate selection of content, integration of teaching materials with high relevance to carry out teaching. This should not only take into account the contents of the history of physics in the textbooks, but also on the basis of the historical development process, or the change of physics thought, or the representative results of physicists in different periods as clues to make students really interested in the history of the development of physics in class. Improve students' interest in physics by stimulating their enthusiasm for independent learning.

(2) Principles of Experimental Teaching in the History of Osmosis Physics.

It is not difficult to find from the sorted data that the textbook does not involve much in the history of physics in scientific inquiry. Many experimental conclusions have been given directly, which makes students unable to understand the significance of the experiment to the research of physics and more unable to understand the research background, research process, research methods and scientists in the experimental process to pay efforts. This kind of history of physics is worth telling students in the corresponding teaching. With the clue of retracing the experimental research of scientific inquiry, the content of physics history is connected with experimental teaching. This allows students to discover the collision of thinking in the experiment and pay attention to the details of the experiment process to improve their hands-on ability.

(3) The Optimization Teaching Principle of the History of Osmosis Physics.

According to the position of the history of physics, online physics, home laboratory and entering society account for about 40%. These three sections are designed to help students make use of their time after class. Through the combination of reading materials and independent inquiry, a detailed understanding of the history of physics related to it. This means that the use of the Internet, new media and other resources is a way to optimize teaching. Teachers can provide students with enough physics history materials in the form of micro classes and official accounts to enrich students' learning time after class.

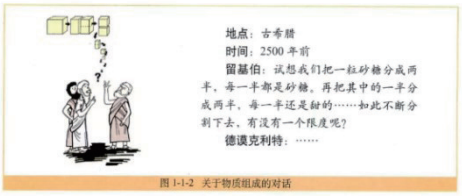
Junior High School Physics Teaching in the History of Osmotic Physics Application Case Display

In the teaching of "molecular movement in the microcosmic world", cases of physics history of "human exploration of the microcosmic material world" and "α particle scattering experiment" are introduced.

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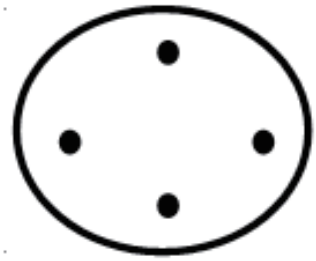
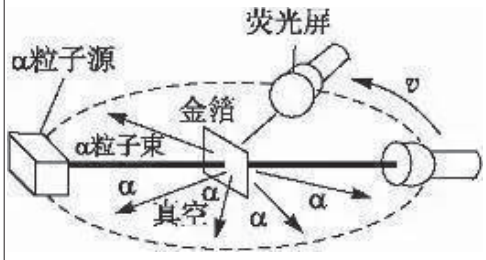
In the teaching section of "Molecular movement in the microcosmic World", the textbook mentions that "people have suspected and confirmed the existence of small structures inside objects" (Volume 1, Grade 8, P21). It directly gives the concept that "matter is composed of molecules", without elaborating on its exploration process. This part is introduced online in the form of physics in the materials of "Human exploration of the microscopic material world" on page P22 and "Experiment of alpha Particle Scattering" on page 54 of volume 2 of Grade 9. However, considering that students are just exposed to physics at this time, they have not developed basic physical thinking. So in this lecture, I'm going to combine the two parts of the history of physics. With the clue of time axis, it will explain the research process and conclusions of different scientists, and guide students to draw conclusions independently.

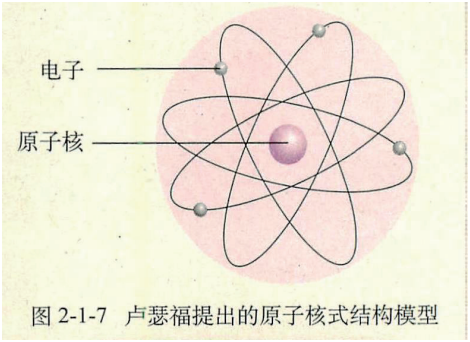
Table 5. Teaching Link Design of Osmotic Physics History Content in the Teaching of "Molecular Motion in the Micro World"

Teachers' activities	student activities	design idea
New lessons are introduced to stimulate interest 2,500 years ago in Ancient Greece, the philosopher Leucippe asked the question, "If you split a grain of sugar in half, would half of it still come from the field? If you split half of it in half, would each half still be sweet? Is there a limit to how far this division can go?"  图 1-1-2 关于物质组成的对话 (Figure 4-1: Dialogue about the composition of matter)  图 1-1-3 人类对物质结构的认识历程 (Figure 4-2: Human cognition of material results)	Consider and answer this question: Each half is sweet, but can it be divided forever? It's impossible to verify. Think and answer: If it is an externally neutral object, if there are negatively charged electrons inside, then there must be a positively charged part.	Refer to the text (information) "Dialogue on material Composition" in P2, volume 1, Grade 9. Combining the content of positive and negative electricity in students' basic scientific accomplishment, guide students to think about the existence of positive and negative electricity in atoms. It leads to the historical development of the internal structure of the atom.

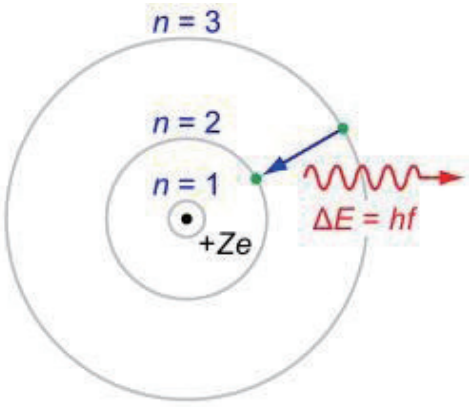
Thinking about this problem, Chinese Mozi proposed that the object is continuously divided into the smallest unit as “end”. In the 19th century scientists theorized about this problem and proposed that common substances consist of large numbers of molecules. Using an electron microscope, it can see the much smaller structures that make up the molecules. In 1803, The British physicist Dalton proposed the atomic theory, which called this even smaller structure “atom”. In subsequent experiments, some scientists found negatively charged electrons in the atoms. But what does that say about the discovery that matter is electrically neutral? Understand the original knowledge to learn new knowledge to teach new lessons Like the students, scientists began a long process of studying the structure of the positively charged parts and negatively charged electrons inside atoms. The work of several of these scientists is representative, and we take a look at each of them in terms of their research time. J. J. Thomson’s “solid charged sphere” model was the accepted structural model until 1910. His model of atomic structure assumed that the positively charged parts were evenly distributed over a spherical structure. The negatively charged parts are embedded in certain locations (similar to the structure of grape cake on red date cake). The structure of these two parts maintains charge balance. To test this, he designed to use X-rays and beta rays to scatter atoms to determine the positions and structural composition of their internal parts.	Observe J. J. Thomson’s model of a solid charged sphere. Think about how the positive and negative parts of an atom are distributed.	Consolidate the electric neutrality of the positive and negative charges in atoms, and let students understand the meaning of “uniform distribution”. This is a good foundation for rutherford scattering experiment and atomic structure model.

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 (Figure 4-3: J. J. Thomson's "Solid Charged Ball") *Cause conflict and improve thinking*  (Figure 4-4: α -ray scattering experiment) Contrary to his assumption, however, X-ray and beta experiments yielded inconsistent results. This experiment was continued in Rutherford's study. In 1908, When Rutherford's assistant Geiger and his student Marsden scattered alpha rays onto metal surfaces of different materials, they found that "the incident alpha rays were passing through about 0.00004cm of gold foil. Alpha particles with a probability of 1 in 20,000 are deflected at a mean Angle of 90°. The propagation direction of other α particles does not change ". Please relate this experimental result to J.J. Thomson's theoretical thinking on model. Do the results prove or disprove the theory?	Consider j. J. Thomson's atomic result model. If the positively charged parts are evenly distributed, the alpha particles do not exhibit large angular deflection. This negates J. J. Thomson's model and considers whether a new structural model can explain this experimental phenomenon. Learn the basic idea of building a "nucleated model" of atoms. Refer to the textbook for "Rutherford nuclear structure model".	Let the students learn to analyze the experimental results. Be able to use basic knowledge to reasonably analyze physical phenomena and results. Cultivate rigorous scientific attitude and perfect the cultivation of scientific thinking. Fully excavate teaching material content, let the student realize the importance of teaching material. At the same time, it also enables students to understand the difficulties in the cross-era development of physical theory. Learn valuable qualities that scientists insist on and improve their scientific attitude and sense of responsibility.

Rutherford didn't overlook such a small discrepancy in the experimental data. The mathematical calculations used to show that the phenomenon, which had previously been suggested by several scientists about the structure of atoms, was caused by alpha particles passing through individual atoms. When it encounters a small positive charge, it scatters at a large Angle. Combined with the "Saturn model" proposed by Japanese scientist Professor Hantaro Nagaoka in 1903, the "nuclear model" of the atom is that the positive charge inside the atom is concentrated in the atomic center.	Refer to the textbook "Rutherford model of nuclear structure" to understand that electrons outside the nucleus revolve around the nucleus.	
However, such an epochal research achievement did not receive positive response from scientists at that time. Although Rutherford attended the Solway International Symposium on Physics in 1911, his findings were not presented. There was no record of it in the press or literature at that time.	Physics is full of doubt and criticism, and requires the ability to think independently, beyond conventional thinking. Thurford rejected his teacher's model of raisin cake and proposed a nuclear structure.	
 图 2-1-7 卢瑟福提出的原子核式结构模型 (Figure 4-5: Rutherford nuclear structure model)		

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But rutherford is the representative of a series of researchers determined to continue their research. With the strong support of Bohr, Moselet and other scientists, rutherford's "nuclear model of the atom" in 1914-1915 was finally accepted by the world. Bohr went further in the field of "atomic structure". He determined the basic laws of motion and spin of an electron revolving around a positively charged nucleus. This also makes an indelible contribution to the advancement of quantum mechanics research.  (Figure 4-6: Bohr model) *Science attitudes and classroom improvement* In this way, the tiny, microscopic structure of an atom has endured the concerted efforts of generations of scientists. They dare to overturn the so-called "expert" theory and face up to the error of experimental results, the courage to innovate. They have the courage to persist in research, play a team spirit, and actively learn from others. Such a few valuable qualities are worth our learning in the future life.		Let students on the basis of learning the knowledge of teaching materials. Understanding the idealization and foundation of junior middle school physics learning is also to cultivate students' interest in learning higher physics knowledge in the future.

This paper studies how to permeate physics history education in junior middle school physics teaching. The history of physics is carefully selected to promote teachers' ability to integrate teaching resources and teaching means in teaching practice. This also makes teachers pay more attention to teaching materials, focus on the analysis of teaching materials, analysis of the educational significance of the compilation of teaching materials. The presentation and analysis of the history of physics in this paper is for the reference of other teachers. But we should also grasp the quantity and degree of the history of physics in the teaching process. Do

not blindly pursue innovative teaching methods and ignore the daily teaching requirements. This maximizes educational value by permeating the history of physics into everyday instruction in a continuous and simple way.

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