

The Fundamentals of Talented Thinking

Training Tasks

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Training Tasks

Tasks for determining the level of change

The essence of all learning is the recognition of new concepts in different cases. We are now acquainted with the concept of levels of change. Now let us practice these levels in different situations. After all, the ability to see the size of change is one of the elements of talented thinking.

I will present some examples of changes in various fields of human activity. Try to determine the level of change described in these examples. Please do not forget that when coming up with these changes, the great minds of the past did not know many of the things that we know now. Therefore, evaluate their results from their point of view, and based on their level of knowledge. I will try to describe them in the following exercises.

Some quotations from various sources will be used, and we must remember that the author was relying on very different principles and was writing for other purposes. Minor changes could cause excessive delight and big ones could simply be unappreciated. Therefore, do not pay attention to the author's emotions. We are the ones who are solving the task, not the author of the quotations.

We will now analyse a couple of examples.

Task 1: The first known device to be driven by steam was described by Heron of Alexandria in the first century. Steam that was tangentially coming from nozzles attached to a ball, made the latter turn. There was no use for this invention, it was simply a toy.

A 16th century Arabian philosopher, astronomer and engineer Taqi al-Din proposed a method for spit rotation using steam flow directed at blades, affixed to the rim of a wheel.

A similar machine was proposed in 1629 by Italian engineer Giovanni Branca for the rotation of a cylindrical anchorage, which turned to lift and release a pair of pestles in mortars.

What is the level of change here?

The solution: Objectively, Heron's device was the first machine that used steam energy for rotary motion. For this reason it can be considered an invention of the fifth level.

Taqi al-Din invented a new type of technology – the steam turbine. It is also the objective fifth level – A new direction in technology.

Branca's invention objectively did not change the essence of al-Din's invention. However, his machine transformed steam energy, not into rotary but reciprocating motion. Objectively, it is a new principle within the limits of a previously created direction - the fourth level. On the other hand, it is doubtful that Branca knew about al-Din's invention, meaning, subjectively it is the fifth level.

Task 2: A Young Moldovan circus team 'Frumos'... debuted in the arena of the Kishinev State Circus. <...> The search for a unique image led to inimitable circus acts never seen before. For the first time a whip, staff and 'kushma' (a special sheep hat) became juggling props. Peculiar acts were created by comic musical actors, who played not only old Moldovan instruments – fluers, kavals but also sopilkas, which are made from a certain type of dried pumpkin. (B. Леров. На арене "Фрумос". "Советская культура". 1.11.88.)

What is the level of change here?

The solution: Despite the assurances of the author of the quotation, nothing has changed in the art of circus. The genres also have remained the same – juggling, comical musical acting. The

technique of juggling and playing did not change either. The only thing that has changed is the props. It is a typical second level of change.

Task 3: “The band ‘Jethro Tull’ was linked to that music genre (*progressive rock* – J.M.). Yet their compositions differed with a strong foundation in jazz”. (А. Гаврилов. Комментарий на обложке альбома «Джезро Талл». «Мелодия», 1987 г.).

To the best of my knowledge, elements of Jazz were previously used in rock music but in the form of random, unrelated elements.

What is the level of change here?

Task 4: In Newcomen’s steam machine, steam was used to push a piston that cooled in the same cylinder, causing the piston to return to its starting position. In other words, engine performance was periodical. In 1763 James Watt improved Newcomen’s steam engine by separating the boiler from the condenser by using a steam distributor. This allowed the steam engine to operate continuously.

What is the level of change here?

Task 5: In 1891 physicist J. Stone suggested calling electrically charged particles ‘electrons’.

What is the level of change here?

Task 6: Before Giotto di Bondone, paintings were flat. Giotto focused his attention on discovering methods that would contribute to the impression of looking at three-dimensional shapes. How do you achieve this? First of all, by using light and shadows. Secondly, by using the reduced term. (Joanna Guze. *Na tropach sztuki*. "Nasza Księgarnia". Warszawa. 1982. s. 144-145)

What is the level of change here?

Task 7: In 1936 K. Zuse built his first computer, using the electrical relay and in 1946 D. Mouchli demonstrated his computing machine working on vacuum tubes - the ENIAC.

What is the level of change here?

Task 8: In the 19th century, the wave theory of light was based on the idea that light is transverse waves in an elastic fluid, called ether. However, Poisson had mathematically proven that transverse waves in an elastic fluid were impossible, as they can only exist in solids. Fresnel introduced the idea that ether has the properties of a both liquid and solid at the same time, ‘saving’ ether theory.

What is the level of change here?

Task 9: (*About I .Grekova’s story ‘the Fracture’ - J.M.*) Among the many I would like to highlight Dr. Chagin, he is outwardly surly, ‘sharp’, but with a delicate psyche and surprisingly noble. To oppose the appearance of the hero with his content, of course, is not the ‘cutting edge’ method. Nevertheless, the vivid description of the man is innovative (I cannot help myself but quote: “Chagin’s two-story house, pretty, frowning, with a roof over the front door that looks very similar to its owner”). (А. Андрианов. Удары счастья. "Литературная газета" 7.10.87.)

What is the level of change here?

Task 10: To prevent fingers from sliding, the surface of the computer ‘mouse’ pad was made textured.

What is the level of change here?

Task 11: Before Faraday, magnetic properties were considered only relevant to solids. Faraday was the first to study the magnetic properties of liquids and gases, and discovered the magnetism of Earth's atmosphere.

What is the level of change here?

Tasks for creating supersystems

Task 12: In early human settlements houses were built haphazardly. Gradually, people started to realise that it is more convenient to build houses according to a general plan; houses were combined into towns and cities. What new features were offered by this combination?

Task 13: The origin of a new plant is given by the combination of parental plant genes through pollination. The origin of a new organism (including human organisms) is given by the combination of the parents' genes. What new positive features and benefits are given by this combination?

Task 14: Combining music and poetry gave some new genres and types of art - songs, cantatas, operas ... Combining painting and theatre gave scenery and set design arts. What types of arts have not been combined yet? Suggest such combinations. What new expressive possibilities can be offered by these combinations?

Tasks for recognising phylogeny and ontogeny processes

In the first group of tasks you will be given the ontogenic process. You will need to name the relevant phylogenic process. Let us analyse one example.

Task 16: The weather is always changing. Name the appropriate phylogeny process.

The solution: Weather is one object, but all weather of a sufficiently large region in a substantial period of time forms the climate. Historical climate change is a phylogenic process with respect to the weather.

Task 17: Educational school curricula vary from first class to last.

Task 18: A child's conceptualisation changes from infancy to adolescence.

Task 19: The process of building a house.

Task 20: The process of decorating a house.

Task 21: The process of writing a book.

Task 22: The process of publishing a book.

Task 23: Biogeocoenosis is a region in which all biological and geological objects interact, forming an independent equilibrium system. One book states that: 'Biogeocoenosis does not have a phylogenesis'. What do you think? What is the phylogenesis of biogeocoenosis?

In the second group of tasks you will be given the phylogeny process. You will need to name the relevant ontogeny process. For example:

Task 24: It is well studied how the wild potato became a crop. What can be considered as ontogenesis in this case?

The solution: The history of the potato as a crop is the history of all potatoes. Meaning, the ontogenesis will be the ‘history’ of one potato bush – from planting to collecting tubers.

Task 25: The development of transport.

Task 26: The development of cars.

Task 27: The development of writing tools.

Task 28: The history of the pencil.

Task 29: The development of plants.

Task 30: The development of trees.

Task 31: The history of human diseases.

Tasks for practicing systematic thinking

This time, let us try solving a new set of tasks. First, let us practice to recognise the system and its manifestations in talented solutions. Secondly, let us try to get some talented solutions in simple (to begin with) situations.

As usual, we will practise together first.

Task 32: In the first half of the 19th century, geology was dominated by the ‘Neptunian’ theory of the origin of rocks, developed by Werner. According to the theory, most rocks derived from the world’s ocean sediments. However, such rocks like granite or basalt did not meet the definition of sedimentary rock.

Hutton, who developed the so-called ‘Plutonic’ theory, explained the problem in the following way: not all rocks have a sedimentary origin; many of them are the result of volcanic activity, the pressure and temperature of the inner layers of the Earth’s crust, weathering, etc. These days all of these processes continue.

Which systemic transition did Hutton make with his theory?

Let us first analyse the prototype – Werner’s theory. Sediments were formed, pressed ... and remain so to the present day. The source of the sediments is the ocean.

Hutton has made major changes in these views. Firstly, he introduced the concept of continuous time: the processes of rock formation did not occur and then stopped, it continues until this day. Secondly, he introduced a number of new sources of rock formations – volcanoes, ‘lava’, wind...and these factors also operate to this day. That is, **supersystem factors** were added.

These two transitions - the introduction of supersystem factors and the dramatic expansion of the time of their actions are Hutton’s merits by reason of his talented thinking.

Task 33: In Sir Arthur Conan Doyle’s story ‘The Disappearance of Lady Frances Carfax’, criminals kidnapped a lonely rich woman and needed to get rid of her. Sherlock Holmes knew that they had ordered a coffin. Obviously, they decided to bury her. However, when Holmes broke into their lair at night and opened the coffin, there was indeed a dead woman – the criminal’s old maid. According to all other indications, Holmes correctly discovered the criminals plan. How were they planning to dispose of the rich girl?

First we need to solve this problem from the perspective of the criminals. They suspected that Holmes would go and check. Nevertheless, they could not change the plan for getting rid of the rich girl under the guise of the maid funeral. Only one thing was left - **the introduction of the time factor**. The dead maid is left in the coffin for the duration of the possible checking period. However, at the very last moment the maid could be replaced with the rich girl.

Here are several tasks for independent solving.

Task 34: The worst enemies of coal mines are methane, coal dust and water. Methane and coal dust are explosive, and ground water can flood the mine. Methane and dust are pumped out by ventilation, and water - by pumps. Although, it is expensive - two complicated and powerful pumping systems. This is also a long process – before they are pumped out, the gas can accumulate again.

How was it possible to make this process a lot cheaper and quicker?

Please, do not refer to not knowing mining equipment. It has nothing to do with it. A simple systemic approach is enough.

(Let us use one of the subsystems of harmful effects. Water can also be a source of energy. It was proposed to guide the pumped out water to a turbine, and then use it for generating additional electricity. This dramatically reduced the costs for ventilation).

Task 35: A classic detective story is based on a smart detective catching a wily criminal. The detective never teams up with the police and the criminal uses a maximum of one or two assistants.

Predict the further development of the criminal's image in a classic detective story.

Again, it is sufficient to only use the hierarchy of systems.

(In later detective novels a detective joins forces with the police, and sometimes, as in Georges Simenon novels, the detective is himself a policeman. The criminal also moves into a supersystem as, for example, in the Rex Stout and Earl Gardner novels, the detective has to fight with an entire criminal organisation).

Task 36: Artificial marble is made by mixing concrete with small fragments of natural marble. After the concrete has set, it is almost impossible to distinguish artificial marble from the real thing. Blocks of any size and shape can be moulded, which it is very convenient. The trouble is that this block is very hard to polish due to the hard concrete.

How to get a polished block of artificial concrete without spending time and effort on polishing?

Do not forget about all the features of the system approach.

(We need to seek help in the supersystem. Its closest element is the form, in which a block of artificial marble is made. If the bottom of the form is smooth, then the block itself will be polished. It was proposed to put a sheet of glass on the bottom of the form).

Task 37: In the medieval world map of Lambert St. Omersky a great Southern continent is shown, and a comment to which states that when we have summer they have winter. In the western hemisphere it shows a big island. This area is provided with a comment: 'Here live our antipodes but their days and nights are opposite ours'.

If we take into account, that before there were wide debates about antipodes existence in general (the official Church, for example, argued that believing in the antipodes is a sin), then what were the system transitions Lambert St. Omersky made?

(The two transitions to the anti-system. Firstly, Lambert swapped seasons; secondly, he swapped days and nights).

Task 38: As we already know, the first chemical theory that explained the process of formation of ore and the process of smelting metals from ores was the theory of phlogiston. According to that theory, ore is a metal, which was left by weightless phlogiston fluid. When the ore is smelted with charcoal, which contains a lot of phlogiston, the latter gets to the ore and metal is obtained.

However, this theory could not explain why the weight of the metal is less than the weight of the ore. After all, if weightless phlogiston got into an ore, the weight of the metal must be equal to the weight of the ore.

What systemic transition can explain this phenomenon?

(The transition to the anti-system. When smelting a metal, phlogiston is not attached to it, on the contrary, some substance is released from it).

Task 39: People, who live near lakes of cold latitudes know that during freezing these reservoirs emit a buzzing sound. Medieval scholar Gerald compared them with the howling of large herds of animals. He also gave an explanation of this phenomenon, which so far is considered as correct.

Try to explain the buzzing noise. What systemic transition did you use?

(Gerald had found the cause in the supersystem. One of its elements is air around the lake. The movement of air under the freezing ice is the cause of the buzzing sound).

Task 40: Studying the flow of current through different substances, Faraday drew attention to the fact that current passes through the water, but does not travel through ice; but after all, ice and water is the same substance!

What systemic transition can help explaining this phenomenon?

(The cause lies in subsystems. Faraday suggested that during freezing, water particles bond to each other and can no longer pass current).

Task 41: In 1774, after beginning to study the process of tin calcination, Lavoisier already assumed that the conversion of metal into ‘earth’ (now we call it metal oxide) is due to a reaction with air, rather than the release of phlogiston. However, a series of experiments showed that no matter how much tin we make, during calcination only a fifth of the air, contained in the vessel, will be joined with it. Remember that in the ancient Greek era the air was still considered as an ‘element’, that is, a single substance. It was inexplicable that only a fifth part was participating in the reaction.

Lavoisier suggested that air is not an element after all. It consists of two parts – ‘clean air’, which is conducive to combustion and respiration, and ‘mephitic air’ that is not participating in these processes. Later, he would call these oxygen and nitrogen.

What systemic transition did Lavoisier use when creating this theory?

(Lavoisier divided air into two subsystems - oxygen and nitrogen).

Task 42: Rhyme is one of the strongest types of rhythm in poetry. It is especially desirable in dramaturgic poetry. However, poetic speech of a character does not sound natural in every situation. In such cases rhyme interferes. It brings clarity into characters’ speeches; on the other hand a speech ‘in rhyme’ is totally unnatural.

Playwrights of the 18th century have solved this problem by writing some parts of character monologues in rhyme with other parts remaining unrhymed. Here is an example of Shakespeare’s sonnet:

*For 'tis the sport to have the engineer
Hoist with his own petard. And 't shall go hard,
But I will delve one yard below their mines,
And blow them at the moon. Oh, 'tis most sweet
When in one line two crafts directly meet.*

(‘Hamlet’, III, 4.)

What systemic transition was used for solving this problem?

(The monologue was divided into two subsystems – rhymed and unrhymed).

Task 43: In the novel ‘War and Peace’, Tolstoy wanted to show the Battle of Borodino in the eyes of different people – from short-spoken Kutuzov to verbose Bezukhov, from professed Napoleon to reasoning Bolkonsky. Such description would take up enormous time and space in the novel but the battle is a short and dynamic event.

How to show the dynamism of the battle and the most versatile look at it? Which systemic transition would be useful?

(The introduction of time. A part of the description is given before the battle - in the form of military plans, deployment of troops, etc).

Task 44: One of the tasks of K. Vonnegut’s novel ‘Slaughterhouse number 5’ is to show that the war was brought to bear upon excessively young boys. Heroic deeds and horrific brutalities alike were done by 17-18-year-olds. The subtitle of the novel is appropriate – ‘The Children’s Crusade’.

To show the absurdity of children’s war, Vonnegut makes the protagonist of the novel watch a film about the war in the reverse order. It turns out as a romantic story about saving the world from war, and bomber pilots, who in such interpretation were dragging the bombs from the ground back into the bomb bays, leaving the aircraft, getting dressed to become ordinary children.

What systemic transition did Vonnegut use?

(The transition to anti-system – the process was given in the reverse order).

Exercises

Exercises for practicing the principle of hierarchy

Let us take the following objects:

- a clock
- a mountain
- a train
- a film
- an apartment
- a sunset
- a country
- a traffic light
- an apple
- a play character

Exercise 1: Design a hierarchy of subsystems of these objects - two or three ranks.

For example, the original system is a simple ballpoint pen.

The first rank of its subsystems: the body, the ink cartridge, and the mechanism for pushing out the cartridge.

The second rank. The body can be divided into upper and lower parts, a cap and a clip, which can be attached to the pocket. The cartridge consists of a cylinder, a ballpoint mechanism, and ink. The mechanism for pushing out the cartridge consists of a button, ratchet, and spring.

The third rank. Lower body part consists of the main and threaded parts. The ballpoint mechanism consists of a wide part, which is inserted into the cartridge, as well as of the narrow part, where the ball is placed, and the ball itself. The cylinder consists of a main tube and lugs that hold the spring. The ratchet consists of a part with teeth and a rotary part.

Exercise 2: For the above mentioned objects please design and name as many supersystems as possible, in which the specified object is included as an integral part.

For example, the ballpoint pen is a part of:

- pens in general (as a type of a pen)
- a set of office supplies lying on the table (or in the bag)
- elongated objects
- the contents of the pocket
- plastic products, etc.

Exercise 3: For the above mentioned objects please name as many qualities or functions for that object as possible, and then suggest the anti-system for each quality or function.

For example, the qualities of a ballpoint pen:

- long (anti-system – something short, e.g. a coin)
- fragile (solid, e.g. a stone)
- light (heavy, e.g. an elephant)
- ink (transparent, e.g. water), etc.

The functions of a ballpoint pen:

- to leave marks on paper (to erase marks, e.g. an eraser)
- to pierce soft objects (to strengthen soft objects, e.g. glue)

- to scratch head (to cause itching, e.g. a flea), etc.

Exercise 4: For the above mentioned objects please name several different subsystem hierarchies, depending on the supersystem, in which you consider that object.

For example,

- in the 'pens in general' supersystem, our scrutinised pen consists of the body, the cartridge and a mechanism for pushing out the cartridge.
- in the 'contents of pocket' supersystem, this pen consists of the body and the clip.
- in the 'plastic products' supersystem, this pen consists of several parts of plastic
- and so on

Exercise 5: Please design this hierarchy, branched to both directions for a randomly selected object.

Exercise 6: What artificial combinations of a pencil with other objects and systems can you name? What new features compared with the pencil are given by that combination?

Exercise 7: Invent new, not yet existing supersystems of a pencil. What can you combine it with? What will be the benefits of the new supersystem?

Exercise 8: You will be given randomly matched pairs of objects from nature or culture. Think of the way they can be combined. What application variants of the combined object can you offer?

Exercises for developing the associative imagination

The system of exercises for the development of the associative imagination is a sequence of exercises¹. It is necessary to perform a group of exercises to consolidate a good skill, and after that we need to move to the next group. This is followed by a few exercises from each group. The rest of the exercises in a group must be the same type.

When you perform exercises from the first group, first of all, you need develop the ability to respond without thinking (first exercise), so that the answer is a natural and free association, without forceful thinking. Only after this skill is achieved, when you stop thinking about your answers, then you can move to the next set of exercises.

Another hurdle that must be overcome is the 'inner censor'. Apart from exercise questions, people inevitably bear in mind another question: 'What will people think about me if I say this?', and desperately try to think of a new word. Nevertheless, during training, this 'inner censor' gradually disappears.

The first group (developing the freedom of associative imagination):

Exercise 9: (*direct associations*) Each participant is given a word that means an object. You must, without thinking and without listening to the 'inner censor', immediately name the first word that came to your head. Naturally, it also has to be an object, not a property or activity.

Exercise 10: (*general chain of associations*) The first participant is given a word that means an object. They need to immediately, without thinking name an object-association. This word will be the starting point for the next participant. This continues until all the participants name their associations.

Exercise 11: (*chain of associations*) Each participant is given a word that means an object. They need to name an association as quickly as possible. It will be the starting point for the next association. Etc.

Exercise 12: (*association bush*) Each participant is given a word that means an object. They need to name five associations as quickly as possible.

Exercise 13: (*double helix*) Each participant is given two words, which mean objects. They need to quickly create two chains of associations, and do it in turn - one word for each chain.

Each exercise should be repeated several times to reach maximum speed. After each exercise a little analysis identifying the types of situations, should be performed with the group.

Typical situations that are constantly repeated:

1. Objects are named that are too close to the source of one or similar groups, such as household, family, professional, etc.
2. This is especially noticeable during the performance of the second exercise, when there are frequent returns to the first words of the general chain group.
3. Such situations are also frequent in the individual chains of associations.
4. However, the association bush has an interesting phenomenon. After using two or three banal associations, a person is forced to look for more distant, more interesting and unexpected ones.

¹ Some of these exercise are taken from practice from other tutors of TRIZ (Theory of inventive problem solving), some of them were invented by me, and some of them suggested by my students.

5. In the double helices there are cases when at first associations from different chains come apart, and then begin to converge, going back to one of the ordinary groups. However, it can also be the opposite way, when one notices the initial convergence and begins 'separating' the chains in different directions. This is the first serious attempt to control their associative imagination.

These and other possible typical situations should be discussed with the participants, at the same time improving the skill to analyse their own associative imagination.

The second group (transitions to anti-systems):

Exercise 14 (*transitional*): You will be given the name of an object. Name as many its properties and functions as possible.

Example: object – **candy**. Properties – sweet, hard, harmful, soothing, sticky, nourishing, round, etc. Features – to bring fun, to serve as a projectile, to be a medium of exchange, to serve as a reward, etc.

Exercise 15 (*transitional*): You will be named a property or a function. Name as many directly opposite properties and functions as possible.

Example: sweet – bitter; hard – soft; harmful – useful; soothing – exciting; sticky – repellent; nourishing – causing hunger; round – shapeless, etc. To bring fun – to make sad; to serve as a projectile – to defend from projectiles; be a medium of exchange – to be the object that reduces the value of other objects; reward – punishment, etc.

Two typical errors are made when performing this exercise. The first - instead of naming the opposite properties (functions), participants cancel the property (feature). Example: sweet – not sweet. Second error - instead of naming the opposite function, they simply name another function. Example: round – square. Square is just a different shape. It is necessary to pay special attention to these errors and try to eliminate them.

Exercise 16 (*gradual anti-association*): You will be given the name of an object. Name its property or function, then appropriate anti-property and anti-function, after that quickly name another object that has that anti-property or anti-function.

Example: candy – hard – soft – a pillow; candy – reward – punishment – fine.

The exercise needs to be practiced until the chain is performed easily and without delay.

Exercise 17 (*mental anti-association*): You need to perform the same actions as in the previous task; however, all the transitional steps need to be performed mentally. Compare with the speed of completion of the previous task. This exercise needs to be repeated till the mental chain becomes almost instantaneous.

The third group – transition to subsystems.

Exercise 18 (*transitional*): You will be given the name of an object. Name its direct subsystems (of the closest rank).

Example: **House** – wall, roof, foundation.

Exercise 19 (*chain down*): You will be given the name of an object. Name one example of several subsystems of decreasing rank.

Example: **House** – walls – bricks – voids – air in voids.

Exercise 20 (*down and up*): You will be given the name of an object. Name one example of several subsystems of decreasing rank, and then generalise the last object.

Example: **House** – walls – bricks – voids – air in voids – **atmosphere**.

Exercise 21 (*subsystem associations*): You need to perform the same actions as in the previous task; however, it needs to be performed mentally.

The fourth group – transition to supersystems.

Exercise 22 (*transitional*): You will be given the name of an object. Name its direct supersystems (of the closest rank).

Example: **House** – street, buildings, dwellings, wind barriers...

Exercise 23 (*chain up*): You will be given the name of an object. Name one example of several supersystems of increasing rank.

Example: **House** – street – quarter – district – city.

Exercise 24 (*up and down*): You will be given the name of an object. Name one example of several supersystems of increasing rank, and then name a completely different supersystem of the last object.

Example: **House** – street – quarter – district – city – **transport**.

Exercise 25 (*supersystem associations*): You need to perform same actions as in the previous task; however, it needs to be performed mentally.

The fifth group – time.

Exercise 26 (*transitional*): You will be given the name of an object. Name ontogeny processes in which the object is active.

Example: **House** – creates an artificial environment for its residents, is a barrier for the wind, throws heat into the atmosphere, puts pressure on land...

Exercise 27 (*transitional*): You will be given the name of an object. Name ontogeny processes in which the object was active in the past.

Example: **House** – before the construction of the house its bricks were piled into blocks and caused deterioration of transport and roads. Prior to that, in the process of production, they consumed a lot of heat and electricity, released moisture into the atmosphere. As a clay piece they were creating the geological structures of the crust. Clay extraction left voids that caused the redistribution of pressure in that region of the crust and changes in the distribution of groundwater. Due to that, there appeared new niche for living organisms.

Exercise 28 (*transitional*): You will be given the name of an object. Name phylogeny processes in which the object is active.

Example: **Houses** – create more complex artificial environment for its residents, start to provide services for residents, become more active technogenic factors for the climate and geological processes.

Exercise 29 (*transitional*): You will be given the name of an object. Name phylogeny processes in which the object was active in the past.

Example: **Houses** – cities occupied even bigger territories (today - about 2% of the total land area). Here we must add roads linking the cities. It is the building of cities and roads, as well as city heating that has changed flora of Europe, destroying most of the forests in the Middle Ages. Redistribution of ground water and the internal pressure in the soil gradually led to the subsidence of large areas. (Total area of subsidence of 50 major cities in China for more than

200 mm is 79 thousand square meters, which is nearly two Switzerlands). In even more ancient times, cities were centres of racketeering on the river trade routes that formed a certain type of economy in these regions.

Exercise 30 (*associations in ontogeny*): You will be given the name of an object. Name ontogeny processes in which the object is active and was active in the past. After that, name the supersystems of those processes or elements of supersystems.

Example: **House** – creates an artificial environment for its residents – the subsystem of this environment is water pipes, sewage, heating, etc. in the apartment; the supersystem is all city communications - city water, city sewers, city heating system, etc.

Exercise 31 (*associations in phylogeny*): You will be given the name of an object. Name phylogeny processes in which the object is active and was active in the past. After that, name the subsystems of those processes or elements of supersystems.

Example: **Houses** – cities occupied even bigger territories. Previously, these were small clearings on which homes and cities were built. Now it is a huge area, which basically is disposed from agricultures.

Exercise 32 (*temporal associations*): You need to perform the same actions as in the two previous tasks; however, they need to be performed mentally.

In all exercises of the second to the fifth group it is necessary to gradually achieve a free orientation in the system hierarchy, as well as in ontogeny and phylogeny. When this is achieved, we can move on to the sixth group.

The sixth group – complex exercises.

The goal of the sixth group is to combine different lines of associative imagination, which so far we have been training separately. Exercises of the sixth group have to come up all the time. I will give you only one example.

Exercise 33: Transitions to anti-associations, as in exercises 16-17. Then scrutinise supersystems for these anti-associations, as in exercises 24-25.

According to this principle it is necessary to create exercises that combine any association directions.