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# Teaching and learning materials

Course:
**Science Methodology**

# Навчально-методичний комплекс

Навчальна дисципліна: **Наукова методологія**


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## Contents / Зміст

## General information / Загальна інформація

Навчальна дисципліна «**Science Methodology**» складена для третього / аспірантського рівня вищої освіти відповідно до:

освітньо-наукової програми 103 «Науки про Землю»,

галузі знань 10 «Природничі науки»

для спеціалізації Конструктивна географія та раціональне використання природних ресурсів в рамках виконання міжнародного проєкту ЕРАЗМУС+ «Комплексна докторська програма з екологічної політики, менеджменту природокористування та техноекології – INTENSE».

**Робоча програма навчальної дисципліни була**:

- рекомендована до затвердження вченою радою навчально-наукового інститутут екології Харківського національного університету імені В. Н. Каразіна;
- схвалена на засіданні кафедри екологічної безпеки та екологічної освімоніторингу довкілля та природокористування;
- погоджена з гарантом освітньо-наукової програми 103 «Науки про Землю» (рівень PhD);
- погоджена науково-методичною комісією навчально-наукового інститутут екології Харківського національного університету імені В. Н. Каразіна;
- затверджена проректором з науково-педагогічної роботи Харківського національного університету імені В. Н. Каразіна.

До навчальної дисципліни також розроблено **силабус** англ.мовою.

На навчальну дисципліну отримано **дві рецензії** українських вчених та **одна рецензія** європейського партнера проєкту.

**Мета і завдання курсу**

Метою курсу є ознайомлення з основними поняттями та аргументами методології науки і методологічні основи організації наукового дослідження в галузі природокористування.

Основне завдання курсу - дати огляд наукових методів планування та проведення незалежних досліджень та докторських програм, планування та виконання окремих докторантур, взаємозв'язків між керівником / дисертаціями та колегами,. Курс надає основну інформацію про фінансування науки, оцінку науковців та про кар'єру в галузі науки.

**Кількість** кредитів: 2 кредити ECTS.
**Кількість годин**: 60 годин (з них аудиторних: 18 години).
**Мова викладання –** англійська, українська
Зміст та дистанційний курс за навчальною дицipліною **розроблено**:
**Надія Максименко**, докт.геогр.наук, проф.,
**Микола Назарук**, докт.геогр.наук, проф.
**Яків Тарароєв,** докт.філософ.наук, проф.

Розроблені матеріали, дистанційний курс та усі супровідні матеріали **розміщено** на: https://dist.karazin.ua/, http://intense.network, http://ecology.karazin.ua/mizhnarodna-dijalnist/intense-integrated-doctora/ .

Доступ до дистанційного курсу може бути наданий після реєстрації.

**Purpose and objectives of the course**

The main task of the course is to give an overview of the scientific methods for planning and carrying out independent research and of PhD programs, planning and accomplishment of individual PhD studies, of the relationships between the thesis supervisor(s) and colleagues. The course further provides basic information on science funding, evaluation of scientists and on science careers.

**Credits** : 2 ECTS,
**Total hours** : 60 hours (optional course) 12 in-class hoursж
**Language** : English, Ukrainian
***The content and distance course of the discipline were developed by:***
**Nadiya Maksymenko**, V. N. Karazin Kharkiv National University (KKNU, Ukraine
**Mykola Nazaruk,** Ivan Franko Lviv National University (LNU), Ukraine
**Jakiv Tararoev,** V. N. Karazin Kharkiv National University (KKNU), Ukraine

## Lectures

The course *"Science Methodology"* is studied in the 2th semester in master program and consists of 3 sections and ends with the exam.
The theoretical material, practical tasks and recommendations for their implementation, questions for self-examination and knowledge control (in particular, examination task) are obtained from the pages of the course in accordance with the structure of the course.
The course consists of a complex of lectures on 6 topics and 3 practical tasks, and an examination task.

# Part 1. The methodology is philosophical

### Lecture 1.1. Methods of scientific knowledge used at the theoretical and empirical level

At the theoretical level of scientific knowledge, several groups of methods are used:
1) General logical research methods;
2) Scientific and theoretical research methods;
3) Specialized theoretical research methods for individual subjects and objects.

The use of general logical methods is connected with the fact that logic is the general methodological framework of any theory since any theory consists of concepts, propositions, conclusions. Laws and methods are necessary to perform operations with these forms of thinking.

***General logical methods include:***

- analysis (decomposition). In this method, the object of research is decomposed into its constituent parts;
- synthesis (articulation). In this research method, an object is constructed from its constituent parts;
- deduction (from general to particular). In this method, the process of "unfolding" of knowledge from general principles to particular conclusions and consequences takes place;
- induction (from private to general). In this method there is a generalization of particular provisions in the form of general statements;
- analogy (similarity by secondary features). In this method, a search is made for the similarity of objects by secondary features;
- historical (comparative). This method, based on a comparison of various phases of the object's development, searches for general laws of its development. It is applicable not only to social systems but also to any developing systems;
- logical (reconstructive). In this method, the reconstruction of lower forms of development is carried out on the basis of the study of higher forms. It is applicable not only to social systems but also to any developing systems.

In addition to this, it is possible to use other logical methods.

Specialized theoretical methods are developed for each specific research object, but they all function on the basis of general logical and general theoretical research methods.

The main general scientific and theoretical - scientific methods include:

- Axiomatic. Its essence lies in the consistent development of the theory. Definition of the basic concepts of the theory is given initially, and a relationship is established between them in the form of general statements that do not require proof since they are of an "intuitively obvious" nature. These statements are called axioms. Further, from these general statements research is conducted by the deductive method in the form of lemmas and theorems, from these consequences other consequences, and so on, until the entire subject of the research is completely exhausted. For the first time, this method was fully applied by Euclid in creating geometry and for a long time, it has been considered a very effective, exemplary method of theoretical research. It was used not only in science but also in philosophy, in particular, by Descartes and Spinoza. And only in the 19th century did it become clear that there was only one, but a very serious drawback in it. This drawback is due to the vagueness of the concept of "intuitive evidence." All intuition is subjective in nature, it is variable and unstable even for one individual.

- The formalization method is a generalized axiomatic method. It was formulated in an attempt to overcome its drawback, that is, to rationalize “intuitive evidence”. The essence of this method is as follows: initially, general statements (an analog of axioms) are postulated, which, however, do not claim to be true. They cover the entire class of possible statements about the specific properties of the subject. A formal system (theory) is constructed deductively on the basis of each of these statements. The author of the method hoped that false premises (axioms) would lead to logical contradictions, and then these conflicting theories along with false axioms would be discarded, one true axiom and the theory connected with it would remain.

At first, the method caused great expectations in its effectiveness, but in 1931 Godel proved the theorem on the incompleteness of any formal system. A consequence of this theorem was the proposition that all judgments about an object strictly in the framework of the theory were equivalent, that is, the theory itself was ambiguous and the choice of one option from this ambiguity was carried out not theoretically, but primarily by empirical experience. It follows that any purely theoretical knowledge is also probable. Gödel's theorem summed up the evidence base for the thesis of the ambiguity of pure theoretical knowledge. Therefore, we can rightfully consider it one of the greatest achievements of 20th-century science.

The hypothetical-deductive method appears as an attempt to solve the problem of the ambiguity of theoretical knowledge by combining theoretical knowledge with empirical methods and choosing one option from the set of possible theories using these methods. Its essence is as follows - the “core” of a theory consisting of one or more hypotheses is initially selected. This “core”, by virtue of its general nature, acts as an analog of an axiom or their system and can be considered as a “cause”. Consequences are derived from this “core” in a deductive way, from these consequences other consequences, and so on, until it becomes possible to verify these consequences empirically. If they are not confirmed, they are discarded along with the “core”, i.e. with its "reasons", and the "core" is recognized as false. If they are confirmed, then the "core" as a cause is recognized as true and accepted.

With the apparent effectiveness of this method, it is not capable of giving an unambiguous result in the case of a true hypothesis and the theory as a whole. This is due to the fact that the “movement” from the “nucleus” to the investigation is of a deductive nature and, therefore, the consequence is uniquely reliable. This leads to the fact that if the result is false, then the nucleus must be recognized as complex. However, the reverse "movement" from the result to the "nucleus" is inductive in nature. Any induction is probabilistic in nature, and accordingly, we can consider the nucleus to be true, with one or another degree of probability.

Thus, summarizing all the above theoretical methods, we can conclude that theoretical scientific knowledge cannot be absolutely reliable, it is always probable, and taking into account the problem of “theoretically loaded facts”, it can be argued that any scientific knowledge is probabilistic.

Methods of scientific knowledge used at the empirical level.

General and special methods are used at the empirical level of scientific knowledge. Special methods of empirical knowledge are developed for each specific object of study, but they all function on the basis of general empirical methods.

General empirical methods include:

1. Contemplation - is a passive and unfocused, unsystematic direct review of the surrounding reality. This method is inherent in the very initial stages of the development of science, first of all, ancient and medieval. It is ineffective and extremely unreliable. It was widely used in antiquity, in particular by Aristotle.

2. The observation method is a focused and systematic review of the surrounding reality, either directly or with the help of an intermediary - the device. The method is very effective. Its effectiveness is due to the fact that it contributes to the accumulation of a significant amount of information, and building it into a system, that is, the information content of its quantity passes into a new quality, which allows a more adequate representation of the nature of the studied object.

An integral part of the observation method, especially where quantitative characteristics of the object are observed, is the measurement procedure based on the comparison method.

3. The comparison method is the establishment of correspondence between the unknown being studied and already known. A good example of the comparison that underlies the measurement procedure is the measurement of the length of a segment with a ruler, when we compare the unknown - the length of the segment, with the known - the number and length of marks on the ruler. This method is the basis of measurement operations, which are widely used in the natural and technical sciences, i.e. where there are measuring instruments. However, in a number of humanities, it has independent value, for example, in linguistics. In particular, it is by the method of comparison that we study dead written languages.

4. The fourth method is the experiment. By experiment we mean the observation of the process or phenomenon under investigation in specially created and controlled conditions under which the researcher can actively influence and intervene in the process or phenomena under study. This allows you to get the maximum information about the investigated process or phenomenon. Its inductive generalization takes place based on the experiment.

The experiment is most effective due to its maximum information content. It is widely used wherever possible. Its disadvantage is its limited use, both due to the limitation of the material capabilities of man and society, and due to ethical and other moral principles.

Sometimes these limitations can be overcome by special forms of the experiment, which include:

1) Natural experiment - a situation in which special conditions of the process are created by nature itself. While the term *natural experiment* lacks an exclusively agreed-upon definition, there is a general consensus that a natural experiment occurs when a particular intervention has been implemented but the circumstances surrounding the implementation are not under the control of researchers (Craig et al., 2012, 2011). For instance, when a researcher does not have the ability to manipulate when and/or where intervention happens [e.g. an environmental structural change (e.g. building a new grocery store), a new program is implemented (e.g. a provincial/state human papillomavirus vaccine program), or a policy change (e.g. federal legalization of cannabis)], those changes would be considered a natural experiment. Two additional features of natural experiments are that the implementation of the intervention is not dependent on whether or not there is a plan to evaluate the intervention and random allocation of the intervention is not feasible for ethical or political reasons (Craig et al., 2012, 2011).

When an intervention deemed a natural experiment takes place, the methodological tool used to evaluate the impact of the intervention is called a *natural experimental study*. Natural experimental studies come in the form of both traditional experimental designs and non-experimental designs. Ultimately, the particular design used by a researcher to evaluate a natural experiment will largely depend on the type of data that is available when the natural experiment occurs. Like any study, a researcher should always strive to use the most robust design possible within a natural experimental study, as each different study design conveys unique strengths and limitations for making inferences about the relationship between the intervention and the particular outcome of interest.

2) A thought experiment is an experiment in which the situation is modeled in consciousness. This avoids unnecessary material costs, life-threatening of the experiment and other factors that impede the conduct of a real experiment. This also includes numerical modeling and mathematical experiment, which is used for the same reasons. With the development of computer technologies and information processing tools, numerical modeling and a mathematical experiment are becoming increasingly important, gradually even crowding out an ordinary experiment, especially where it requires a lot of finance.

Thought experiments, which are well-structured, well-defined hypothetical questions that employ subjunctive reasoning (irrealis moods) – "What might happen (or, what might have happened) if . . . " – have been used to pose questions in philosophy at least since Greek antiquity, some pre-dating Socrates. In physics and other sciences, many thought experiments date from the 19th and especially the 20th Century, but examples can be found at least as early as Galileo.

In thought experiments, we gain new information by rearranging or reorganizing already known empirical data in a new way and drawing new (a priori) inferences from them or by looking at these data from a different and unusual perspective. In Galileo's thought experiment, for example, the rearrangement of empirical experience consists in the original idea of combining bodies of different weights. Thought experiments have been used in philosophy (especially ethics), physics, and other fields (such as cognitive psychology, history, political science, economics, social psychology, law, organizational studies, marketing, and epidemiology). In law, the synonym "hypothetical" is frequently used for such experiments.

Regardless of their intended goal, all thought experiments display a patterned way of thinking that is designed to allow us to explain, predict and control events in a better and more productive way.

In terms of their theoretical consequences, thought experiments generally:

- challenge (or even refute) a prevailing theory, often involving the device known as reductio ad absurdum, (as in Galileo's original argument, a proof by contradiction),
- confirm a prevailing theory,
- establish a new theory, or
- simultaneously refute a prevailing theory and establish a new theory through a process of mutual exclusion

Thought experiments can produce some very important and different outlooks on previously unknown or unaccepted theories. However, they may make those theories themselves irrelevant, and could possibly create new problems that are just as difficult, or possibly more difficult to resolve.

In terms of their practical application, thought experiments are generally created to:

- challenge the prevailing status quo (which includes activities such as correcting misinformation (or misapprehension), identify flaws in the argument(s) presented, to preserve (for the long-term) objectively established fact, and to refute specific assertions that some particular thing is permissible, forbidden, known, believed, possible, or necessary);
- extrapolate beyond (or interpolate within) the boundaries of already established fact;
- predict and forecast the (otherwise) indefinite and unknowable future;
- explain the past;
- the retrodiction, postdiction, and hindcasting of the (otherwise) indefinite and unknowable past;
- facilitate decision making, choice, and strategy selection;
- solve problems, and generate ideas;
- move current (often insoluble) problems into another, more helpful and more productive problem space (e.g.: functional fixedness);
- attribute causation, preventability, blame and responsibility for specific outcomes;
- assess culpability and compensatory damages in social and legal contexts;
- ensure the repeat of past success; or
- examine the extent to which past events might have occurred differently.
- ensure the (future) avoidance of past failures

3) Physical modeling. In this form of the experiment, in sensory reality, it is not the whole object under the investigation that is reproduced, but only some of its properties, which facilitates the process of the experiment itself. It is used mainly in the technical sciences, although it can be used even in the study of living and social systems.

Scientific modeling is a scientific activity, the aim of which is to make a particular part or feature of the world easier to understand, define, quantify, visualize, or simulate by referencing it to existing and usually commonly accepted knowledge. It requires selecting and identifying relevant aspects of a situation in the real world and then using different types of models for different aims, such as conceptual models to better understand, operational models to operationalize, mathematical models to quantify, and graphical models to visualize the subject.

Modeling is an essential and inseparable part of many scientific disciplines, each of which has its own ideas about specific types of modeling. The following was said by John von Neumann.

... the sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct which, with the addition of certain verbal interpretations, describes observed phenomena. The justification of such a mathematical construct is solely and precisely that it is expected to work—that is, correctly to describe phenomena from a reasonably wide area.

There is also increasing attention to scientific modeling in fields such as science education, philosophy of science, systems theory, and knowledge visualization. There is a growing collection of methods, techniques, and meta-theory about all kinds of specialized scientific modeling.

A scientific model seeks to represent empirical objects, phenomena, and physical processes in a logical and objective way. All models are *in simulacra*, that is, simplified reflections of reality that, despite being approximations, can be extremely useful. Building and disputing models are fundamental to the scientific enterprise. Complete and true representation may be impossible, but scientific debate often concerns which is the better model for a given task, e.g., which is the more accurate climate model for seasonal forecasting.

Attempts to formalize the principles of the empirical sciences use an interpretation to model reality, in the same way, logicians axiomatize the principles of logic. The aim of these attempts is to construct a formal system that will not produce theoretical consequences that are contrary to what is found in reality. Predictions or other statements drawn from such a formal system mirror or map the real world only insofar as these scientific models are true.

For the scientist, a model is also a way in which the human thought processes can be amplified. For instance, models that are rendered in software allow scientists to leverage computational power to simulate, visualize, manipulate and gain intuition about the entity, phenomenon, or process being represented. Such computer models are *in silico*. Other types of scientific models are *in vivo* (living models, such as laboratory rats) and *in vitro* (in glassware, such as tissue culture).

Models are typically used when it is either impossible or impractical to create experimental conditions in which scientists can directly measure outcomes. Direct measurement of outcomes under controlled conditions (see Scientific method) will always be more reliable than modeled estimates of outcomes.

Within modeling and simulation, a model is a task-driven, purposeful simplification and abstraction of a perception of reality, shaped by physical, legal, and cognitive constraints. It is task-driven because a model is captured with a certain question or task in mind. Simplifications leave all the known and observed entities and their relation out that are not important for the task. Abstraction aggregates information that is important but not needed in the same detail as the object of interest. Both activities, simplification, and abstraction, are done purposefully. However, they are done based on a perception of reality. This perception is already a *model* in itself, as it comes with a physical constraint. There are also constraints on what we are able to legally observe with our current tools and methods, and cognitive constraints which limit what we are able to explain with our current theories. This model comprises the concepts, their behavior, and their relations informal form and is often referred to as a conceptual model. In order to execute the model, it needs to be implemented as a computer simulation. This requires more choices, such as numerical approximations or the use of heuristics. Despite all, these epistemological and computational constraints, simulation has been recognized as the third pillar of scientific methods: theory building, simulation, and experimentation.

A simulation is the implementation of a model. A steady-state simulation provides information about the system at a specific instant in time (usually at equilibrium, if such a state exists). A dynamic simulation provides information over time. A simulation brings a model to life and shows how a particular object or phenomenon will behave. Such a simulation can be useful for testing, analysis, or training in those cases where real-world systems or concepts can be represented by models.

## Lecture 1.2. Specificity of science and philosophy

Despite the affinity of science and philosophy, they are not identical. Even Gottfried Leibniz (a famous German philosopher and mathematician of the 11th century) gave a definition of identity. Two sets are identical when the properties of one are the properties of the other, and vice versa. So, philosophy and science is specific knowledge, and each has its own distinct features. In his work "Scientific Thought as a Planetary Phenomenon" V.I. Vernadsky wrote: "Science is inseparable from philosophy and cannot develop in its absence. It may be out of contradiction with the fundamentals of philosophy (not to mention skeptical philosophies), or in its realistic systems, or systems that acknowledge the truths of the truth that are clearly established, and believe that there can be no such contradiction with them as, for example, a number of new Indian philosophies. At the same time, science cannot go so deep into the analysis of concepts; philosophy creates them, based not only on scientific work but also on the analysis of the mind." As you can see, philosophy does not coincide with or replace natural science. Science studies reality, the system of "man - world" in parts.

Every science has its own subject - something that science knows something about. The subject of science reveals its name: say, zoology or geology (from the Greek: zoo - animal, geo - earth, logic - word, concept) – these are the sciences about animals or the earth, the earth's crust. Therefore, with respect to most sciences, it is easy to determine what they are researching.

The word "philosophy" is of Greek origin.

It can literally be translated as "the love of wisdom." Among Ukrainian philosophers of the seventeenth- and mid-nineteenth centuries, philosophy was often referred to as the word "love of wisdom." In this sense, the word was used by Hrygoriy Skovoroda. It is necessary to determine what wisdom is and what love in it is; then we can clarify what philosophy is in its essence and purpose.

In all nations, wisdom is called perfect and complete knowledge (the knowledge of everything) and the corresponding perfect way of life. In the first place there must be a perfect life, for it, first of all, attests to the perfection of knowledge and imparts the sage to the life (the carrier of wisdom), his thoughts, words, and deeds of indisputable authority. Why was philosophy called the reasoning about nature, about the general order of the entire human and natural world?

Not all philosophers agree that philosophy grows directly from people's daily lives, and philosophical reasoning is accessible to everyone.

For example, Ortega - y - Gasset in the book “The Rebellion of the Masses” (1930) emphasized that philosophy does not need the attention of the masses: it cherishes its needlessness, if it accidentally helps someone, it rejoices only of its humanness. But it was not because of arrogance or contempt for the average person, Ortega-y-Gasset observed, but for other far more compelling reasons. What makes philosophy indifferent to the masses and turned to itself is, firstly, the way of the spiritual life of the "man of mass", inherent to it dependence of thought and feeling, lack of ability and inclination to the spiritual effort, etc. Secondly, (most importantly), this is the very essence of philosophical thinking: its problematic nature. Philosophy, Ortega - y - Gasset emphasized, "begins with self-doubt. It lives as much as it struggles with itself, denying itself." (Ortega- y Gasset H. What is philosophy.M.,1991). Simultaneously with Ortega –y- Gasset, Martin Heidegger expressed the same thoughts. According to them, philosophy is not found in everyday life. And this is not surprising. It does not make life easier but complicates it. Philosophy doubts the self-evidence that everyday lives with, and thereby puts it at the brink of extinction itself. (Heidegger M. What is Philosophy? // Questions of Philosophy. - 1993. - No. 8. - P.113 - 123.)

It is interesting to analyze the definitions of philosophy by the famous philosophers of modern times.

Philosophy is the science of relating any knowledge to the essential purposes of the human mind, and the philosopher is not the virtuoso of knowledge, but the legislator of the human mind (Kant).

Philosophy is the day of thought (Hegel).

Any philosophy is the confession of its creator (Nietzsche).

Philosophy is the doctrine of ways of realizing the meaning of human existence (Berdyaev).

Philosophy is the education of a person close to God (Scheller).

Philosophy is the work of competent thinking (Ortega - y - Gasset).

The list of such claims could be continued.

The most common is the understanding of science as a particular dynamic system of knowledge about the environment, the world of nature, its laws, societies and thinking. The main function of science is the knowledge of the objective world, the real processes and phenomena, their essence.

An important problem of philosophy of science is the combination of rational - logical and intuitive - figurative thinking. In his time, I. Kant noted that science is not capable of giving value guidance. It must limit its competence to the study of "what exists, without claiming to indicate "how it should be“. “Contemporary science, by contrast, seeks to attract value orientations. This is especially pronounced in ecology and environmental education. In modern scientific methodology, the idea of finding a new synthesis is widespread ” (M. Moiseev, E. Wilson) “radically different concepts" (H. Ortega-y- Gasset), "a new methodology" (B. Commoner). That is why the problems of correlation between natural and social, moral and rational, scientific "sophistication" are extremely actualized. It is notable that they are studied not only by philosophers (M. Heidegger, L. Memford, S. Krymsky, M. Mamardashvili, E. Fromm, I. Frolov, etc.) but also by well-known natural scientists, whose special works largely contributed to the formation of the modern European mentality (A.Einstein, M.Born, N.Viner, V.Heisenberg, P.Kapitsa). A significant shift in the research process is the use of a socio-natural approach on an ecological basis. The significance of the socio-natural approach is, first and foremost, a return to the holistic worldview that was previously cultivated in natural philosophy. The socio-natural approach in modern scientific knowledge is largely formed on the principles of ecology. Its integrative nature, its focus on the organic combination of various factors of the natural and socio-cultural environment is so effective that methodologists endow this scientific direction with the status of a scientific approach. This applies not only to the natural sciences but also to the socio-humanitarian sciences.

**Philosophy of science** is a sub-field of philosophy concerned with the foundations, methods, and implications of science. The central questions of this study concern what qualifies as science, the reliability of scientific theories, and the ultimate purpose of science. This discipline overlaps with metaphysics, ontology, and epistemology, for example, when it explores the relationship between science and truth. Philosophy of science focuses on metaphysical, epistemic and semantic aspects of science. Ethical issues such as bioethics and scientific misconduct are often considered ethics or science studies rather than the philosophy of science.

There is no consensus among philosophers about many of the central problems concerned with the philosophy of science, including whether science can reveal the truth about unobservable things and whether scientific reasoning can be justified at all. In addition to these general questions about science as a whole, philosophers of science consider problems that apply to particular sciences (such as biology or physics). Some philosophers of science also use contemporary results in science to reach conclusions about philosophy itself.

While philosophical thought pertaining to science dates back at least to the time of Aristotle, philosophy of science emerged as a distinct discipline only in the 20th century in the wake of the logical positivist movement, which aimed to formulate criteria for ensuring all philosophical statements' meaningfulness and objectively assessing them. Charles Sanders Peirce and Karl Popper moved on from positivism to establish a modern set of standards for scientific methodology. Thomas Kuhn's 1962 book *The Structure of Scientific Revolutions* was also formative, challenging the view of scientific progress as the steady, cumulative acquisition of knowledge based on a fixed method of systematic experimentation and instead arguing that any progress is relative to a "paradigm," the set of questions, concepts, and practices that define a scientific discipline in a particular historical period.[1]

Subsequently, the coherentist approach to science, in which a theory is validated if it makes sense of observations as part of a coherent whole, became prominent due to W.V. Quine and others. Some thinkers such as Stephen Jay Gould seek to ground science in axiomatic assumptions, such as the uniformity of nature. A vocal minority of philosophers, and Paul Feyerabend in particular, argue that there is no such thing as the "scientific method", so all approaches to science should be allowed, including explicitly supernatural ones. Another approach to thinking about science involves studying how knowledge is created from a sociological perspective, an approach represented by scholars like David Bloor and Barry Barnes. Finally, a tradition in continental philosophy approaches science from the perspective of a rigorous analysis of human experience.

Philosophies of the particular sciences range from questions about the nature of time raised by Einstein's general relativity to the implications of economics for public policy. A central theme is whether one scientific discipline can be reduced to the terms of another. That is, can chemistry be reduced to physics, or can sociology be reduced to individual psychology? The general questions of philosophy of science also arise with greater specificity in some particular sciences. For instance, the question of the validity of scientific reasoning is seen in a different guise in the foundations of statistics. The question of what counts as science and what should be excluded arises as a life-or-death matter in the philosophy of medicine. Additionally, the philosophies of biology, of psychology, and of the social sciences explore whether the scientific studies of human nature can achieve objectivity or are inevitably shaped by values and by social relations.

Distinguishing between science and non-science is referred to as the demarcation problem. For example, should psychoanalysis be considered science? How about creation science, the inflationary multiverse hypothesis, or macroeconomics? Karl Popper called this the central question in the philosophy of science. However, no unified account of the problem has won acceptance among philosophers, and some regard the problem as unsolvable or uninteresting. Martin Gardner has argued for the use of a Potter Stewart standard ("I know it when I see it") for recognizing pseudoscience.

Early attempts by the logical positivists grounded science in observation while non-science was non-observational and hence meaningless. Popper argued that the central property of science is falsifiability. That is, every genuinely scientific claim is capable of being proven false, at least in principle.

An area of study or speculation that masquerades as science in an attempt to claim a legitimacy that it would not otherwise be able to achieve is referred to as pseudoscience, fringe science, or junk science. Physicist Richard Feynman coined the term "cargo cult science" for cases in which researchers believe they are doing science because their activities have the outward appearance of it but actually lack the "kind of utter honesty" that allows their results to be rigorously evaluated.

A closely related question is what counts as a good scientific explanation. In addition to providing predictions about future events, society often takes scientific theories to provide explanations for events that occur regularly or have already occurred. Philosophers have investigated the criteria by which a scientific theory can be said to have successfully explained a phenomenon, as well as what it means to say a scientific theory has explanatory power.

One early and influential theory of scientific explanation is the deductive-nomological model. It says that a successful scientific explanation must deduce the occurrence of the phenomena in question from a scientific law. This view has been subjected to substantial criticism, resulting in several widely acknowledged counterexamples to the theory. It is especially challenging to characterize what is meant by an explanation when the thing to be explained cannot be deduced from any law because it is a matter of chance, or otherwise cannot be perfectly predicted from what is known. Wesley Salmon developed a model in which a good scientific explanation must be statistically relevant to the outcome to be explained. Others have argued that the key to a good explanation is unifying disparate phenomena or providing a causal mechanism.

Although it is often taken for granted, it is not at all clear how one can infer the validity of a general statement from a number of specific instances or infer the truth of a theory from a series of successful tests.[14] For example, a chicken observes that each morning the farmer comes and gives it food, for hundreds of days in a row. The chicken may, therefore, use inductive reasoning to infer that the farmer will bring food *every* morning. However, one morning, the farmer comes and kills the chicken. How is scientific reasoning more trustworthy than the chicken's reasoning?

One approach is to acknowledge that induction cannot achieve certainty, but observing more instances of a general statement can at least make the general statement more probable. So the chicken would be right to conclude from all those mornings that it is likely the farmer will come with food again the next morning, even if it cannot be certain. However, there remain difficult questions about the process of interpreting any given evidence into a probability that the general statement is true. One way out of these particular difficulties is to declare that all beliefs about scientific theories are subjective, or personal, and correct reasoning is merely about how evidence should change one's subjective beliefs over time.

Some argue that what scientists do is not inductive reasoning at all but rather abductive reasoning or inference to the best explanation. In this account, science is not about generalizing specific instances but rather about hypothesizing explanations for what is observed. As discussed in the previous section, it is not always clear what is meant by the "best explanation." Ockham's razor, which counsels choosing the simplest available explanation, thus plays an important role in some versions of this approach. To return to the example of the chicken, would it be simpler to suppose that the farmer cares about it and will continue taking care of it indefinitely or that the farmer is fattening it up for slaughter? Philosophers have tried to make this heuristic principle more precise in terms of theoretical parsimony or other measures. Yet, although various measures of simplicity have been brought forward as potential candidates, it is generally accepted that there is no such thing as a theory-independent measure of simplicity. In other words, there appear to be as many different measures of simplicity as there are theories themselves, and the task of choosing between measures of simplicity appears to be every bit as problematic as the job of choosing between theories.[ Nicholas Maxwell has argued for some decades that unity rather than simplicity is the key non-empirical factor in influencing the choice of theory in science, persistent preference for unified theories in effect committing science to the acceptance of a metaphysical thesis concerning unity in nature. In order to improve this problematic thesis, it needs to be represented in the form of a hierarchy of theses, each thesis becoming more insubstantial as one goes up the hierarchy.

When making observations, scientists look through telescopes, study images on electronic screens, record meter readings, and so on. Generally, on a basic level, they can agree on what they see, e.g., the thermometer shows 37.9 degrees C. But, if these scientists have different ideas about the theories that have been developed to explain these basic observations, they may disagree about what they are observing. For example, before Albert Einstein's general theory of relativity, observers would have likely interpreted an image of the Einstein cross as five different objects in space. In light of that theory, however, astronomers will tell you that there are actually only two objects, one in the center and four different images of a second object around the sides. Alternatively, if other scientists suspect that something is wrong with the telescope and only one object is actually being observed, they are operating under yet another theory. Observations that cannot be separated from theoretical interpretation are said to be theory-laden.

All observation involves both perception and cognition. That is, one does not make an observation passively but rather is actively engaged in distinguishing the phenomenon being observed from surrounding sensory data. Therefore, observations are affected by one's underlying understanding of the way in which the world functions and that understanding may influence what is perceived, noticed, or deemed worthy of consideration. In this sense, it can be argued that all observation is theory-laden.

Should science aim to determine the ultimate truth, or are there questions that science cannot answer? *Scientific realists* claim that science aims at truth and that one ought to regard scientific theories as true, approximately true, or likely true. Conversely, *scientific anti-realists* argue that science does not aim (or at least does not succeed) at the truth, especially truth about unobservables like electrons or other universes. Instrumentalists argue that scientific theories should only be evaluated on whether they are useful. In their view, whether theories are true or not is beside the point, because the purpose of science is to make predictions and enable effective technology.

Realists often point to the success of recent scientific theories as evidence for the truth (or near truth) of current theories. Antirealists point to either the many false theories in the history of science, epistemic morals, the success of false modeling assumptions, or widely termed postmodern criticisms of objectivity as evidence against scientific realism. Antirealists attempt to explain the success of scientific theories without reference to truth. Some antirealists claim that scientific theories aim at being accurate only about observable objects and argue that their success is primarily judged by that criterion.

# Part 2. Philosophical understanding of the scientific dimensions of the environment

## Lecture 2.1. The multifunctional importance of science in the context of the environment

Modern life demonstrates endless ideas, views, concepts, theories that trace the effort to make sense of the dramatic changes, taking place in the society and the environment. The search for new approaches to solving environmental problems in modern philosophy is reflected in studies of a new type of rationality, the orientation of which does not lead to environmental crisis, the search for truth and the growth of scientific knowledge. In contrast to new European science, modern science views nature as a coherent organism to which man belongs, the biosphere - as a global ecosystem. Studying systemic objects that are evolving and human-dimensional requires new strategies for action. Synergistic approaches prove that non-force effects play a significant role in such systems, and bifurcation theory provides several scenarios for the system behavior. This is where moral principles begin to play a significant role. In activities with complex systems, the guidelines are not only knowledge, but also moral principles, there are prohibitions on dangerous actions for man and nature (Science and Culture. "COP" of philosophy questions // Vopr.filos., 1998, No. 10, p.6 -7)

Modern databases and knowledge bases in various fields of science are gigantic repositories of endless facts and basic truths, and global computer networks are powerful tools for accessing them at high-speed anywhere in the world. Under these conditions, the methodology and principles of modern science are taking on new characteristics. The importance of methodological, systemic, interdisciplinary knowledge of a person, which is needed for rational management with different knowledge and a huge amount of data in solving new, non-standard problems, is growing.

Science as a social phenomenon expresses the essential, fundamental interests of mankind. It is a powerful intellectual means of knowledge and development of reality, a direct productive force in the development of modern civilization. Today, science has already penetrated into such depths of matter that every further step forward must agree with the interests of man and must be done in a conscious, responsible manner.

It is an important ability of the researcher to operate a new kind of information - metadata - large arrays, clusters unified on a certain basis of data and knowledge, to search and separate metadata from the world information resources, to analyze them holistically, performing and solving new problems. An important role in the process of cognition belongs to the subject of cognition - the researcher who has a direct influence on the object - the environment, forming ideas about this object, which in general are never absolutely complete. At the same time, the process of cognition as the interconnection of subject and object is often mediated, where the mediators are the means of cognition of material (devices, tools, computers, etc.) and ideal (concepts, scientific theories, concepts, etc.).

A new challenge for science is to provide open access to data reflecting common facts of nature or social development. Scientific databases are not always static. In the course of the research, scientists use different sources to create a new base that is intended for specific research. Synthesis of data obtained from various sources helps to understand nature and is an essential component of the scientific process. It is important that the marginal cost of any copy of information obtained from the Internet has decreased to almost zero, which simplifies the synthesis of data obtained from different sources.

Important new networking principles for the organization of modern science and the formation of virtual communities are based on supranational, public interests to gain new knowledge. They are known as a public movement of the 'open source'. According to the same principles, public and charitable foundations were created to support such activity, called the "public scientific information commons" space. This phenomenon reflects a new corporate ethic in the world of social science regarding the results of societal and non-proprietary research. For example, the operating system of the International Scientific Library (Public Library of Science) was created and is constantly being developed. Science, by definition, is "a systematic study of the nature and properties of the material universe through observations, experiments, and measurements." All this takes great effort and at times brings only disappointment. Scientists spend weeks, months or even years for some studies, sometimes going into a dead end. Undoubtedly, science has a positive effect on various spheres of human life.

The present stage of science development reveals a special and organic connection of science with other forms and ways of world development, scientific and extra-scientific knowledge. At the same time, (unlike other ways of knowing the world), only science is characterized by its subjective and objective attitude to it. Science does not exhaust and potentially is unable to exhaust the content of culture, but it provides only a conceptual cut of a multifaceted reality, which, in combination with other ways of knowledge - philosophy, art, religion, morality and cultural creativity - is capable in principle (ideally) claim a systematic and holistic development of the world. By revealing fundamentally new, incomprehensible possibilities of its transformation to man, science becomes the most important component of human culture, serves the progress of the fundamental foundations of being. Science itself in relation to man, its development and activity is an attributive component of modern culture.

Today, we trace the so-called anthropo-ecological approach in global scientific research pursued by the new meta-science - philosophical globalization. There is a rapid update of knowledge about man, ethnos, humanity, as a whole. According to scientists, the ethical revolution is a revision of fundamental social ideas that will use a socio-genetic approach, as well as problems of spirituality and morality.

The most common is the understanding of science as a particular dynamic system of knowledge about the world, the laws of nature, society and thinking. The following definition of science is quite common: *science is an integral designation of specialized human activity in the knowledge of the world for the use of the obtained results in practice, as well as the system of logical-epistemological, methodological and social-organizational formations of this sphere. Science is a sphere of* *human activity that is a rational way of knowing the world; it generalizes and organizes* knowledge *about reality-based on empirical verification and mathematical proofs.*

As a multifunctional phenomenon, science is:

1) the field of culture;

2) the way of knowing the world;

3) a certain system of organization (academies, universities, institutes, laboratories, scientific societies, etc.);

The main function of science is the knowledge of the objective world, the real processes, and phenomena, their essence. Discovery of the objective laws of nature, society and thinking, a creative reflection of the processes and phenomena of reality is the main goal of science. Without knowledge of these laws that explain the cause of phenomena, it is only possible to describe various facts, the accumulation of empirical material, and such knowledge cannot be entirely scientific, although it is the basis for the final formation of science. The discovery of laws transforms science into a system of knowledge that ensures its preservation, transferability and practical use. The essential characteristic of science is the continuous production of new knowledge that adequately reflects reality, not its involvement in the existing system of knowledge, which serves to understand and transform the material world. The most important characteristics of the features of science include systematic and rational nature of its methods and fields of application; possibility and necessity of hereditary transfer of scientific knowledge in the process of formation and reproduction of the staff; functioning as a social institute of the ever-increasing practical and ideological significance of the results of scientific activity. For more than three centuries, science has been a form of cognition of man's attitude to the world. For science, the essence of being is in its object, which is expressed through theory. Science is a theory of the real.

The initial concepts of each science are the object and subject of the research. The way how truly and specifically these categories are determined depends on the efficiency and constructiveness of all scientific activity. German philosopher I. Kant laid the foundations for the distinction between the subject and the object of study.

*An object is a fragment of reality directed by the cognitive or practical activity of the subject, that is, what studies and explores this branch of* science*.* It is directed by the work of a researcher, who opposes it as an objective reality. The object of cognition is distinguished by means of forms of practical and cognitive activity produced by society.

The subject of the study is the parties, properties, and relationships that this scientific studies. The subject of science cannot be identical with the object it studies, because it is an empirically given reality that represents one or the other side of the objective world. The subject of science reproduces the empirical reality on an abstract level, revealing the most significant from a practical point of view laws, connections and relations of this reality.

The subject of any science is the result of theoretical abstraction, which helps to distinguish the patterns of development and operation of an object which are specific to this science. If the object of study is a part of objective reality with a property that only this science learns, then the subject of science is the result of research or activity.

Understanding of a scientific fact is important in the study of environmental issues. The creative nature of the scientific fact is that the scientist does not passively reflect the objective reality, but refracts it in his mind through the lens of existing knowledge, using the means of logical and practical operations that have developed for a certain time in science (Stepin, Yelsukov, 1974). *The scientific fact is an empirical scientific generalization, which is continually re-examined, and a logical analysis, a return to the newly realized phenomenon by repeated verification by new persons* (Vernadsky, 1988). It is based on the existing theory and the characteristics of objective reality are fixed by experiment. (Great Interpreter. Dictionary, 2004).

In addition, a scientific fact (or result) is new knowledge gained in the process of fundamental or applied scientific research, which is fixed on the media of scientific information in the form of a report, scientific work, scientific communication on research work, monographic research, scientific discoveries, etc. (Great Interpreter. Dictionary, 2004). A scientific fact is not just the knowledge on which a certain science is built; it is the quintessence of any research. Its Majesty's scientific fact remains the same in its application to any theoretical construct. Theories have the ability to age and scientific facts always remain relevant (Petlin, 2016).

The laws of nature play a unique role in the study of the problems of interaction between human society and nature because they act regardless of our desire. It is the laws of nature that determine everything that happens in the universe. Man seeks to know the laws of nature and to build his activity according to them, because such a path is a way to success. Man is subject to the laws of nature, and the knowledge of natural laws is a no less important task than the knowledge of the laws of the world.

The implementation of natural laws depends on the parameters of the environment - the availability of appropriate conditions that ensure the transition of the consequences of controlling the law from the realm of reality.

A particular, even unique, place among all the concepts of science is occupied by categories - fundamental concepts, the broadest in scope and the most important for the development of theory and practice, needed to formulate the content of the basic principles and laws of science.

Knowledge of the categories of any science helps to understand and purposefully explore various connections and relationships in the subjects, phenomena that we study, orienting on the aspects that should be paid attention to reveal the essence of objects and phenomena. Categories (from the Greek *expression*) are the most general, fundamental concepts that reflect the most essential, natural connections and relations between reality and cognition. They reproduce being and cognition in a general and most concentrated form.

Environmental philosophy, like any other theoretical reflection, seeks first to understand the essence of the environment conceptually, to present it categorically, conceptually. This is quite difficult because the environment is such a multifaceted phenomenon of social life that it cannot be clearly defined. By its nature, the environment is a multidisciplinary, multifactorial phenomenon. It can be depicted as a chain that connects the following concepts: organism, life, nature, life activity, the natural environment, the world, the Universe and more. Categories of philosophy are different from any concept in their commonality. This is because they are not confined to any framework, as is the case in any other science. The system of categories is the ideal framework, the basis of philosophical knowledge. They are the language of philosophy.

Outlook and methodological functions are the most important functions of the categories. The worldview is that the content of each category forms certain ideas about the essential properties and attitudes of the objective world, on one side or another of objective reality. The methodological function of categories is that they give cognition the initial conditions and prospects of its implementation, expand its boundaries, form the criteria of understanding, influencing the formation of the scientific worldview.

A **worldview** or **world-view** is the fundamental cognitive orientation of an individual or society encompassing the whole of the individual's or society's knowledge and point of view. A worldview can include natural philosophy; fundamental, existential, and normative postulates; or themes, values, emotions, and ethics.

Worldviews are often taken to operate at a conscious level, directly accessible to articulation and discussion, as opposed to existing at a deeper, pre-conscious level, such as the idea of "ground" in Gestalt psychology and media analysis.

*The scientific worldview is a view of the world (universe), of nature and society, of everything that surrounds us and everything that happens to us*. It is grounded and built on the scientific achievements of modern science, imbued with methods of scientific knowledge. The worldview is understood as a system of general ideas about the world at large, about the natural and social processes that take place in it. A scientific worldview is a view of the world and the place of the person in it, which reflects things and processes as they really are. V.I. Vernadsky called the scientific worldview "representations of the phenomena available to scientific study given by science". He wrote: "By this name we mean a certain relation to the world of phenomena around us, for which each phenomenon is within the limits of scientific study and finds explanation which does not contradict the basic principles of scientific search. At the heart of the outlook is the method of scientific work. This science-tested search engine is testing everything that somehow enters the scientific world. Every conclusion is weighed, the fact-checked, and whatever turns out to be contradictory to scientific methods is mercilessly rejected".

Whether science can reach conclusions with substantial worldview import, such as whether supernatural beings exist or the universe is purposeful, is a significant but unsettled aspect of science. For instance, various scientists, philosophers, and educators have explored the implications of science for a theistic worldview, with opinions spanning the spectrum from positive to neutral to negative. The presuppositions and reasoning of science can and should be worldview independent, but empirical and public evidence from the sciences and humanities can support conclusions that are worldview distinctive. Asserting that science can say nothing about worldviews and the opposite extreme of insisting that science decisively supports one particular worldview; weakening science so severely that it lacks truth claims; and burdening science with unnecessary presuppositions. Worldview-distinctive conclusions based on empirical evidence are suitable for individual convictions and public discussions, but not for institutional endorsements and scientific literacy requirements.

The scientific outlook is characterized by the following features:

1) explanation of the facts, their comprehension in the system of the corresponding science;

2) identification of the causes and natural connections of things is partial and generalized;

3) science involves forecasting, development of events and phenomena in the future;

4) an important feature of the scientific worldview is systematic, that is, a set of scientific ideas, which is put in order on the basis of certain theoretical principles.

An essential characteristic of science is the continuous production of new knowledge that adequately reflects reality and its integration into an existing system of knowledge that helps to understand the material world.

A generalized system of knowledge about nature that surrounds man, his understanding and attitude to the basic principles of nature being is a natural aspect of the scientific worldview.

What is a scientific worldview, and why should we care? One worldview can knit together various notions, and therefore understanding a worldview requires analysis of its component parts. Stripped to its minimum, a scientific worldview consists strictly of falsifiable components. Such a worldview, based solely on ideas that can be tested with empirical observation, conforms to the highest levels of objectivity but is severely limited in utility. The limits arise for two reasons: first, many falsifiable ideas cannot be tested adequately until their repercussions already have been felt; second, the reach of science is limited, and ethics, which composes an inevitable part of any useful worldview, are largely unfalsifiable. Thus, a worldview that acts only on scientific components is crippled by a lack of moral relevance. Organized religion traditionally has played a central role in defining moral values, but it lost much of its influence after the discovery that key principles (such as the personal Creator of Genesis) contradict empirical reality. The apparent conundrum is that strictly scientific worldviews are amoral, while many long-held religious worldviews have proven unscientific. The way out of this conundrum is to recognize that *non*scientific ideas, as distinct from *un*scientific ideas, are acceptable components of a scientific worldview because they do not contradict science. Nonscientific components of a worldview should draw upon scientific findings to explore traditional religious themes, such as faith and taboo. In contrast, unscientific ideas have been falsified and survive only via ignorance, denial, wishful thinking, blind faith, and institutional inertia. A worldview composed of both scientific components and scientifically informed nonscientific components can be both objective and ethically persuasive.

## Lecture 2.2. Methodological aspects of the scientific doctrine of the environment

The field of knowledge, which studies the means and principles of organizing cognitive and transformative activity, is called scientific methodology. The modern rapid growth of methodological research is driven by revolutionary changes in social practice, science, technology and other spheres of life. Development of methodology is particularly influenced by the actual processes of differentiation and integration of scientific knowledge, emergence and development of new industries, transformation of science into a direct productive force of society. It is worth noting that there are new issues concerning human and environmental interaction at the global and regional level. Features and practical solutions to these problems affect the functioning and development of all environmental components at any level. Their study requires the elaboration of interdisciplinary programs and projects, effective interaction of all branches of scientific knowledge. In this case, there is a need not only to combine the efforts of specialists of different profiles but also to combine different ideas and decisions in the conditions of fundamental incompleteness and uncertainty of information regarding the most difficult object of cognition. Therefore, they are developing such methods and tools that are able to ensure the effective interaction and synthesis of methods of different sciences on a single conceptual basis (for example, systematic approach, etc.). It is the methodology of science that characterizes the components of scientific research - its object, object of analysis, research tasks, the totality of research tools needed to solve the problem. The methodology combines our understanding of the research object with the theoretical content of science and its methods. The methodology is a certain hierarchy of relationships between the ontological, epistemological, real - abstract, concrete - formalized. The following methodological levels of scientific knowledge are distinguished (Z.E Dzenis, 1980):

1) a common scientific methodology based on philosophy and logic;

2) general scientific methodology - uses interdisciplinary concepts and approaches common to different sciences;

3) methodology of related groups of sciences - earth sciences, social sciences;

4) methodology of specific sciences (specifically scientific methodology), the methodology of geography;

5) partial methodology - methodology of separate scientific directions and disciplines (methodology of social geography).

In modern science, the methodology is understood above all, as teaching about the principles of construction, forms, and means of scientific and cognitive activity. Although in the doctrine of the environment these methodological foundations play an important role, which, according to the classification of Y.G. Yudin, belongs to the specific scientific. It is clear that such forms as the environment is a complex reality represented by many different types of systems - polycentric supersystem unity. The complexity of a research object shapes the methodological complexity of its cognition.

First of all, this is manifested in the need for widespread use of environmental, systemic and synergistic approaches, although the problem of the interdependence of the subject and the object of cognition is quite relevant.

The methodology of the object of its research is the activity of gaining new scientific knowledge, providing a critical review of the existing conceptual apparatus, principles, and approaches of scientific knowledge.

The role of philosophical methodology in science and social practice is determined first and foremost by the fact that the main categories of philosophy become the reference points for the development of man's world - his knowledge and transformation.

The methodology is a system of methods of cognitive activity and teaching about them. It covers the development and critical analysis of general philosophical methods, the methodology of scientific knowledge as a set of methods of research, which are applied in a particular field of knowledge. The philosophical or fundamental methodology is the highest level of the methodology of science, which defines the general principles of cognition and the categorical structure of science as a whole, as well as the worldview interpretation of the results. Philosophical methodology performs two types of functions. First, it reveals the essence of scientific activity and its interconnection with other spheres of activity, that is, it examines the science of practice, society and human culture. Secondly, the methodology solves the problem of improving and optimizing scientific activities, goes beyond philosophy, though it relies on the developed worldview and general methodological guidelines and postulates. Consequently, the leading ideas of philosophical doctrines are philosophical concepts of scientific knowledge, dialectical method, and theory of scientific creativity.

Any human activity - spiritual or practical, purely cognitive or transformative, individual or collective, that is, the development of the world by man, is always accompanied by the implementation of certain methods.

*The method (from the Greek μέθοδος - the path to anything) in the most general sense means the way to achieve the goal, ordering for this particular activity*. Expanded meaning: a method is a system of regulatory principles of any kind of activity, a set of appropriate techniques and operations. Methods are divided into two broad groups - methods of empirical and theoretical levels of scientific knowledge.

Empirical knowledge is based on direct experience (Greek *etreigia - argument*), The theoretical level of scientific knowledge involves a logical generalization of experience, social practice, the abstraction of the most essential properties of a large number of single real objects, and the construction of a special, theoretical world, whose objects are largely idealized. Of course, the empirical and theoretical levels of scientific knowledge are organically linked, not just by the commonality of the objects of study. Without the prior accumulation of the empirical material, the construction of a theoretical explanation would be impossible, but on the other hand, theory, to some extent, is a prerequisite for cognition at the empirical level, constantly accompanying it.

Coming out of the depths of philosophy, it does not completely break with it, although it acquires the features of a separate, specialized science. Certainly, the path of knowledge in philosophy is different from that in the specific sciences. Philosophers do not agree on a common definition of philosophy, so they do not recognize the only way to study entity. The doctrine of value (axiology) is important in the theory of cognition. Axiology (from the Greek words axiā, - value; and -λόγος, - word, doctrine) - the doctrine of the essence, structure, and regularities of the functioning of spiritual values. Therefore, philosophy naturally favors a world of spirit, dominated by thoughts and values, ideas and ideals of truth, holiness, goodness, beauty, experiences of vital, aesthetic, social, religious, theoretical (cognitive) and political values. Being human is impossible to think beyond such values. The very existence of a person is an endless evaluation, recognition or non-recognition of values.

Philosophy explores not only ontological issues but also axiological ones: why is everything there? For a long time, the aim in philosophy was to know the essence of the good, the evil, the beauty, the perfection, love, justice; justification of human virtues was put forward: dignity, honesty, virtue, etc. While exploring spiritual values, separate conceptual directions formed in philosophy. In particular, in axiology, the following areas are distinguished: ethics, aesthetics, philosophy of culture, philosophical anthropology, philosophy of religion, eco ethics, etc.

Generalizing scientific achievements, finding common ground in phenomena, revealing common links and patterns, philosophy interacts with all branches of knowledge, generates general methodological principles that apply in any science. This is the connection between philosophy and science.

A special place in the knowledge of nature belongs to the solution to philosophical problems of the environment.

We live in an age in which the destruction of the environment has become a major concern. However, until recently, environmental problems have not become a major issue for the philosophy of education. The reason for this is that for a very long time the philosophy of education was intimately related to the concept of nature as the foundation and the model of human activity. We can see such an understanding of nature not only among the philosophers of Ancient Greece but also among the modern pioneers of pedagogy.

If we consider this situation, we may understand the challenge the environmental problem poses to the philosophy of education. Nature in this age of environmental problems cannot function as the foundation upon which an edifice of education can be built. It has become clear that nature is vulnerable to human intervention.

Philosophy of education has responded to this turn of events by not paying attention to the concept of nature. This has sometimes taken an anti-foundational and anti-traditional form that is typical of postmodern thinking. More often though, this omission has occurred by way of shifting the discussion of education exclusively to social and political issues.

It is obvious that the philosophical study of the environment has come to exist because philosophers, like other citizens, are concerned about the dramatic changes and damages in the natural world. This concern, however, may not be the only factor that motivates to do environmental philosophy. For some scholars, the motivation for studying the environment philosophically is that it is philosophically intriguing. Accordingly, this paper suggests that in environmental philosophy two approaches can be distinguished: practical and philosophical.

The practical approach is a plausible response from philosophers concerning the worries they have about the state of the world. Accordingly, many environmental philosophy books, especially textbooks, begin with a list of environmental problems adopted from environmental sciences and public debates. The problems are somewhat clear and apparent. The next step is to use philosophical expertise to analyze these problems, that is, to apply philosophical concepts and theories to increase our understanding of the problems in question. The practical approach took shape early on in John Passmore's Man's Responsibility for Nature (1974), Part Two of which is titled 'Ecological Problems'. Such problems: pollution, the depletion of natural resources, overpopulation and the issue of preservation of the wilderness, are accounted for practical consequences 'of man's dealings with nature' (Passmore 1974, 43).

Passmore's choice of words is noteworthy because he associates ecological problems with human behavior and with the worldviews behind human action. This account puts emphasis on moral and social philosophy, and the key issue turns out to be what the societal and/or individual responses to the ecological problems should be like. If overpopulation is an ecological problem (or a source of such problems), the question for philosophers to study is the following: is it morally appropriate to implement coercive policies to reduce population growth?

Consequently, in the 1970s the philosophical study of the environment was commonly called

environmental ethics. It was clear to its practitioners, however, that the moniker 'environmental ethics' is too narrow because in the philosophical study of the environment none of the traditional fields of philosophy are excluded.

The practical approach is cognate with environmental pragmatism, a US-born school of environment

al philosophy that nominally saw the daylight in the 1990s in an edited volume by Andrew Light and Eric Katz. The editors define environmental pragmatism rather broadly as 'the open-ended inquiry into the specific real-life problems of humanity's relationship with the environment' (Light & Katz 1996, 2). Pragmatists aim to find workable solutions to problems, and this same aim dictates all philosophers: 'pragmatists cannot tolerate theoretical delays to the contribution that philosophy may make to environmental questions'. In other words, the pragmatists require environmental philosophy to be politically effective, and much of the practical environmental philosophy thus far has failed in that respect.

Dale Jamieson (2008, 6) has claimed that 'Even if there were no environmental problems, there would still be a place for reflecting on ethics and the environment.'

In other words, there are environmental philosophical problems independent of environmental problems. What are these problems like and why should their study be pursued? Bertrand Russell (1967, 177) wrote in his autobiography: 'It is a great thing to find a puzzle; because, so long as it is puzzling, one knows one has not got to the bottom of things.'

In philosophy, problems have many names, such as puzzles, dilemmas, paradoxes, and antinomies, reflecting the specific nature of the problem. In the philosophical literature, the precise definition of 'problem' seems, however, to be lacking. When searching for definitions, one encounters lists of specific problems. Russell's classic The Problems of Philosophy (1912) is a prime example. Problems are so highly valued in the philosophy that the notion of the problem may, to some extent, characterize the whole field, as the problem of evil in the philosophy of religion, the problem of demarcation in the philosophy of science and the species problem in the Darwinian philosophy of biology. Philosophers tend to see problems where others do not, and the impulse to problematize may override the impulse to find solutions. In environmental philosophy, the most famous specific problem is the Last Man argument.The Last Man argument is a variation of Robinson Crusoe's cases concerning the moral responsibilities of a socially isolated person. In environmental ethics, its focus has shifted from duties to oneself, and to God, to duties to the non-human nature: are plants, animals and non-animated nature morally considerable? This argument was famously formulated by Richard

Routley in 1973. Routley's problem is the following: is it morally acceptable for the last existing human to wipe out all life on Earth? This person knows that he is not harming any other human through his destructive actions, so there seem to be no moral restraints. As I see it, Routley's argument is a persuasive argument the force of which is the presupposition that most people would think of the wanton destruction of life as morally deplorable. If so, Routley's argument, in its intended sense, might not be an instance of a philosophical problem at all because the problem has a plausible solution: people immediately recognize the wrong course of action. Nevertheless, in philosophy, a mere sentiment about right and wrong is not a proper argument but, instead, something in need of justification. If this is the case, the argument converts into a problem generating a philosophical debate. For instance, some philosophers think that the LastMan argument proves that there is value in nature independent of human beliefs (Attfield 2003). Others deny this interpretation without rejecting, however, the original sentiment: they may claim that only a person with malicious character might act like a vandal (Hill 1983). In this interpretation, the problem is primarily about the reasons for action and secondarily about what is the right act for the Last Man. The Last Man argument is a good example of an enduring philosophical problem in the field of environmental philosophy. It is telling that Routley's own solution has gained hardly any attention. In the philosophical environmental philosophy, the focus is on philosophical problems that are formulated in an environmentally meaningful way. The Last Man argument hits deep in the heart of an eternal-like philosophical problem: are there values independent of valuers or do values result from the acts of valuation? A variant of this problem, one concerning piety, was examined already in Plato's Euthyphro. Both of the aforementioned approaches have their limitations. The major limitation of the philosophical approach is that the problems under scrutiny are abstract and rather distant from real-life environmental concerns. Even though arguments, such as the Last Man argument, may convince us about the value of the natural world, they provide less guidance when it comes to real-life situations and, thus, fail to qualify as good (environmental) philosophy (de-Shalit 2000,1). Some environmental philosophers are happy to keep environmental philosophy abstract. For example, J. Baird Callicott (1999, 40-43) emphasizes the significance of debate over ideas. Ashe sees it, environmental philosophers are as efficient as environmentalists when they practice environmental philosophy philosophically. The practical approach has limitations if its starting point is a realist assumption of environmental problems. By the realist assumption, I refer to the existence of a problem

independent of humans. The problems are in the world, and the human task is either to solve them or to adapt to them. This assumption is, however, rather one-sided since in (practical)philosophy we cannot take the problems for granted: but problems of environmentalism are what they are by virtue of the human debate about them. Therefore, environmental philosophy is human self-reflection in which the focus is on human understanding of the reality, of nature and of the limits of human understanding and knowledge as well as the conceptions of the just society and good life. Such problems are still at the heart of the philosophical inquiry, at least more so than the flow of ever-changing topics.

The key issue in environmental philosophy appears to be how to mix the philosophers' fascination with (pure) intellectual problems with the practical, real-life concerns over environmental degradation. One answer comes from the pragmatist philosopher Bryan Norton(2005) who characterizes environmental problems as wicked. The wickedness stems, partially, from the difficulties not only in finding a solution but also in defining the problem. A wicked problem is unique making it impossible to find a permanent solution to it by means of trial and error, and whatever we learn from experience is only temporary and local. Humans are devoid of an opportunity to test how much greenhouse gases may be safely emitted into the atmosphere and whether it is safe to bury radioactive waste into the bedrock, and still, we can not fully stop emitting greenhouse gases and something must be done to the used uranium.Paraphrasing Sahotra Sarkar (2012, 2), part of environmental philosophy is to determine which problems are environmental problems and which are quasi-environmental problems or environmental pseudo-problems. As much as philosophers aim to change the world they also aim to problematize their own aspiration to change. As much as they see solutions, they also see problems in these solutions.Philosophical inquiry starts from the emergence of a problem. In the beginning, the problem is in articulated and unclear, but something in it halts and demands further reflection. The formulation of problems is a research task in itself, and their composers are part of the philosophical legacy as much as those who propose creative solutions. Therefore, there is place for both approaches, practical and philosophical, in the philosophical study of the environment.

# Part 3. The methodology of organization of the scientific research

## Lecture 3.1. Organization of scientific research. Recommendations for preparing a dissertation

Research conducted for the purpose of contributing towards science by the systematic collection, interpretation, and evaluation of data and that, too, in a planned manner is called scientific research: a researcher is the one who conducts this research. The results obtained from a small group through scientific studies are socialized, and new information is revealed with respect to diagnosis, treatment, and reliability of applications. The purpose of this review is to provide information about the definition, classification, and methodology of scientific research.

Before beginning the scientific research, the researcher should determine the subject, do the planning and specify the methodology. In the Declaration of Helsinki, it is stated that 'the primary purpose of medical researches on volunteers is to understand the reasons, development, and effects of diseases and develop protective, diagnostic and therapeutic interventions (method, operation, and therapies). Even the best-proven interventions should be evaluated continuously by investigations with regard to reliability, effectiveness, efficiency, accessibility, and quality'.

The questions, methods of response to questions and difficulties in scientific research may vary, but the design and structure are generally the same.

Classification of Scientific Research

Scientific research can be classified in several ways. Classification can be made according to the data collection techniques based on causality, relationship with time and the medium through which they are applied.

1. According to data collection techniques:
   - Observational
   - Experimental
2. According to causality relationships:
   - Descriptive
   - Analytical
3. According to relationships with time:
   - Retrospective
   - Prospective
   - Cross-sectional
4. According to the medium through which they are applied:
   - Clinical
   - Laboratory
   - Social descriptive research

Another method is to classify the research according to its descriptive or analytical features. This review is written according to this classification method.

## I. Descriptive research

1. Case series
2. Surveillance studies
3. Observational studies: cohort, case-control, and cross-sectional research
4. Interventional research: quasi-experimental and clinical research

## II. Analytical research

I. **Descriptive Research:** in this type of research, the participant examines the distribution of diseases according to their place and time in society. It includes case reports, case series, and surveillance studies.

a. **Case Report:** it is the most common type of descriptive study. It is the examination of a single case having a different quality in the society, e.g. conducting general anesthesia in a pregnant patient with mucopolysaccharidosis.

b. **Case Series:** it is the description of repetitive cases having common features. For instance; case series involving interscapular pain related to neuraxial labor analgesia. Interestingly, malignant hyperthermia cases are not accepted as case series since they are rarely seen during historical development.

c. **Surveillance Studies:** these are the results obtained from the databases that follow and record a health problem for a certain time, e.g. the surveillance of cross-infections during anesthesia in the intensive care unit.

II. **Analytical Scientific Research:** the most important difference between this and descriptive research is the presence of a comparison group. They are categorized as observational and interventional research.

a. **Observational Research:** the participants are grouped and evaluated according to a research plan or protocol. Observational research is more attractive than other studies: as necessary clinical data is available, coming to a conclusion is fast and they incur low costs. In observational studies, the factors and events examined by the researcher are not under the researcher's control. They cannot be changed when requested. All the variables, except for the examined factor or event, cannot be kept constant. Randomisation can be restrictedly used in some cases. It might not be always possible to apparently and completely detect a cause and effect relationship. The results are considerably similar to real-life situations since the events are examined as they are and special conditions are not created. Since the repetition of the observed cases is impossible most of the time, it may not be possible to recreate the same conditions.

Moreover, some studies may be experimental. After the researcher intervenes, the researcher waits for the result, observes and obtains data. Experimental studies are, more often, in the form of clinical trials or laboratory animal trials.

Analytical observational research can be classified as cohort, case-control and cross-sectional studies.

**Cohort Studies (Prospective, Retrospective, and Ambidirectional):** A cohort is a group formed by patients having common characteristics. A cohort study is the one in which a group of patients is followed-up in time, e.g. comparison of academic performances of children (who underwent anesthesia in their neonatal period) in their adolescence.

Firstly, the participants are controlled with regard to the disease under investigation. Patients are excluded from the study. Healthy participants are evaluated with regard to exposure to the effect. Then, the group (cohort) is followed-up for a sufficient period of time with respect to the occurrence of disease, and the progress of the disease is studied. The risk of healthy participants getting sick is considered an incident. In cohort studies, the risk of disease between the groups exposed and not exposed to the effect is calculated and rated. This rate is called *relative risk.* Relative risk indicates the strength of exposure to the effect on the disease.

Cohort research may be observational and experimental. The follow-up of patients prospectively is called a *prospective cohort study*. The results are obtained after the research starts. The researcher's following-up of cohort subjects from a certain point towards the past is called a *retrospective cohort study*. Prospective cohort studies are more valuable than retrospective cohort studies: this is because in the former, the researcher observes and records the data. The researcher plans the study before the research and determines what data will be used. On the other hand, in retrospective studies, the research is made on recorded data: no new data can be added.

In fact, retrospective and prospective studies are not observational. They determine the relationship between the date on which the researcher has begun the study and the disease development period. The most critical disadvantage of this type of research is that if the follow-up period is long, participants may leave the study at their own behest or due to physical conditions. Cohort studies that begin after exposure and before disease development are called *ambidirectional studies*. Public healthcare studies generally fall within this group, e.g. lung cancer development in smokers.

- **Case-Control Studies:** these studies are retrospective cohort studies. They examine the cause and effect relationship from the effect to the cause. The detection or determination of data depends on the information recorded in the past. The researcher has no control over the data.
- **Cross-Sectional Studies:** in cross-sectional studies, the patients or events are examined at a particular point in time. Prevalence studies (the percentage of a population having a disease at a certain time) are the ones in which the diagnosis and disease mechanism are detected and the cause and effect relationship is examined at the same level.

Cross-sectional studies are advantageous since they can be concluded relatively quickly. It may be difficult to obtain reliable results from such studies for rare diseases.

Cross-sectional studies are characterized by timing. In such studies, the exposure and result are simultaneously evaluated. While cross-sectional studies are restrictedly used in studies involving anesthesia (since the process of exposure is limited), they can be used in studies conducted in intensive care units.

b. **Interventional Research (Experimental Studies):** in this type of research, there is a control group aimed to be tested. The researcher decides upon which effect the participant will be exposed to in this study. Post-intervention, the researcher waits for the result, observes and obtains the data. Interventional studies are divided into two: quasi-experimental and clinical research.

- **Quasi-Experimental Research:** they are conducted in cases in which a quick result is requested and the participants or research areas cannot be randomized, e.g. giving hand-wash training and comparing the frequency of nosocomial infections before and after hand wash.
- **Clinical Research:** they are prospective studies carried out with a control group for the purpose of comparing the effect and value of an intervention in a clinical case. Clinical study and research have the same meaning. Drugs, invasive interventions, medical devices and operations, diets, physical therapy, and diagnostic tools are relevant in this context.

Clinical studies are conducted by a responsible researcher, generally a physician. In the research team, there may be other healthcare staff besides physicians. Clinical studies may be financed by healthcare institutes, drug companies, academic medical centers, volunteer groups, physicians, healthcare service providers, and other individuals. They may be conducted in several places including hospitals, universities, physicians' offices and community clinics based on the researcher's requirements. The participants are made aware of the duration of the study before their inclusion. Clinical studies should include the evaluation of recommendations (drug, device and surgical) for the treatment of a disease, syndrome or a comparison of one or more applications; finding different ways for recognition of a disease or case and prevention of their recurrence.

## Dissertation proposals

### Aims and objectives

The primary focus of your research project is usually expressed in terms of aims and objectives.

Many students find it difficult to understand the difference between aims and objectives. However, in the academic context, there is a clear distinction between these terms.

**Aim -** what you hope to achieve.

**Objective -** the action(s) you will take in order to achieve the aim.

**Aims** are statements of intent. They are usually written in broad terms. They set out what you hope to achieve at the end of the project.

**Objectives**, on the other hand, should be specific statements that define measurable outcomes, e.g. what steps will be taken to achieve the desired outcome. When writing your objectives try to use strong positive statements.

**Strong verbs -** collect, construct, classify, develop, devise, measure, produce, revise, select, synthesize

**Weak verbs -** appreciate, consider, enquire, learn, know, understand, be aware of, appreciate, listen, perceive

Objectives should also be **S.M.A.R.T. -** which means they should be:

**Specific** – be precise about what you are going to do

**Measurable** –you will know when you have reached your goal

**Achievable** – Don't attempt too much – a less ambitious but completed objective is better than an over-ambitious one that you cannot possibly achieve.

**Realistic** – do you have the necessary resources to achieve the objective – time, money, **skills**, etc.

**Time constrained** – determine when each stage needs to be completed. Is there time in your schedule to allow for unexpected delays.

### How many aims or objectives should there be?

Please check with your project supervisor. Some tutors are happy with one clear strong aim, while others like to see a main aim supported by at least two subsidiary aims.

Likewise, there is no fixed number of objectives but you will be required to produce sufficient objectives to be able to measure progress towards meeting the aim/s.

### Example of aim and objectives

**Aim:**

To investigate the relationship between tectonic-plate movement and the gravitational effect of the alignment of the major planets.

**Objectives:**

Data sets will be extracted from the known historical record of tectonic-plate movement

• Data sets will be extracted from astronomical tables detailing the various alignments of the major planets covering the same period as data from the geological record.

• The data from both sets will be synthesized to establish if correlation points exist between major geological events and planetary alignments.

**Methodology**

Here you should explain what methods you intend to use in researching and developing your report.

The general idea is that, should someone else choose to carry out the same or a very similar type of study, they should be able to understand and copy your methods from your descriptions.

**Writing approach**: Descriptive.

**In every type of dissertation?** Usually, yes. Your thesis or dissertation will involve a large body of research. It is important to explain what research methods you used to collect your info.

Remember that you do not include your questionnaires, interview transcripts, etc. here - you will put these in the dissertation's appendices.

**Example of a methodology statement**

You will need to discuss with your project supervisor the extent and level of detail required; original research will obviously require a more detailed description than a project based solely on secondary research.

The following sample statements are intended to give a flavor of the approach one could take but they are not to be assumed to represent a complete methodology.

**1. Literature survey**

Secondary data will be reviewed initial through the university library using a range of information sources such as the OPAC system, academic and commercial abstracts, bibliographic databases, and Internet search engines.

To aid the search, a table of key terms will be constructed and the sources located will be correlated with this. A secondary cross-reference table will be developed so that data can be viewed from different perspectives.

**2. Data collection and sampling**

To test current practice against the historical record an on-line survey will be conducted to gather primary source data from companies currently engaged in the export of goods related to heavy engineering projects.

The survey will collect quantitative data on the range of goods requiring an end-user license. A systematic yet random sample of companies will be drawn from members of the British Business Register.

**3. Data analysis**

As the number of companies, engaged in the defined activity, has yet to be established the data analysis method has not yet been decided. However, it is anticipated that a commercial spreadsheet package such as MS Excel would be suitable, although more sophisticated analysis software such as SPSS is available within the university's IT center should this be required.

**Literature survey**

This may also be called a **Literature Review**.

This section describes the existing and established theory and research in your report area. You are providing a context for your work.

This section can be used to show where you are filling a perceived gap in the existing theory or knowledge, or you are proposing something that goes against or is controversial to existing ideas. You must accurately reference all sources mentioned here and give a full citation in the Reference List.

**Writing approach**: Descriptive.

**In every dissertation proposal?** Not necessarily.

Sometimes the literature survey can be a discrete piece of writing that is set and marked separately. It is also common practice to embed your literature survey in the main body of your dissertation. This will depend on the preferences of your department or tutor. Make sure you check whether to include this separately or not.

**Scope and constraints**

Here you should set the boundaries, for example, there may be just too much material to cover and some limits may need to be placed on the project, or you may not be able to conduct some research due to constraints imposed by time, cost or availability of materials.

**Resources**

Here you should list resources that you will need to complete the study.

**Outline of sections/chapters**

Here you give an outline of the structure of your dissertation. This is usually restricted to the main body as the overall structure is often prescribed.

The main discussion will require a more detailed breakdown than other sections. You should give suggested chapters headings and one or two paragraphs about the proposed content.

**References**

The reference list at the end of your work demonstrates the depth of your research. It also acknowledges your sources of information, protecting you against the serious charge of plagiarism (passing off others' ideas as your own).

If you have included a literature survey this is where you list all of your research reading.

If you have presented your literature survey separately, you will have still had to refer to some aspects of that reading in your introduction (statement of the problem). Those aspects must be cited and referenced here.

If you don't know how to reference take a look at the tutorial on Referencing.

Learning to reference correctly is an essential skill at university. It requires organization and attention to detail, but needn't be hard. Good referencing demonstrates to your lecturers the range of your reading and research. It will also prevent any problems with plagiarism and academic misconduct.

Plagiarism worries a lot of people, but if you understand what referencing is for, as well as how to do it, then you won't have anything to worry about.

This section will clearly outline the principles behind referencing, the mechanics of the Harvard referencing system, and how to ensure your work remains within the bounds of excellent academic conduct.

We have provided an extensive list of examples of Harvard referencing that you will return to again and again because it is essential when you are writing a paper to get those citations right.

Referencing involves three stages:

1. Borrow something from a source, whether words that you quote, or an idea that you paraphrase or summarise (in your own words).
2. Follow this with a citation, which is usually the name of the author of what you borrowed and the year it was published.
3. Add these author names to a reference list at the end of your assignment, which gives full details of the source within a standardized format.

There are several referencing styles with each one having set practices for setting out references within a piece of work and the reference list.

Always check with your tutor which referencing style they want you to use. If no style is specified, Harvard is considered a default style.

Always be consistent in how you reference in terms of punctuation and layout.

**What is plagiarism?**

Plagiarism is taking the words, theories, creations or ideas of another person and passing them off as your own.

This can be deliberate – copying a passage from a book or journal or pasting something from the internet into an assignment without referencing the original source, with the aim of pretending that you wrote it.

However, most often, it comes about accidentally due to poor or inadequate referencing, such as not realizing that you still have to put a citation even when you have rephrased something in your own words.

Regardless of the reason, plagiarism is a serious issue that can result in failing an assignment, failing the year or even having to leave the course. It is all about academic integrity, and being able to show how your ideas have developed, who has influenced you, and how you interpret your research. Without referencing, we can't know any of that!

The key rule is to make sure you include the name of the author and the year of publication whenever you use something from a source, whether it is a direct quote or something you have put into your own words, and then connect this to the full details in the reference list.

Sound confusing? Don't worry, there is a lot of help available, starting with RefWorks.

RefWorks is a useful tool that allows you to create an online store of references for items you have consulted. So, while you are searching for articles and books on the library catalog, you can store references as you go. RefWorks even puts them into the correct referencing format for you.

References can be organized in folders, for example, you could organize references by assignments, unit, usefulness - whatever suits you. These are stored and can be accessed from any computer with an internet connection.

## Lecture 3.2. Scientific Publishing Requirements

Publishing original research in a peer-reviewed and indexed journal is an important milestone for a scientist or a clinician. It is an important parameter to assess academic achievements. However, technical and language barriers may prevent many enthusiasts from ever publishing. This lecture highlights the important preparatory steps for creating a good manuscript and the most widely used IMRaD (Introduction, Materials and Methods, Results, and Discussion) method for writing a good manuscript.

The publication of original research is the ultimate and most important step toward the recognition of any scientific work. However, the process starts long before the write-up of a manuscript. The journal in which the author wishes to publish his/her work should be chosen at the time of conceptualization of the scientific work based on the expected readership.

The journals do provide information on the "scope of the journal," which specifies the scientific areas relevant for publication in the journal, and "instructions to authors," which need to be adhered to while preparing a manuscript.

The publication of scientific work has become mandatory for scientists or specialists holding academic affiliations, and it is now desirable even at an undergraduate level. Despite a plethora of forums for presenting the original research work, very little of it ever gets published in a scientific journal, and even if it does, the manuscripts are usually from the same few institutions.It serves the purpose of academic recognition; and certain publications may even contribute to shaping various national policies. An academic appointment, suitable infrastructure, and access to peer-reviewed journals are considered as the facilitators for publishing.

The lack of technical and writing skills, institutional hurdles, and time constraints are considered as the major hurdles for any scientific publication.

Maintaining the ethics and science of research and understanding the norms of preparing a manuscript are very important . This Lecture brings together various aspects to be borne in mind while creating a manuscript suitable for publication. The inputs provided are relevant to all those interested, irrespective of whether they have an academic or institutional affiliation. While the prospect of becoming an author of a published scientific work is exciting, it is important to be prepared for minor or major revisions in the original article and even rejection. However, persevering in this endeavor may help preserving one's work and contribute to the promotion of science.

Important considerations for writing a manuscript include the following:

- Conceptualization of relevant scientific work.
- Choosing an appropriate journal and an alternative one.
- Familiarizing with instructions to authors.
- Preparing a skeletal framework for writing the manuscript.
- Delegating time for thinking and writing at regular intervals.

Steps Involved in Manuscript Preparation

A manuscript should both be informative and readable. Even though the concept is clear in the authors' mind, it is important to remember that they are introducing some new work for the readers, and, hence, appropriate organization of the manuscript is necessary to make the purpose and importance of the work clear to the readers.

Choosing the appropriate journal for publication: The preferred choice of journal should be one of the first steps to be considered, as mentioned earlier. The guidelines for authors may change with time and, hence, should be referred to at regular intervals and conformed to. The choice of journal principally depends on the target readers, and it may be necessary to have one or more journals in mind in case of nonacceptance from the journal of the first choice. A journal's impact factor is to be considered while choosing an appropriate journal.

- Title and authorship: The title of a manuscript gives the first impression of the manuscript. It is estimated that a reader dedicates less than 2 s to read the title.[6] Most of the search engines use keywords to locate relevant articles, and, consequently, the title needs to be well thought of. A comprehensive title may have the following three important keywords: general, indicating the area or specialty the article belongs to; intermediate, referring to a specific disease or condition; and specific, referring to particular tests or interventions.[6] It is important for the title to convey the new information the concerned study is offering. Abbreviations should be avoided, and many journals have limitations on the number of characters to be included in the title. In addition, some journals require a short running title for the readers' ease of reading.
- Majority of journals with good impact factors have specific authorship criteria. This prevents problems related to ghost authorship and honorary authorship. Ghost authorship refers to a scenario wherein an author's name is omitted to hide financial relationships with private companies; honorary authorship is naming someone who has not made substantial contribution to the work, either due to pressure from colleagues or to improve the chances of publication.
- Most of the journals conform to the authorship criteria. They are listed as the following:
- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; ANDDrafting the work or revising it critically for important intellectual content; ANDFinal approval of the version to be published; ANDAgreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
- Some journals require authors to declare their contributions to the research work and manuscript preparation. This helps to prevent honorary and ghost authorship and encourages authors to be more honest and accountable.

***Abstract***: An abstract is a stand-alone part of the manuscript giving a brief overview of the contents; it may influence the editors, peer reviewers, and readers regarding the quality of the manuscript. It can be freestyled or structured as per the journals' norm. A structured abstract has sections pertaining to Background, Aim, Materials and Methods, Results, and Conclusion. There is a word limit of 250 words for abstracts in majority of the journals. The abstract should be revised every time the manuscript is revised or changed.

Keywords: are mentioned at the bottom of the Abstract section. These words denote the important aspects of the manuscript and help identify the manuscripts by electronic search engines. Most of the journals specify the number of keywords required, usually between 4 and 8. They need to be simple and specific to the manuscript; a good title contains majority of the keywords.

The general flow of the manuscript follows an IMRaD (Introduction, Materials and Methods, Results, and Discussion) structure. Even though this has been recommended since the early 20th century, most of the authors started following it since the 1970s.

***Introduction:*** The Introduction section sets the tone of the manuscript and, hence, should be focused. It provides a relevant background for the study with appropriate references and establishes the context of the work. Any word or name with standard abbreviation should be written in its expanded form the first time, with the abbreviation in parenthesis. Subsequently, only the abbreviation should be used throughout the manuscript. The Introduction section is generally in the form of a funnel, with the first paragraph highlighting the magnitude and importance of the disease in question. Subsequent paragraphs summarize the relevant facts known and the areas with uncertainty in the context of the study question; this is followed by the relevance of the current study and ends with the aim of the study

A common error while writing an introduction is an attempt to review the entire evidence available on the topic. This becomes confusing to the reader, and the purpose and importance of the study in question get submerged in the plethora of information provided. Issues mentioned in the Introduction section will need to be addressed in the Discussion section, and it is important to avoid repetitions and overlapping. Some may prefer to write the introduction section after preparing the draft of the Materials and Methods and Results sections.

The last paragraph in the Introduction section defines the aim of the study or the study question using active verbs. If there is more than one aim for the study, specify the primary aim and address the secondary aims in a separate sentence. It is recommended that the Introduction section should not occupy more than 10–15% of the entire text.

***Materials and Methods:*** The Materials and Methods section is the link between the Introduction and Results sections. The entire section is described in the past tense. It describes the methods and means used to conduct the study in such a way that other researchers should be able to perform a similar study with the given information. The type of the study (prospective/retrospective; interventional/observational; and cohort/randomized controlled/case–control study) should be clearly documented. It is then important to describe the place where it was conducted, the time duration taken, and to specify whether ethical approval had been sought and granted. The subsequent paragraph describes the study participants with selection and exclusion criteria and provides information regarding the informed consent.

This is followed by a detailed description of the study protocol. At times, some of the methods used may be very elaborate and not very relevant to majority of the readers, for example, if polymerase chain reaction (PCR) is used for diagnosis, the type of PCR performed should be mentioned in this section, but the entire procedure need not be elaborated in the “methods” section. Either a relevant reference can be provided or the procedural details can be given online as supplemental data.

It is important to mention both the generic and brand names of all the drugs used along with the name of the manufacturer and the place of manufacturing. Similarly, all the hematological, biochemical, hormonal assays, and radiological investigations performed should provide the specifications of the equipment used and its manufacturer’s details. For many biochemical and endocrine parameters, it is preferred that the intra- and interassay coefficients of variation are provided. In addition, the standard units of measurements and the internationally accepted abbreviations should be used.

There are online guidelines available to maintain uniformity in reporting the different types of studies such as Consolidated Standards of Reporting Trials (CONSORT) for randomized controlled trials, Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) for observational studies, and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for systematic reviews.[ Adherence to these guidelines improves the clarity and completeness of reporting.

Statistical analysis: One of the most important deterrents for publishing clinical research is the inability to choose and perform appropriate statistical analysis. With the availability of various user-friendly software systems, an increasing number of the researchers are comfortable performing complex analyses without additional assistance. However, it is still a common practice to involve biostatisticians for this purpose. Coordination between the clinicians and biostatisticians is very important for sample size calculation, creation of a proper data set, and its subsequent analysis. It is important to use the appropriate statistical methodologies for a more complete representation of the data to improve the quality of a manuscript.[ It may be helpful to refer to a recent review of the most widely used statistical analyses and their application in clinical research for a better data presentation. There is some evidence that structured training involving data analysis, manuscript writing, and submission to indexed journals improves the quality of submitted manuscripts even in a low-resource setting.

***Results:*** The Results section mirrors the Materials and Methods section and, for every step/intervention performed, there would be a result. It is a useful practice to put together the results in an orderly manner at the beginning of the manuscript preparation so that the message to be given becomes clear. It starts with the sample size, inclusion and exclusion details, which may be shown effectively as a flow chart, and followed by the basic characteristics of the study sample, usually represented in the form of a table.

The results of the study are summarized in the form of tables and figures. Journals may have limitations on the number of figures and tables, as well as the rows and columns in tables. The text should only highlight the findings recorded in the tables and figures and should not repeat every detail. Primary analysis should be presented in a separate paragraph. Any secondary analysis performed in view of the results seen in the primary analysis should be mentioned separately.

When comparing two groups, it is a good practice to mention the data pertaining to the study group followed by that of the control group and to maintain the same order throughout the section. No adjectives should be used while comparing, except for the statistical significance of the findings. The Results section is written in the past tense, and the numerical values should be presented with a maximum of one decimal place.

Statistical significance as shown by P-value, if accompanied by odds ratio and 95% confidence interval gives important information of direction and size of treatment effect. The measures of central tendencies should be followed by the appropriate measures of variability (mean and standard deviation; median and interquartile range). Relative measures should be accompanied by absolute values (percentage and actual value). The interpretation of results solely based on bar diagrams or line graphs could be misleading, and more complete data may be presented in the form of box plots or scatter plots.

***Discussion:*** The Discussion section provides the interpretation of results and describes them in the context of available evidence. The first paragraph summarizes the main results in 2–3 sentences. The subsequent paragraphs should review the results in the context of the available body of literature elaborating on the similarities and differences. Any result not conforming to expectations or previous evidence should be analyzed, and any unexpected result should be highlighted as such.

The strengths and weaknesses of the study should be discussed in a separate paragraph. This makes way for implications for clinical practice and future research.

The section ends with a conclusion of not more than one to two sentences. The Conclusion section summarizes the study findings in the context of the evidence in the field.

***References:*** A referencing tool such as EndNote™ may be used to store and organize the references. The references at the end of the manuscript need to be listed in a manner specified by the journal. The common styles used are Vancouver, Harvard, American Psychological Association (APA), etc.Despite continued efforts, standardization to one global format has not yet become a reality.

A referencing tool such as EndNote™ may be used to store and organize the references. The references at the end of the manuscript need to be listed in a manner specified by the journal. The common styles used are Vancouver, Harvard, APA, etc. Despite continued efforts, standardization to one global format has not yet become a reality.

It is important to understand the evidence in the referenced articles to write meaningful Introduction and Discussion sections. Online search engines such as Pubmed, Medline, and Scopus are some of the sources that provide abstracts from indexed journals. However, a full-text article may not always be available unless one has subscription for the journals. Those with institutional attachments, authors, and even the research division of pharmaceutical companies may be unconventional but helpful sources for procuring full-text articles. Individual articles can be purchased from certain journals as well.

*Basic Principles of Reference List Entries in APA style*

A reference list entry generally has four elements: the author, date, title, and source. Each element answers a question:

- author: Who is responsible for this work?
- date: When was this work published?
- title: What is this work called?
- source: Where can I retrieve this work?

Answering these four questions will help you create a reference entry for any type of work, even if you do not see a specific example in the Publication Manual that matches it. Consistency in reference formatting allows readers to understand the types of works you consulted and the important reference elements with ease.

To learn more about content and format of the author, date, title, and source, visit the page on reference elements.

*Correspondence Between Source and Reference List Entry*

The following figure shows the first page of a journal article. The locations of the reference elements are highlighted with different colors and callouts, and the same colors are used in the reference list entry to show how the entry corresponds to the source.

Additionally, the in-text citation for a work corresponds to the reference list entry. For example, the in-text citation for the work in the example is Botto and Rochat (2018) or (Botto & Rochat, 2018).

View the reference examples to see the basic principles of references in action.

*Punctuation in Reference List Entries*

Use punctuation marks in reference list entries to group information.

• Ensure that a period appears after each reference element—that is, after the author, date, title, and source. However, do not put a period after a DOI or URL because it may interfere with link functionality. And if a title ends with a question mark, the question mark replaces the period.

• Use punctuation marks (usually commas or parentheses) between parts of the same reference element. For example, in a reference for a journal article, use a comma between each author's last name and initials and between different authors' names, between the journal name and the volume number, and between the journal issue number and the page numbers.

• Do not use a comma between the journal volume and issue numbers. Place the issue number in parentheses directly after the volume number instead.

• Italicize punctuation marks that appear within an italic reference element (e.g., a comma or colon within a book title). Do not italicize punctuation between reference elements (e.g., the period after an italic book title or the comma after an italic journal title).

*Suggested Citations*

Some works contain suggested citations. These citations often contain the information necessary to write an APA Style reference but need editing for style. For example, you may need to change the capitalization of the title or the punctuation between elements. You may also need to put elements in the proper order of author, date, title, and source.

***Acknowledgements:*** This section follows the Conclusion section. People who have helped in various aspects of the concerned research work, statistical analysis, or manuscript preparation, but do not qualify to be authors for the study, are acknowledged, preferably with their academic affiliations.

***Conflicts of Interest (COI):*** It is important for authors to declare any COI relevant to the manuscript. The COI may be personal, commercial, political, academic, or financial. These may have negligible to very significant impact on the quality of the manuscript. Example: Holding a post in a pharmaceutical company or being a beneficiary of grants from pharmaceutical industry may have COI with the quality of research.[ Even reviewers and the editorial board members need to declare COI before accepting to review an article.

## Questions for self-control

1. How can theoretical methods be classified? What common logical methods of theoretical knowledge do you know? Explain their essence.
2. What are the specific theoretical methods and how do they relate to logical and general theoretical ones?
3. What is an axiomatic method?
4. What is a formalization method, how is it related to the axiomatic method, and how does Gödel's theorem relate to it?
5. What is a hypothetical-deductive method and how does it relate to the formalization method?
6. Why don't theoretical methods ensure the uniqueness of theoretical knowledge?
7. Why is scientific knowledge probabilistic?
8. How can methods of empirical cognition be classified?
9. What are specific empirical methods and how do they relate to general empirical methods?
10. What is the method of contemplation and how does it differ from the method of observation? Give examples from natural science.
11. What is the comparison method and how is it related to the measurement procedure?
12. What is an experiment method and how is it related to induction methods?
13. What are the drawbacks of the experiment method and how do they solve these problems?
14. What are "quasi-experiments", namely, a natural experiment, an imaginary experiment, mathematical and physical modeling?
15. What do synergistic approaches prove?
16. What is the theory of bifurcation?
17. Explain the essence of "*public scientific information commons".*
18. What does philosophical globalism do?

19. Define the concept of "science".
20. What is the main function of science?
21. How did the German philosopher I. Kant differentiate between the subject and object of the study?
22. What reproduces the subject of science?
23. Scientific fact in the study of environmental problems.
24. What determines the implementation of natural laws?
25. What is the worldview function of categories?
26. What is the methodological function of categories?
27. Define the concept of "scientific worldview"?
28. What is called scientific methodology?
29. What methodological levels of scientific knowledge are distinguished according to Z.E. Dzenis, 1980?
30. What is called a methodology?
31. What is a "method"?
32. What is "Axiology"?
33. What is the relationship between philosophy and natural science?
34. What is empirical knowledge based on?
35. What is the difference between the purpose and task of the study?
36. How is the purpose of the thesis determined?
37. How are the objectives of the study defined?
38. What do they mean when they say that goals should be S.M.A.R.T.?
39. How many aims or objectives should there be?
40. What are the requirements for methodology when writing a thesis?
41. What materials are not usually included in the main text of the thesis?
42. What is called secondary data and where can we get it from?
43. What programs are most appropriate to use when analyzing numeric arrays?
44. What should the literature review include?
45. What is the list of references at the end of the thesis?
46. What steps does the link include?
47. What style of reference is dominant in the US?
48. What is plagiarism?
49. Can plagiarism be accidental?
50. What is refworks?

**Тексти лекцій, презентації та додаткові матеріали розміщно у дистанційному курсі на базі платформи MOODLE.**

# Workshops / Практичні заняття

## Workshop 1
## Methods of scientific knowledge used at the theoretical and empirical levels.

The purpose of the workshop is to deepen theoretical knowledge of the scientific knowledge methods used at the theoretical and empirical levels, namely, general logical methods, an axiomatic method, a method of formalization, a hypothetical-deductive method, a contemplation method, an observation method, a method of experiment and its varieties.

The scientific seminar is held in the form of a forum in which students make presentations and participate in discussions. For the seminar, students should prepare a short report, which is a structured and critical overview of information on one of the topics suggested below. The seminar is aimed at deepening and consolidation of students' theoretical knowledge regarding methods of scientific knowledge used at theoretical and empirical levels, namely general logical methods, the axiomatic method, the method of formalization, the hypothetical-deductive method, the observation method, the contemplation method, the method of experiment and its varieties.
Topics of the workshop reports 1
1. Classification of scientific knowledge methods used at the theoretical level.
2.General-logical methods.
3.Axiomatic method.
4. Formalization method and Gödel's theorem.
5. Hypothetical-deductive method.
6. Classification of methods of scientific knowledge used at the empirical level.
7. The observation method and contemplation method.
8. Comparison method and measurement procedure.
9.Method of experiment and scientific induction
10. Methods of quasi-experiment.

Discussion questions

1. How can the methods of scientific knowledge used at the theoretical level be classified?
2. What group of methods underlies all other groups of theoretical methods and why?
3. List and describe all the basic general logic methods.
4. What function in scientific cognition do general-logical methods play?
5. What is an axiomatic method?
6. What is the main advantage and main disadvantage of the axiomatic method?
7. What is the formalization method and how does it relate to the axiomatic method?
8. What does Gödel's theorem say about the possibilities and properties of theoretical knowledge?
9. How is the hypothetical-deductive method related to the formalization method?
10. What are the main advantages and main disadvantages of the hypothetical-deductive method?
11. How can the methods of scientific knowledge used at the empirical level be classified?
12. What empirical methods are basic?
13. What is the method of contemplation and what are its disadvantages?
14. What is the observation method and what are its benefits?
15. What is a comparison method?
16. How is the measurement procedure related to the comparison method?
17. What is an experiment method, what are its advantages and disadvantages?
18. How is the method of experiment related to scientific induction?
19. What are the limitations of the experimental method and how are these limitations offset?
20. List and characterize all major quasi-experiments.

# Workshop 2
## Methodological aspects of the scientific doctrine of the environment

**The purpose of the workshop** is to deepen theoretical knowledge about:
the main function of science - knowledge of the objective world, real processes and phenomena, their nature in relation to nature management;
- the main aim of science is to discover the objective laws of nature, society and thinking, to creatively reflect the processes and phenomena of reality in the doctrine of the environment.

The scientific seminar is held in the form of a forum in which students make presentations and participate in discussions. For the seminar, students should prepare a short report, which is a structured and critical overview of the information on one of the following topics. The seminar is aimed at deepening and consolidation of students' theoretical knowledge about the main function of science - knowledge of the objective world, real existing processes and phenomena, their essence and the main purpose of science - discovering the objective laws of nature, society and thinking, creative reflection of processes and phenomena of reality in the light of the doctrine of the environment.

**Topics of the workshop reports 2**
1. “Public scientific information commons”.
2. The subject and object of study in philosophy by I. Kant of the environment.
3. Scientific fact in the study of environmental problems.
4. Methodological levels of scientific knowledge by Z.E. Genesis, 1980 of the environment.
5. “Axiology”.

**Discussion questions**
1. What do synergistic approaches prove?
2. What is the theory of bifurcation?
3. What does philosophical globalism do?
4. Define the concept of "science".
5. What is the main function of science?
6. What reproduces the subject of science?
7. What determines the implementation of natural laws?
8. What is the worldview function of categories?
9. What is the methodological function of categories?
10. Define the concept of "scientific worldview"?
11. What is called scientific methodology?
12. What is called a methodology?
13. What is the relationship between philosophy and natural science?
14. What is empirical knowledge based on?

# Workshop 3
## Scientific Publications

***The aim of the workshop*** is to consolidate theoretical knowledge regarding the rules of scientific publication.
**Progress**
1. Prepare a scientific article for publication according to the recommendations given in the theoretical part of the course and the requirements of a specific scientific journal.
2. **Send the practical work in the form of an attached file for verification.** Be sure to specify the site of the magazine whose requirements are the basis for the design of the article.

**Детальні вказівки щодо підготовки до практичних робіт та семінарських занять розміщно у дистанційному курсі на базі платформи MOODLE.**

# Independent work / Самостійна робота

Activities of Independent work : reading and discussion of assigned papers for seminars and preparation for lectures; course group assignment; group work: contribution to the group case-study projects and contribution to the preparation and delivery of individual presentation.

**Independent work:**

| |
|---|
| Studying the first topic the students receive knowledge about:<br>1) the field of culture;<br>2) the way of knowing the world;<br>3) a certain system of organization (academies, universities, institutes, laboratories, scientific societies, etc.); |
| When studying the second topic students must master the theoretical material of the discipline on the issues:<br>1) a common scientific methodology based on philosophy and logic;<br>2) general scientific methodology - uses interdisciplinary concepts and approaches common to different sciences;<br>3) methodology of related groups of sciences - earth sciences, social sciences;<br>4) methodology of specific sciences (specifically scientific methodology), the methodology of geography;<br>5) partial methodology - methodology of separate scientific directions and disciplines (methodology of social geography). |

**Детальні вказівки щодо самостійної роботи розміщено в дистанційному курсі на базі платформи MOODLE.**

## Final control / Підсумковий контроль

Final control of the course "Science Methodology" is conducted according to the curriculum for PhD students in order to determine the students' mastering level in electronic learning materials.
The test consists of closed tasks in which the PhD student should demonstrate logic, coherence, integrity, use of basic concepts and terms, logical conclusions, express their opinion on the problem. Its performance reflects the reproductive, reproductive-algorithmic, creative levels of knowledge.
The test task consists of 40 questions. Each correct answer is rated at 1 point. Points for correct answers add up. Maximum score for the final control is 40 points.
The PhD students should be responsible for their readiness to the final test.
In order to master theoretical electronic materials in the process of independent preparation for the completion of the final test task, PhD students should thoroughly familiarize themselves with the lecture materials, consider and understand the content of the questions for the exam, study recommended sources, special compulsory and additional literature. Access to the Internet resources online, which are also referred to in the literature, is useful. Students test their knowledge through self-monitoring questions.
Active participation in the forum will give an opportunity to discuss issues from many sides, help develop thinking and language, facilitate assimilation of the material.
Preparation for the final exam should be creative and independent, based on the knowledge gained.

### *Questions to prepare for the final test*

1. The subject of science reveals its name
2. perfect and complete knowledge (the knowledge of everything) and the
3. All philosophers agree that philosophy grows directly from people's daily lives, and philosophical reasoning is accessible to everyone
4. Who said: "Philosophy is the work of competent thinking"
5. The main function of science is...
6. A significant shift in the research process is the use of a socio-natural approach on an ecological basis
7. A new kind of information is...
8. Scientific databases are always static
9. The anthropo-ecological approach in global scientific research pursued by the new meta-science

10. Science is an integral designation of specialized human activity in the knowledge of the world for the use of the obtained results in practice, as well as the system of logical-epistemological, methodological and social-organizational formations of this sphere.
11. The initial concepts of each science are
12. Scientific fact (or result) is
13. By its nature, the environment is
14. The field of knowledge, which studies the means and principles of organizing cognitive and transformative activity, is called
15. Methodology is a system of methods of cognitive activity and teaching about them
16. A method is a system of regulatory principles of any kind of activity, a set of appropriate techniques and operations
17. Methods are divided into two broad groups
18. Without the prior accumulation of the empirical material, the construction of a theoretical explanation is possible
19. Axiology - the doctrine of the essence, structure, and regularities of the functioning of spiritual values.
20. The leading ideas of philosophical doctrines are philosophical concepts of scientific knowledge, dialectical method, and theory of scientific creativity.
21. In activities with complex systems, the benchmarks are not only knowledge but also...

22. The anthropoecological approach in global scientific research is exploring a new meta-science called...
23. According to post-positivism, the theory, in addition to the empirical basis, has other grounds, which are called...
24. The disadvantage of the axiomatic method is...
25. According to the formalization method, the following are false conclusions...
26. The consequence of Godel's theorem is the assertion that any purely theoretical knowledge is...
27. The problem with the hypothetical-deductive method is that...
28. The basis of all theoretical methods is..
29. The experiment cannot be applied in..
30. The comparative method cannot be used in..
31. The observation method is always different from the contemplation method in that..
32. The physical modeling method is most common in…

**Підсумковий тест розміщено в дистанційному курсі на базі платформи MOODLE.**

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