

# The Diagnostic Assessment of Scientific Literacy

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## Framework for diagnostic assessment

The aims of science education are clearly reflected in the elements of the models created for the interpretation of scientific literacy (see e. g. Holbrook & Rannikmae, 2009) and in the theoretical frameworks of international assessments (OECD-PISA 2007): applying scientific knowledge in real-life situations, knowledge about the nature and methods of science, scientific investigation and attitudes towards science. One of the prerequisites to achieving the goals of effective science instruction is the regular collection of information on students' knowledge and the development of their thinking, and based on the results, assisting learning through special programs and individualized tasks.

Within the framework of the 'Developing Diagnostic Assessments' project of the Center for Research on Learning and Instruction of the University of Szeged the construction of a diagnostic assessment system of scientific knowledge is currently in progress, together with the development of a content framework of diagnostic assessments and the development of an item bank related to it. The content framework (Korom, B. Németh, Nagy & Csapó, 2012) covers three dimensions (thinking, application, and disciplinary), each of which describes the fields of assessment in three age groups (grades 1-2, 3-4, 5-6) and in three content fields (Physical Systems, Living Systems, Earth and Space). The three dimensions correspond to the three main objectives of science education: fostering thinking, application of knowledge and acquisition of disciplinary knowledge (Csapó, 2004).

### Thinking dimension

The psychological dimension examines whether learning science improves general cognitive skills (e.g. analogical, deductive, probabilistic and proportional reasoning) and scientific thinking including IBL skills (e.g. formulation of research questions and hypothesis, prediction, designing experiments, identifying variables, collecting data, interpretation and explanation of results).

### Application dimension

The application dimension is organized along the social expectations of learning and places the emphasis on the social usability of knowledge, its applicability in different contexts, knowledge transfer and the ability to create links between science, technology, society and the environment. The dimension examines the application of knowledge in everyday situations (personal, social, global contexts).

### Disciplinary dimension

The disciplinary dimension gives priority to professional factors; it examines how well the students acquired the different subject matters of the science subjects (Physics, Chemistry, Biology, Geography) relative to the curricular standards in the well-known contexts of school activities.

## Computer-based diagnostic items developed in the eDia system

Within the framework of the project we have developed a system eDia (Electronic Diagnostic Assessment) suitable for online assessment. The test items follow the principles of the framework and make use of the opportunities provided by computer-based assessments. The type and appearance of the items and the mode of responding are varied. There is also opportunity to watch short videos and simulations. The item bank consists of items that are balanced along a number of different parameters, out of which the ones suited to a given assessment aim can be selected to construct a test for a specific purpose.

#### References

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The kangaroo can log twice as fast as the elephant. Decide if the statements are true or false!  
 Answer with a click!

The kangaroo can log twice as far as the elephant during a given period of time. true false  
 The kangaroo can log the same distance during twice as much time as the elephant. true false  
 The elephant can log half of the distance as the kangaroo during a given period of time. true false

With which tool can you present the functioning of the enlsted body parts?  
 Pull the expressions onto the appropriate objects!

mouthpart of butterflies tentacle of butterflies leg of tree-frog mouthpart of bugs beak of ducks and teals

Which animal sound can you hear? Click on the picture of the right animal.

Class 4.c is on a trip. Their accommodation is in the village down in the valley. On Tuesday they will start from here to the tourist house near the peak.

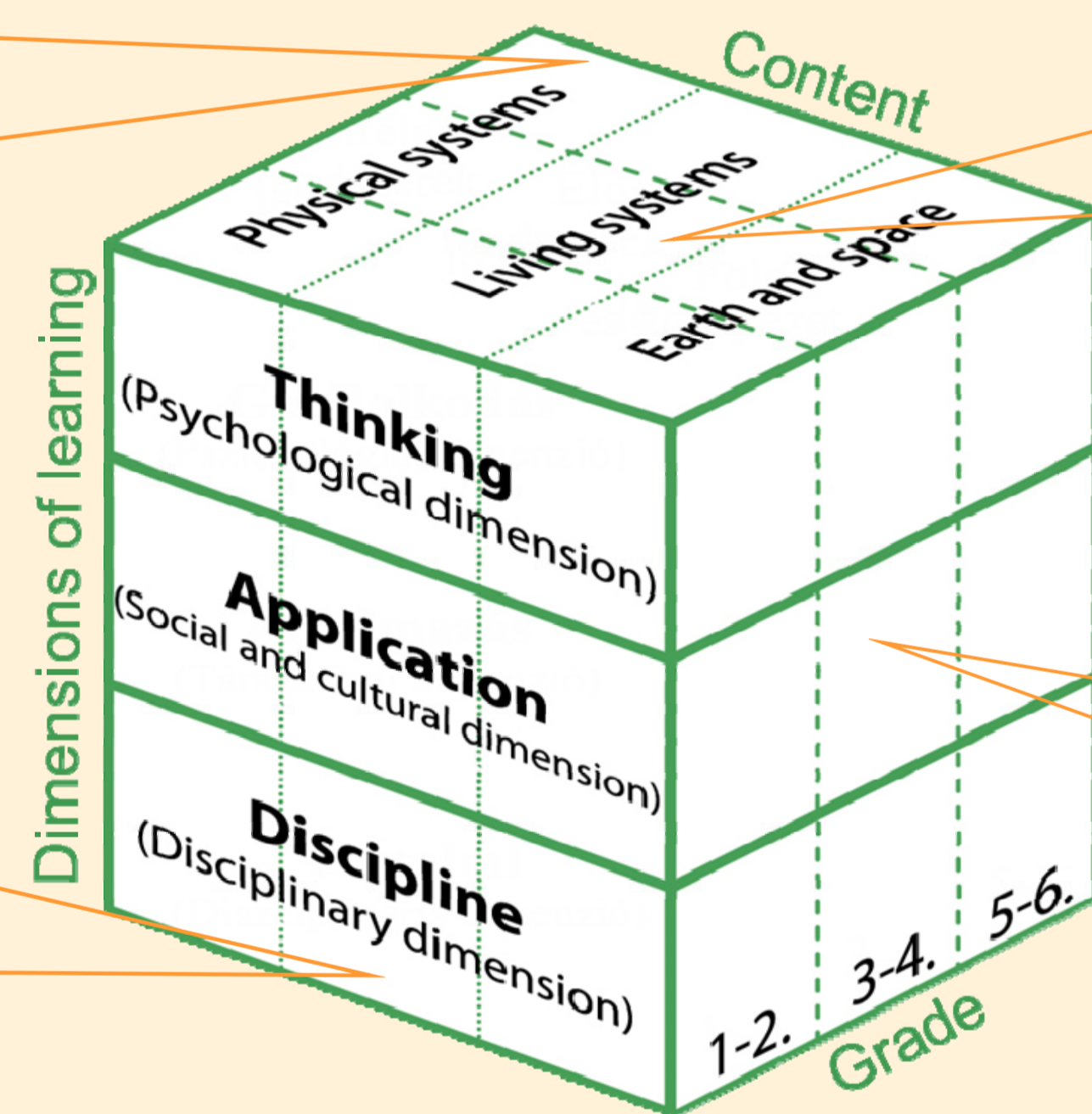
1550 m

What is the temperature in the village? °C

How much is the fall between the two places? m

150 m

What was the temperature at the tourist house if the temperature decreases 1°C n every 200 metres? °C



## Sample tasks to assess IBL skills

At a school lesson the students studied the ancient Greek ships. In order to decide in which direction the ship goes faster they carried out an experiment. They made scale-models of the ships and they put them into a canal filled with water.

**Before the experiment:**

- onto the scale-modell they tied a weight hanging on a string that pulled the ships with the same constant force;
- they set the same plimsoll line with putting weights into the ships...

**Setting up the experiment system:**

**During the experiment:**

- the students drifted the ships first in one direction, then in the other;
- in both cases they measured the time during which the ships floated along the canal.

What roles did the following factors have in the experiment? Pull the factors (variables) into the appropriate set!

direction of the ship pulling weight passing time pressing weight

**fixed variable** (During the experiment its value does not change.)  
**independent variable** (During the experiments its value was changed freely.)  
**dependent variable** (Its value depended on the setting of the independent variable.)

In an experiment the researchers examined the breathing of yeast fungi. They set up a test tube experiment of four kinds using distilled water, sugar and dried yeast. The detection of the developing carbon-dioxide took place with the help of an indicator.

Set up the four experimental systems in such a way that you can prove: the developing carbon-dioxide is the result of breathing of the yeast fungi!

Move the names of the materials under the test tubes! You may use one material more than once.

distilled water sugar dried yeast indicator

The thickening of tree trunks is not even, it follows the changes of the seasons. In spring the growth is faster, while in winter it stops growing. The yearly growth can be seen in the form of reeds in the cross-section of the tree. The reeds are thicker in wetter years and thinner in drier years. Warmer weather urges, colder weather inhibits the thickening of the tree.

The tree on the chart produced its first reed in 1994.

Answer the questions on the basis of the reeds!  
 Write the appropriate years!

Which year was the most wettest?  
 \_\_\_\_\_

Which year was the most driest from the last 3 years of the life of the tree?  
 \_\_\_\_\_

Which 3 year-period was the most driest? List the 3 years in the textbox separated by coma!  
 \_\_\_\_\_

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