Comeniusprojekt TEWISE

METHODS OF CHECKING STUDENTS' PERFORMANCES

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1 INTRODUCTION

When it comes to checking and assessing students' performances, this is mostly done by means of „conventional tests" or „revisions". These methods enable the examiner – from his point of view - to obtain a number of marks quickly and easily. The necessity of this form of checking students' performances is not to be questioned here.

However, checking students' performances should not only serve the purpose of obtaining a number of marks.

Making use of different examination methods offers advantages not only for students but also for teachers.
This means for example:

- less stressful ways of "checking knowledge"
- opportunities for self control and self assessment
- addressing and stimulating different skills of students
- securing and increasing knowledge obtained in lessons
- more fascinating classes due to a variety of methods
- learning from mistakes

2 METHODS AND THEIR APPLICATIONS

In order to provide a survey of the different methods and in order to be able to compare them with each other, it was important to find a framework. A structure that seemed fairly clear was found in the articles of the documentation entitled "New ways of written forms of student assessment in grammar schools in Vienna" and has therefore been adopted.

Every method has been described schematically as follows: procedure, instruction[1] for students, teacher's material and preparation time, variations, possible problems and a commentary page. Sample student texts for some methods and examples from books have been added in the appendix.

2.1 Everything depends on exact definitions and good explanations

What is being checked
The methods in this chapter enable pupils to revise and add depth to prior knowledge. In addition, they focus on the students' ability to express themselves. The teacher, on the other hand, can use this process to check a student's comprehension of concepts and expressions.

2.1.1 On the trail of a fact – a detective game

Expert knowledge and exact definitions are asked for. With the help of this method knowledge obtained in lessons can be revised and increased.

Procedure
In this activity the main aim is identifying a concept or procedure with the help of three more or less direct clues. The students are expected to be able to, firstly, formulate these clues or put them into words as precisely as possible.

The following rules are essential for the information given:

All information on the cards must be factually correct. It is, however, more difficult to keep to this guideline with fairly general statements than with more direct clues.

Clues should become more precise in the order of 1 to 3 (5), i.e. pupils should first describe more general characteristics then clearer and finally unmistakable features of the expression or process in question.

Instruction for pupils

- Choose three expressions from a given topic
- Find three (five) explanations for each term.
- These explanations for a term should become more precise in an order of 1 to 3. i.e.: first look for general features of an expression or process in question, then find clearer and finally unmistakable characteristics.
- Describe an expression or process from its own point of view*: "I am …, I see to it that …,* etc.
- Check your explanations again. If you think they are okay
- Write your definitions onto the empty cards. Use a separate card for each of the three expressions you chose!

Material/preparation
The only work the teacher has to do is find a set of expressions (in case the pupils aren't asked to find them themselves).

Variations

- Guessing in groups: Pupils read out their definitions. Pupils who guess should not only find the expression but should also take a good look at technical correctness and accuracy of description.

- Correction by a partner: Every pupil gets one expression from a certain topic and writes down three explanations on an A5 paper. Two pupils swap their cards and correct them with regard to technical correctness and structure. Then they agree on a joint definition. See appendix.

If you want other classes to use the cards as "playing-cards", empty playing cards can be used and the reverse side of the card can be designed by the pupils according to the topic.

Possible problems
Feedback from pupils shows that choosing different levels of difficulty takes a lot of time.

Comment
I use this method at all levels. Sometimes older pupils laugh at this "game" when they do it for the first time. However, they do feel challenged not later than when they correct the definitions. In my experience five definitions for one term are too many. Pupils find it particularly difficult to find definitions in different degrees of difficulty. Choosing the exact words has proved equally difficult.
Examples in the appendix.

2.1.2 Taboo

Taboo is a game in which players explain technical terms without mentioning them explicitly. Participants are supposed to guess these terms within a certain time.

Procedure

1. First each participant writes **one** technical term on **one** index-card. This can also be done in pairs or groups.

2. Underneath this term they write two more expressions which must not be mentioned in the explanation of the original term, they are taboo.

3. Now the game leader collects the cards and sorts out terms that come up twice.

4. Then the class is divided into two groups: A and B.

5. Now one pupil from group a (A1) and one from group B (B1) are seated at the teacher's desk.

6. A1 paraphrases the first terms. (Take turns after 1 minute) B1 makes sure taboo expressions are not mentioned.

7. gestures and sounds are not allowed.
8. The leader takes notes of the score on the board and interrupts the game after one minute.

9. Object of the game: Each group must guess as many terms as possible. for The group gets a point for each correct guess.

10. Now it is B1's turn to paraphrase and A1 keeps an eye on the taboo-words.

11. In the next round A2 and B2 continue.

12. The game is over when all terms have been guessed.

This game is particularly suitable as a revision exercise for a test after a certain unit as it forces pupils to differentiate precisely between various terms.

Variation
The teacher prepares the cards.

Material/preparation
Playing cards with the technical terms and the taboo words. On the one hand, less time in class is needed if the teacher prepares the cards, but on the other hand, preparation time is longer.

Comment
This is a game in which knowledge can be revised . Additionally, it stimulates participants' ability to express themselves.

2.2 Seeing connections

What is being checked
The following methods give an insight into whether pupils see connections and understand procedures.

2.2.1 A net of terms

Pupils are given cards with various terms related to a certain topic or process. They are supposed to arrange these cards in a way so as to create a meaningful relation between the terms.

Instruction for pupils
The aim is to match terms correctly

- Carefully study the terms on the cards.
- Put aside those terms that don't go with the topic in your view.
- Also put aside those terms that have something to do with the topic, but which you still cannot fit in.
- Arrange the remaining cards in an order that is meaningful to you. Put those expressions close together that you think are closely connected. Still, leave some space between them.
- Check the position of each card. Make changes where necessary.
- If you are satisfied with your order, fix the cards on the paper.
- Look at those cards again that you put aside in the first phase. Maybe they do fit in? Complete your map of terms.
- Draw lines between those terms that in your view are connected with each other. In many cases it makes sense to draw an arrow in order to mark the direction of the relation.
- On the lines, write down what sort of relation it is.

Variation
Additionally, pupils are supposed to find reasons why some cards don't fit into the net of terms.

Material/preparation
Little cards with the terms; envelope for the cards; depending on the number of cards: an A4 or A2 paper per pupil on which they can fix their cards; glue; (scissors if the cards have not yet been cut out) preparation work is made easier if the pupils are asked to cut out the cards themselves.

Possible problems
It takes some pupils a lot of time to cut out the cards. As small cards can easily get lost keep some in reserve. Takes quite some time.

Comment
I used this type of task for a Biology test.
Pupils should by no means simply write the terms on a sheet of paper and then fill in the connecting arrows! In order to try out different possibilities it is important to rearrange the terms.

2.2.2 Putting terms into order

Procedure
Key expressions of the subject-matter are written on cards and handed out to small groups. Now each group arranges the cards so as to link up the expressions with each other. By arranging the cards in a certain way pupils will find a topic.
Each group then, with the help of their arrangement, explains their result, that is the connection between the key expressions, to the other groups. In an exam or revision pupils can use their cards and thus organize the exam themselves.

Material/preparation
Cards with expressions taken from the topic.

Comment
With this method the teacher can check to what extent pupils see connections. In addition, pupils practise working in groups.

2.2.3 Theses-salad

Procedure
the teacher writes elements of theses on a worksheet. The pupils put together these pieces so that suitable theses are created. When completed, they are modified or discussed in a plenary session. Added information enables the pupils to check or prove the respective theses. Finally, the results are presented.

Variation
The elements of the theses are put together in groups .
Example in the appendix.

2.2.4 Disaster meeting

The pupils are confronted with a fictitious problem. In order to solve the problem they have to apply cross-curricular knowledge. This method can be applied for different science tasks at an advanced level.

What is being checked?
Applying knowledge

Procedure
Pupils are given a problem they can solve in groups. It can take them some lessons to complete the task. They might be allowed to use the internet or relevant literature.

Material/preparation
Preparation of the topics. Introduction of discussion rules.

Variation

- Pupils might be asked to prepare a panel discussion for citizens' action because of fictitious danger.
- Pupils might be asked to write a biased article for a pressure group that wants to manipulate an uninformed majority of people etc.

Possible problems
In large classes it is difficult to integrate all pupils in the disaster meeting. A panel discussion in which the audience can participate seems to be more suitable here. Disaster conference as well as panel discussion cannot do without a presenter.

Comment
The teacher can watch the groups, help, ask questions. He/she can assess the pupils' ability to solve a complex problem and apply cross-curricular knowledge by observing the discussions and seeing the results.

Examples in the appendix.

2.2.5 Revision cards

What is being checked?
Pupils' understanding of a certain subject-matter and their ability to integrate it into a network.

Procedure
The teacher prepares and hands out cards with questions to small groups or pairs. It is also possible to have the questions on A4 paper which can then be cut up into strips by the pupils.
A pupil picks a card and puts the question on the card to somebody in the group. Thus pupils test each other's knowledge by asking questions. Not learning by heart but understanding and connecting knowledge is the main object of this method.

Material/preparation
The teacher forms questions and writes them on cards or A4 paper.

Variation
Each group hands in written answers.

Comment
The pupils are not so much focussed on technical terms. Depending on the questions this method can include the children's environment.
Example in the appendix.

2.3 Working with questions

2.3.1 Bio? Logical! Checking knowledge without arousing fear

Basically, we ought to proceed on the assumption that competing with others is not something negative but positive. This principle ought to be valid also as regards school and can be reached if checking learner performance is not connected with fear. This method is particularly suitable for younger learners.

What is being checked?
Learners' current knowledge of a topic

Procedure
Without previous announcement pupils are asked to number ten lines on a sheet of paper from 1 to 10. The teacher asks questions which can be answered by a single word or a number. Pupils write down their answers and then swap their answer sheets. (possibilities: swap with your neighbour, with somebody from another row.) To enable pupils to check and correct the answers the teacher reads out the questions again. Volunteers answer them orally in class. Questions and open points are answered and the pupils tick the correct answers. Then the answer sheets are given back.

Material/preparation
This method takes very little time and thus can be integrated into lessons without problems. The only materials needed are pencil and paper.

Comment
The aim of this written way of checking attainment by classmates is giving individual learners an objective critical view of their knowledge and performance and thus enabling them to act accordingly. There are nor marks. The names of the winners or those learners who have at least answered 8 questions correctly and have thus reached top positions

2.3.2 Assessing questions instead of correcting answers

For science lessons it is essential that learners can give precise answers when asked knowledge questions. At the same time a basic understanding for concepts of science is often neglected. A way of stimulating this understanding is organizing lessons, producing materials and developing ways of checking attainment that focus on the ability to ask "correct" questions.

What is being checked?
A basic understanding of scientific concepts.

Procedure
Possible procedure:

1. Lessons focus on a certain scientific concept (biological balance, biological cycles, … A good definition for the concept is found, written down and put up in class for everybody to see at this stage.
2. In the first phase the pupils work on questions with regard to this topic. Relevant questions are chosen.
3. In the second phase the concept is dealt with and discussed with the help of the questions. As a result, the learners are supposed to find answers. These answers need not necessarily be correct but should help comprehend the concept and problems related to it.
4. In the next phase the concept is being looked at again, summed up, and new questions are found.
5. Compiling the test: The teacher uses the questions found in the different phases to compile a test. The main aim in this test is not finding answers but finding out those questions that in their view are closely related to the concept.
   The teacher divides the questions into two categories:
   - questions closely related to the concept
   - questions not related to the concept

   Questions that don't fit into any of these two categories are sorted out. The teacher now chooses the same number of meaningful questions with regard to contents from each category (between 10 and 30 in total) and writes them on a sheet of paper.
6. Carrying out and marking the test: The test is marked according to the previous classification into the two categories. Learners get points for answers that correspond with the categories the teacher has established beforehand. Learners can take a look at the illustration that goes with their topic and use this information when evaluating the questions.

Instruction for pupils

1. Carefully study the concept. Reread it if you feel unsure at any point of the test.
2. To begin with, read through all the questions without evaluating them.
3. Read the list again and mark those 5 questions <+> that in your view most clearly and unmistakably relate to the concept. Consider each question carefully and put it in relation to the concept before marking it <+>.
4. Start again and now mark 5 more questions that in your view still relate clearly and unmistakably to the concept. Continue marking until you have marked a total of 15 questions <+>.
5. Finally mark the remaining 15 questions <->. These questions do not relate clearly and unmistakably to the concept in your view.

Material/preparation
Collecting or producing pictures, figures and diagrams that go with the concept; Collecting the questions, choosing the questions.

Variation
This method can be varied with regard to graphic and verbal details - text plus illustration, illustration with or without legend, text only – so that when evaluating the questions different achievements as regards memory or abstraction for example are required.

Possible problems
It is not always easy to choose and categorize questions. It can be helpful and more objective to ask colleagues for help.

Comment
This method of checking what pupils have learned requires that they have become acquainted with and practised asking “meaningful” questions in the scientific sense of the word and that they have learned to differentiate between more and less important questions for the idea of a concept. If this method is used the first time it can be advised to consider and discuss the evaluation together with the learners. Questions on the eco-system or biological balance for example do not directly relate to metabolism ‘(which does take place in some changed form at any rate). Questions on the flow of energy on the other hand directly refer to an understanding of how metabolism works. The question how plants absorb substances is not as important for the concept as the question what substances they absorb and emit.
Of course not all questions can be categorized with 100%certainty. It is therefore important that contestants are allowed to express and give arguments for the criteria they have chosen. The ensuing discussion on contents of a concept can possibly be a valuable result of a lesson. **Examples in the appendix.**

2.3.3 Working out a test on one’s own

Pupils can prove their knowledge by formulating and also answering test questions on a certain topic.

What is being checked?
Expert knowledge, whether they have understood certain topics.

Procedure
Learners independently formulate questions on a limited subject-matter. The questions ought to be of high quality and the wording ought to be correct as far as contents and language are concerned. For that purpose it ought to be clarified what high quality questions are. Questions that can be answered by yes, no, a number or a technical term are not high quality ones.

Variation 1
Pupils are given the chance to revise a certain topic at home.

In a lesson they formulate questions and answer them. The teacher collects the sheets. In the next lesson pupils get their sheets back and can now correct questions and answers. the corrections are made with a different colour pen. Both the formulations and the answers can be corrected.

Variation 2
The pupils are asked to write their test questions on two sheets . Sheet A contains questions on the topic they feel sure about, Whereas B contains questions on a topic they don't feel so sure about or they have problems with. In addition, variation 1 can be applied then.

Material/preparation
No preparation is necessary. However, correcting this work takes much more time than correcting a traditional test.

Traps/Possible problems
Pupils that have problems expressing themselves find this method difficult in the beginning.

Note/Comment
It is sometimes much more difficult to find correct questions on a topic than to answer test questions. It can be helpful to demand that the test should contain certain elements, like a sketch or a minimum number of independent questions for example. Many pupils favour this way of checking their knowledge. By posing the questions themselves they feel less under pressure.

2.3.4 Asking questions about a text

What is being checked
Text comprehension, the ability to pose questions.

Procedure
All pupils are given a text they have to read. On their own/in pairs/in groups they then formulate questions on the text. Pupils swap their questions and cross read and correct them.

Material/preparation
Choose an appropriate text and make photocopies.

Variation
Start a competition: The class is divided into two groups.
The following rules apply: A group is given a point, for every correct question, for every correct answer and for detecting mistakes in the questions. Points are withdrawn for the same questions.
The teacher writes down the score on the board. The group with the most points wins the competition.

Comment
As points are also given if groups detect mistakes, learners tend to be more attentive.

2.3.4 Wh-questions

Wh-questions are: Who? What? Why? When? How? With whom? What for?
Wh-questions offer a good opportunity to order and review a certain topic.

What is being checked
To what extent have the essentials of a certain subject-matter been understood.

Procedure
The students tackle a certain subject-matter by asking appropriate W-questions. These questions can be answered orally or in written form.

Material/Preparation
None

Comment
Helpful for children who have problems reproducing a certain learned topic.

2.3.6 AHA-questions

Procedure
Students collect open questions on a certain topic and put them into a box.
Somebody draws a questions, a pupil tries to answer it (with or without the help of the class or the teacher).
Thus all questions are worked through.

Material/Preparation
A shoe-box. Glue and brown paper for the variation.

Variation
Grouping questions. The questions drawn can first be sorted according to themes. they are glued to the paper and then answered.

Comment
The learners are given the possibility to answer open questions on a certain subject-matter without stress. The teacher gets an overview over what are problem areas within a certain subject matter.

2.4 Working with drawings

2.4.1 A fantasy animal

What is being checked
The ability to apply what has been learnt.

Procedure
Example: After a lesson on articulates pupils are asked to make the design for a fantasy-articulate.

- The animal must be drawn.
- Its habitat must be described. Its build and physiology must enable a stable population to habitat, supply of food and possible enemies or competitors.
- Reproduction and social behaviour are also taken into consideration.
- The animal is given a Latin and a German/English… name.
- A fictitious newspaper article about the discovery of a new species can be added.
- In the assessment, not only originality but also factual correctness in the description of organ systems play an important role. Changes that might be possible as far as evolution is concerned are not only allowed but also asked for.

This type of work can take up 4 lessons. The internet and relevant literature can be allowed as sources.

Material/Preparation
An internet connection, but it is not essential. if the teacher puts the result on the net, this also takes some time.

Variation
Pupils can be asked to produce either drawings or descriptions separately. This method is also suitable for advanced learners to describe new creatures. In that case physiology should be given more attention.

Instead of articulates any other organism can serve as model for the new creation. Bacteria or unicellular organisms are for example suitable for more advanced pupils.

Note/Comment
The teacher can watch the groups, assist, ask questions and by watchíng discussions and results assess the learners' ability to solve a complex problem.

The results can be published on the class-website. Pupils then feel their work is being appreciated.

2.4.2 Pictures in the mind

What is being checked
Have learners understood a certain topic or procedure

Procedure
The pupils are asked to draw a picture pertaining to a certain topic or complete a drawing given to them. It should be made clear to them that they are not expected to produce a perfect drawing. A certain time limit is set for the production or completion of the drawing. Afterwards the results can be ordered according to certain criteria, they can be exhibited in the classroom and be used as basis for further discussions in class.

Material/Preparation
All that is needed is paper or photocopies of the drawings.

Variation
The drawings can be produced before, during and after the lesson. Thus the pupils can see how their ideas have changed during the lesson.

Comment
According to Gropengiesser this attention towards changing ideas is the first step towards a more self-directed learning process.

2.4.3 Team drawings

The pupils are given a task they should first carry out alone but should then break into pairs and groups of 3 respectively.

What is being checked
The ability to apply what has been learned, the ability to optimize a product in a team.

Procedure
Example: Spiders. After a unit on spiders, pupils are faced with the task to draw a spider from memory. First neither the book nor help from a neighbour are allowed.

- The teacher explains that their drawing needn't be beautiful but that they should try to give a reconstruction of a spider in as much detail as possible. Additionally, the animal can be drawn from different angles.

- After 15-20 minutes 2 or 3 pupils respectively swap drawings. Now they try to optimize somebody else's work, but may undertake changes only with the "author's" consent. Not only are discussions allowed but even welcome.

- The animal can then be given names at will, also fantasy names are possible.

- While still looking at somebody else's drawings pupils are given criteria for the score. Among others, these criteria can be:

1 point for 8 legs, segmentation of legs, "claws", hair, pattern on the back, 6 or 8 eyes, chiliceres, pedipalpe (additional point if segmented) spider-teats, hair, head-chest-part – hind part , position of limbs, …

Those pupils who achieve more than 2/3 of all possible points are given extra points in addition to the participation points. Particularly good team work can also be emphasized.

- Finally pupils should use their books and copy a spider in as much detail as possible. Thus what has been learned is being secured.

Material/Preparation
Specialized books according to the topics.

Comment
The teacher can observe how pupils work in groups, can assist, ask questions and can assess students' knowledge by means of the drawings.

2.5 Games

2.5.1 Trimino – a puzzle

What is being checked
Expert knowledge

Procedure
Trimino is a puzzle that consists of 9 equilateral elements. An expression has been written on each of the three sides. A picture or sketch has been glued to the back page of the puzzle. then all the triangles have to be cut out.

Instruction for pupils

a) Before you start, read through the instruction carefully and completely.

- Try to solve the puzzle. if you put the 9 small triangles together you will get a big one. All but the expressions on the borderline have a "partner" that goes with them. so, for example "tick" and "wood tick" should lie opposite of each other.

- Way of checking: Turn over the puzzle back to front with the help of a book. If you solved it correctly, you will see a picture.

- Turn the puzzle over again. If you solved it correctly, you can continue to do b). If there are mistakes, correct them first.

- Copy the2 expressions into you notebook.

b) Explaining the expressions

Explain all the expressions in complete sentences. Make sure you formulate what you say as clearly as possible.

Material/Preparation
You can draw the triangle yourself and fill in the expressions and terms by hand. However, copies produced with the Microsoft Publisher are nicer but take some effort. Individual expressions can be exchanged quickly as required.

The triminos should be made from different coloured paper. Otherwise it is almost impossible for the teacher to rearrange cards if they got mixed up. Keeping the individual puzzles in little bags fastened with a clip saves time and effort.

Variation
- Pupils can put together the picture without paying attention to pairs of terms. They still have to write the explanations.

- The children could also produce a trimino themselves at the end of a certain topic. The puzzles are then swapped and displayed.

Possible problems
Foliating the game prolongs the life-span of the individual parts of the puzzle but makes them rather slippery so that they are tricky to put together and turn over. The children have to be told exactly how to turn the trimino over before they put it together.

Comment
Trimino is excellent for open or self directed learning as putting the puzzle together is a welcome change to the written. **Examples in the appendix.**

2.5.2 Pupils produce a simple board game

What is being checked
Expert knowledge, ability to cooperate in a group.

Procedure
In groups pupils formulate questions as well as answers to a given topic. The rules are simple and can be applied in all subjects.

Instruction for pupils

1. Formulate questions on animals, health/environment and plants.

2. Write the questions on the outside of the cards (take blue cards for questions on animals, green cards for questions on plants and red cards for questions on health/environment). Write the appropriate answer on the inside of the folded cards.

3. Mark the playing board with a lot of blue, green and red dots but only with a few yellow and black dots. The dots serve as the playing fields.

4. Swap your questions with another group.

5. Rules of the game:

   If, after throwing the dice, you reach a

   - Blue dot ⇨ pick a blue card
   - Red dot ⇨ pick a red card
   - Green dot ⇨ pick a green card

   If you can answer the question, continue throwing the dice until you don't know an answer.

   If you don't know an answer, it's the next player's turn.

   - White dot ⇨ take a short break
   - Black dot ⇨ back to the beginning

   You get a point for each round.

Material/Preparation
If learners produce the game themselves, little preparation is needed. Providing cartons (playing boards) and cards for the questions, coloured stickers (dots on the board), dice and pieces.

Possible problems
The teacher is hardly able to check all the questions and answers for correctness in one lesson.

Note/Comment
These games are excellent for Open Learning, when you have just finished with a topic or the end of term.

2.5.3 An advanced board game “BIO-Tour”

The idea of checking knowledge by means of a game can be well used in lessons or exam preparations respectively. When looking for questions and answers learners revise a certain subject matter. When formulating the questions and answers they practise using technical terminology to express biological connections. Pupils will see the importance of formulating questions precisely when they play the game at the latest.

BIO-TOUR is a board game for 2-6 players. The object is to be appointed “BIO-TOP” after answering different questions. For each correct answer every player gets fragments of a key with which they can hurry to the “BIOSAFE” where they can undergo a final test. The game contains various components which make the game more exciting: So, for example you can “attack” a competitor and steal fragments of their key or burden them with additional questions with the “BIOHAZARD”. Additionally, the “BIO-GENOM”, a chance element, can put the competitor out of action for one round.

What is being checked
Expert knowledge, using technical terminology to express things

Procedure

Preparation

1. Before starting to play the game: Pupils prepare about 15 cards with questions and answers per topic.

2. Additionally, a key has to be cut out from paper for each player in as many parts as there are topics.

3. On each part of the key the shortened version of one of the topics is written – e.g. «ev» for evolution.

4. Furthermore 13 small paper plates the size of the hatched playing fields are needed, on 12 of which the short form of a topic has to be written. In addition, one more piece, the “BIO-HAZARD”, is needed. There should be about the same number of plates with the same short form. The expression “BIO-GENOM” is written on the 13th little plate.

Starting the game

1. First every player chooses a playing piece and puts it on the “BIO-PORT” (start)
2. All small plates are put face down, randomly, on the grey spaces of the board.
3. The question cards are sorted according to topics and put on piles face down.
4. The piece “BIO-HAZARD” is put on the space marked “start”. The youngest player starts to roll the die.

How to play: The number of spots on the die indicates the number of spaces each player can move their playing piece in any direction. When “6” is thrown the player can roll the die again. If a space with a little plate is reached, a questions of the appropriate topic has to be answered. If the answer is wrong, the player remains in his old position and throws the die again in the next round. If the answer is correct, the playing piece is put on the space “BIOTHEK”. In the next round the player is automatically asked one more question on the same topic. If also this answer is correct, they get a fragment of their key with the appropriate short form of the topic. The game is then continued from the position of the “BIO-THEK”. If the answer is wrong, he is asked questions in the following rounds until a correct answer is given.

Special features: When a player reaches a space occupied by another piece, that piece can be “attacked”. he makes known which part of the key of the opponent he wants to capture. In order to start the attack the player has to answer a questions on this topic. The player who has been attacked can try to beat back by answering a question on the same topic. If the answer is correct, the fragment of the key can be kept, if it is wrong, it has to be handed over to the attacker.

Such an “attack” on a contestant is also possible with the special playing piece called “BIO-HAZARD”. The “BIO-HAZARD” can be activated as follows:

1. A “6” is thrown twice successively.
2. A player reaches the space with the “BIO-HAZARD”.
3. A player lands on the plate of a topic the key fragment of which he already owns. When answering one more question correctly, the player can use the “BIO-HAZARD”.

The player to activate the “BIO-HAZARD” sets it on a space that is occupied by another player. Now an “attack” is carried out according to the rules described above. If the “victim’s” answer is wrong, the fragment of the key must be returned.

When a player lands on a space with the plate entitled “BIO-GENOM”, he must answer a question on a topic chosen at random. If the answer is wrong, go back to “BIOPORT” and miss a turn. If the answer is correct, you can send another player back to the start.

End of the game: You can end the game by moving to “BIOSAFE” if the complete key has been collected. You are there asked one final question from each of the topics. In order to be entitled “BIOTOP” a certain agreed on number of questions has to be answered correctly. If not successful, leave the “BIO.SAFE” and continue playing in the next round.

Material/Preparation
Large amount of time needed.
Example in the appendix.

2.6 Miscellaneous

2.6.1 Hold a one- or two-minute talk

What is being checked
Here, pupils have to talk about a certain topic in small groups. Knowledge is relevant, but not the most important thing.

Procedure

- On their own,/in pairs/in groups pupils formulate any number of questions and write each question on a slip of paper. The questions are put into envelopes. The number of envelopes depends on the number of groups formed in the next lesson.

- In the next lesson, pupils get together in groups of four, each group is given an envelope with the questions. The questions are put on the table face down. One pupil picks a question and gives a talk on the topic for one or two minutes.

Rules: The audience must not interrupt, they take notes on open points and mistakes. After the “lecture” they give feedback, open points are discussed.
A “time keeper” makes sure the time is kept.

Material/Preparation
Slips of paper, envelopes

Possible problems
The level of noise can be quite high when questions are discussed in more groups at the same time. One pupil per group can be appointed the “noise monitor” and make sure that only one person speaks in the feedback session at a time. The teacher cannot correct all the mistakes.

Comment
Pupils that don’t feel like talking in big groups have no difficulties in talking in a small group. More pupils have a chance to speak. The teacher can take his time observing and listening in to individual pupils.

2.6.2 Making predictions in an exam

An experiment corresponding to the topic is prepared and introduced to the pupils. Before it is carried out, pupils are asked to predict the results.

Procedure

- An experiment is presented. special attention should be given to making the general requirements of the experiment clear.
- After setting up the experiment a screen is put in front of it.
- A transparency with the setup of the experiment is shown.
- Pupils are now asked to predict the expected observations on their worksheet and give reasons for their predictions.
- After about 15 minutes the screen is removed and the pupils write down what they actually observe. Then they critically compare their predictions with their observations.

Material/Preparation
Setup of experiment, transparency, worksheet.

Comment
This type of checking knowledge is very unusual and takes relatively long. Pupils are encouraged to write down their own ideas and find reasons for their choices.

2.6.3 Applying physical laws

What is being checked
To what extent can pupils with simple means apply the physical laws they have worked with theoretically.

Procedure
The pupils are assigned tasks that can be solved inside the school building.
Example: parallelogram of force
The physical principle is acquired theoretically by means of examples in the classroom.

- The pupils carry out movements imitating the longitude and the direction of two forces as instructed by the teacher. First they are told to go some steps into different directions from a common starting point. The goals are marked. Then a pupil starts walking from her partner's goal, repeating her steps and keeping to the original direction. The four points found in this way (starting point, goal 1, goal 2 and goal 3) equal the corner points of a parallelogram.
- The teacher draws a bird's eye view of the position of the points on the board.
- Then groups of 3 to four pupils are asked to "walk" their own parallelograms in the corridor or outside respectively and take a graphic note of their results.

Afterwards the results can be briefly presented in class.

More examples:

Distance-Time-diagrams: walking, measuring and keeping a record of the result. Afterwards the diagrams can be shown in Excel.

Showing distances in the solar system by positioning pupils: Pupils are "planets and the sun" and have to show distances according to real data at a reduced scale.

Material/Preparation
None

Possible problems
With lively classes it can be quite loud in the school building. The teacher doesn't see all the pupils.

Comment
Very popular with younger pupils.

2.6.4 Obligatory and voluntary exercises in (Maths) tests

Separating reproduction from creativity in tests and their assessment.
If tests are supposed to be a learning process for the pupils that offers opportunity to form new thoughts and connect ideas, it seems to make sense to separate these tasks from those that require mere reproduction of gained knowledge as prescribed in the Austrian "Leistungsbeurteilungsverordnung", the legal text on assessing stundents' performances. This is basically true for all subjects in which tests are written although naturally I confine myself to Mathematics as regards experience and realization.

Procedure
Every example is divided into part a) and b). a) can be interpreted as general things, b) as special things. Parts a) are restricted to familiar algorithms (routine examples, examples from school exercises with different numbers) cause no surprise for pupils as the subject matter has been made known to them beforehand. As regards parts b), pupils are required to think independently, to connect familiar structures, to be familiar with technical terms and the history of mathematics, to produce evidence, general problems [with form variables instead of concrete numbers] to produce their own examples or find new ways of solving a problem. If part b) is a calculation, it can be based on the results in part a). However, it can also start from the same objects or simply be in a thematic connection with part a).

Material/Preparation
About a week or so before a test pupils are given my old tests on a respective topic plus solutions (if possible and as long as they make sense). Thus they have examples of part a) they can practise and also get an idea of possible b)questions. In the remaining lessons before the test we then discuss at least some of these old b)-questions, which can serve as an eye-opener for many pupils. Preparation time for the teacher, when devising the test, amounts to the same as when they develop the examples. This includes developing a point system themselves instead of simply

picking one from a book. It takes me longer to assess tests with the help of a point system.

Criteria of assessment
In order to reach a **sufficient** mark pupils must have accomplished more than half of part a). In order to reach a **satisfactory** mark all the completely correct a) parts are necessary, whereby technical imperfections can be compensated for by elements from part b)[if elements from part b) are mathematically independent of, but more difficult than part a) it can compensate for part a)]. In order to reach a **good** mark all examples in a) and one example in b) have to be solved correctly (a technical mistake in part a) can be compensated for by an additional example in part b). In order too reach a **very good** mark all a) examples and all but one in b) have to be solved.

Variation
In rare cases (i.e. short calculations) an example can contain two a)-parts. In exceptional cases due to the subject matter b)-parts can be completely separate from a)-parts as independent examples. They are then put off till the end of the instruction (e.g. finding the second solution for oblique-angled triangles, in this case pupils also have to find out which triangles [part a)] offer a second solution. The requirements for a **Good** and a **Very good** have to be adjusted accordingly.

Possible problems
It is not always easy to find b)-parts that require the same amount of time. If they don't, there is no direct injustice for pupils as they are all given the same tasks and thus the same chances, but there can be an imbalance if a pupil proves to be very competent in an b)-part that takes longer and if he/she is less competent where a word or a term as an answer is enough.
It is disputed whether the b)-parts should be worded according to the age of the pupils in simple and clear language or whether understanding also technical language and complicated sentences can be an educational goal. It is also uncertain what might be the adequate mark for those pupils (these cases are rare but they do exist) who solve al the b)-parts without problems and more than completely but are not able to complete a single calculation without mistakes. There are jobs that require this type of personality but this is still not true for large parts of professional life even if they presently increase in number due to more and more calculator-assisted calculations.

Comment
This system seems to show pupils' strengths and weaknesses more clearly than a point system. Mathematically less gifted pupils can reach a Sufficient without stress, whereas more talented pupils can show their creativity and ability to connect what they have learned. Last but not least tests can represent a **learning process**. It also seems important that attainment and not mistakes are assessed.
Example in appendix.

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Other sources/personal contacts:

Holub P.; BG/BRG Mössingerstraße; 9020 Klagenfurt

Holub S. ; BRG Viktring; 9073 Viktring

Salomon G.; Universität Haifa, Israel;

Vohryzka M.; BRG Viktring; 9073 Viktring

Witschel E.; BRG Viktring; 9073 Viktring

4 APPENDIX

4.1. On the trail of a fact

Some examples on the topic “evolution”.

SELECTION

1. I belong to the factors of evolution.
2. I apply pressure and am sometimes unfair.
3. I can support, direct and divide.
4. A black sheep would fall a prey to me.
5. I choose advantageous phenotypes.

ANALOGY

1. I can supply decisive information even for an ecologist.
2. I am not bothered about the relationship between creatures.
3. I am traced back to environmental conditions.
4. I can explain, for example, why homogeneous forms of the body appear on different continents.
5. I am based on convergent development.

GENE-POOL

1. Hardy and Weinberg took great interest in me.
2. I am a pool for dispositions.
3. If I am changed this is a small evolutionary step.
4. My being divided up is called separation.
5. I am the whole of all genes of a population.

COEVOLUTION

1. I value the principle of cooperation.
2. Some kinds of orchids can tell you a thing or two about me.
3. I weld together different kinds of creatures.
4. If it weren’t for me, insects wouldn’t pollinate blossoms.
5. I cause a together- and towards-development of two kinds.

4.2. Theses-salad

Example: globalisation

jumbled words and phrases

Possible result:
globalisation -----increases----- the amount of international trade -------- decreases ---- the power-----of national states, poor countries -------are excluded from ---- the process of globalisation ----everything ----can ---- be produced ----- and ----- sold ------everywhere at any time.

4.3. Disaster meeting

Instruction according to a suggestion to Prof. Dr. Gavriel Salomon:

An airplane has lost radioactive freight above a nearby lake. The pupils are asked to take the roles of the local government and find out the following things:

- How big is the real danger?
- What can be communicated to the public?
- How can the freight be located and if necessary recovered?
- What safety precautions must be taken into consideration?
- What problems dependent on physics could arise when recovering the fright?
- What experts should be consulted?
- What damages could occur in nature?
- How can the recovery team be protected?
- Where could information about support while planning the recovery be found?
- etc

4.4. Revision cards

What is most important about this topic?
Try to find a heading and some sub-headings.
What could a graphic survey look like?
From the topic, name two terms that belong together.
Does this topic appear somewhere in everyday life?
Try to describe the topic in two or three sentences.
What if this thing or topic didn't exist?
What should everybody know about this topic?
Who is this knowledge particularly important for?
What would you like to ask somebody about this topic?
What is it that touches you about the topic?
What could be seen in a film about this topic?
What could be the title of a book or film about this topic?
What easy exam question would you put on this topic?
What would be a difficult exam question on this topic?
What about your knowledge do you feel unsure about?
What about this topic are you an expert in?
What would you explain about it to a child under 10 years of age?

4.5. Pupils work out a test on their own

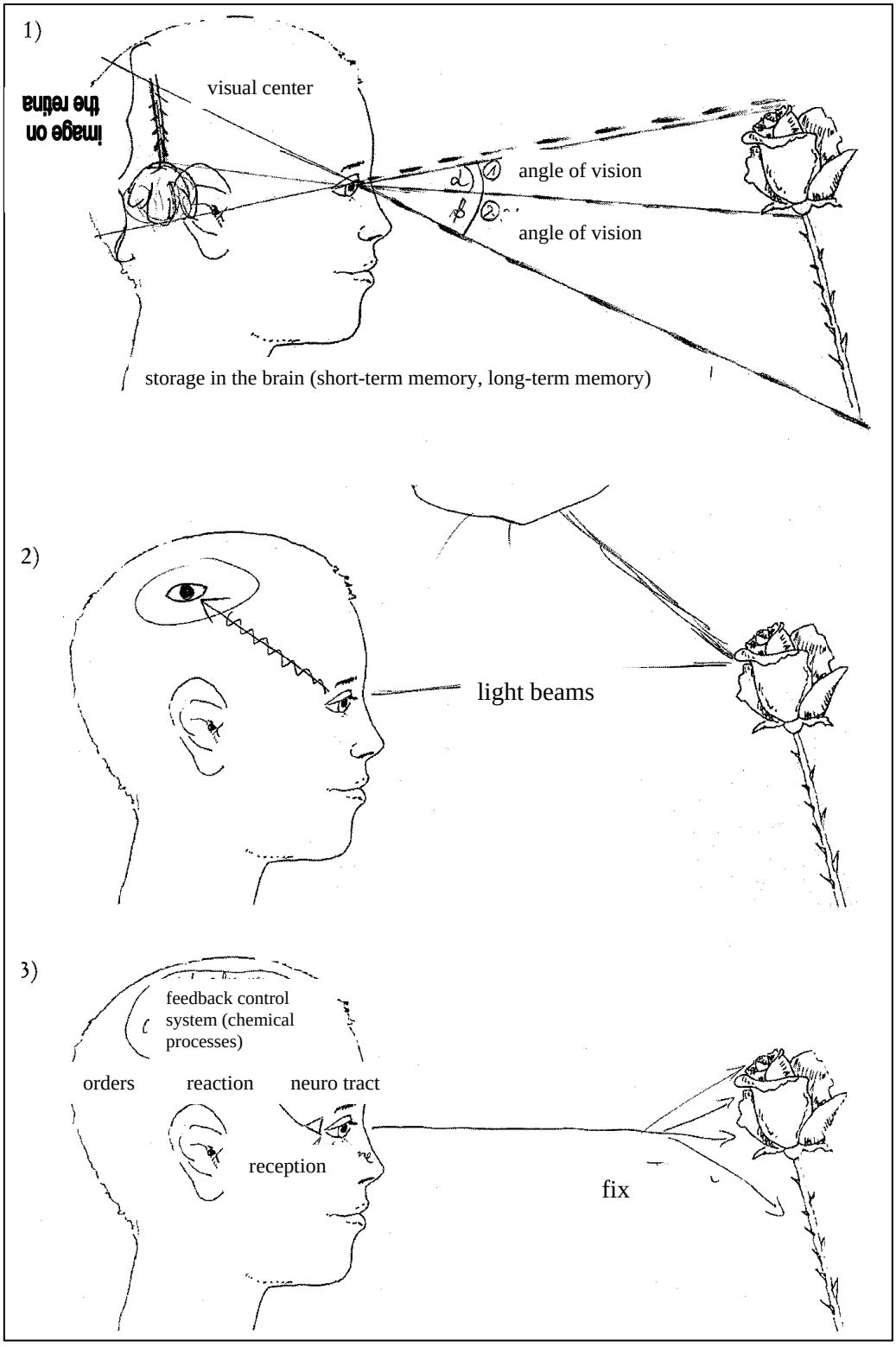
Possible scoring system:

- quality/degree of difficulty of the question: maximum 5 point per question

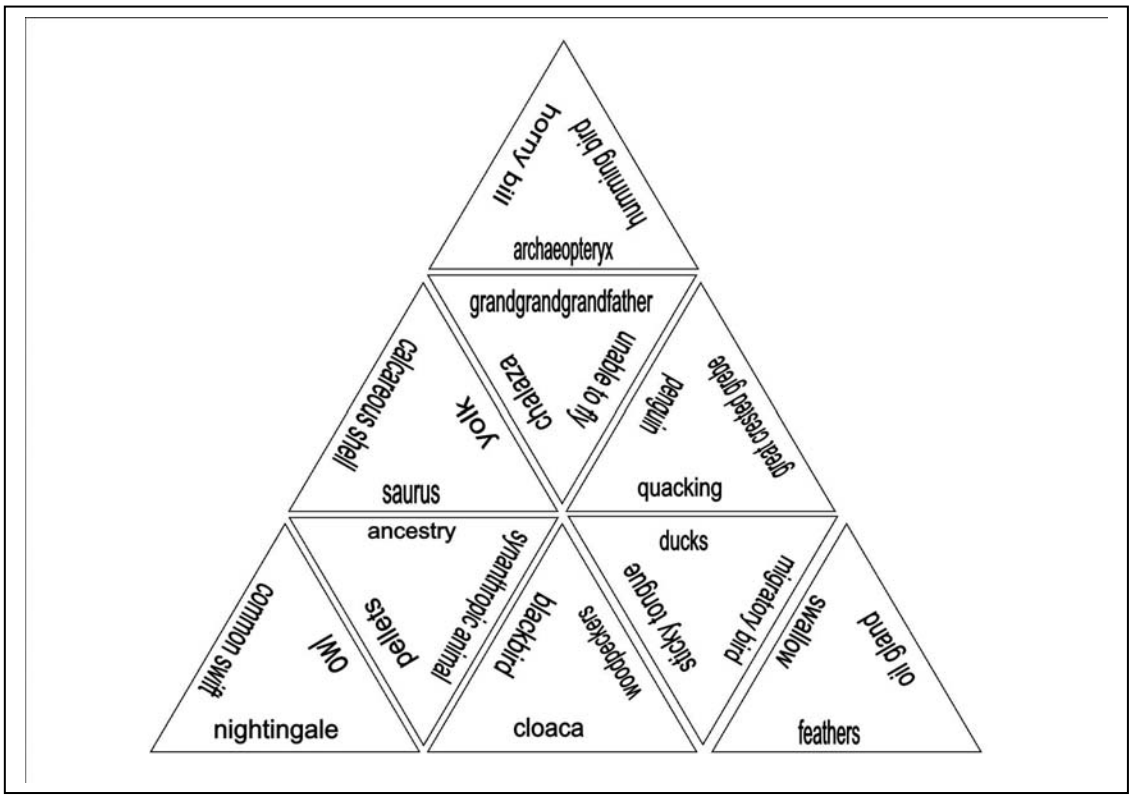
- factually and linguistically correct formulation: maximum 5 points per question

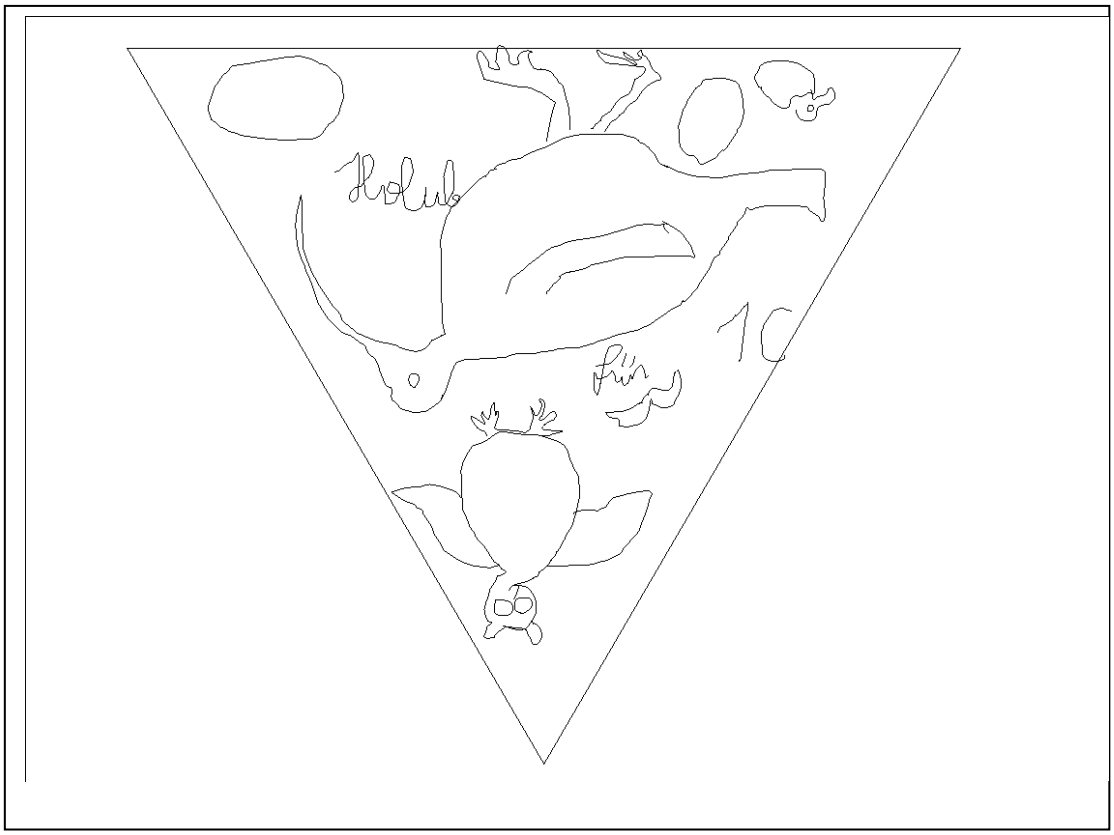
answering the questions: maximum 5 points per question

1.1. Pictures in the mind

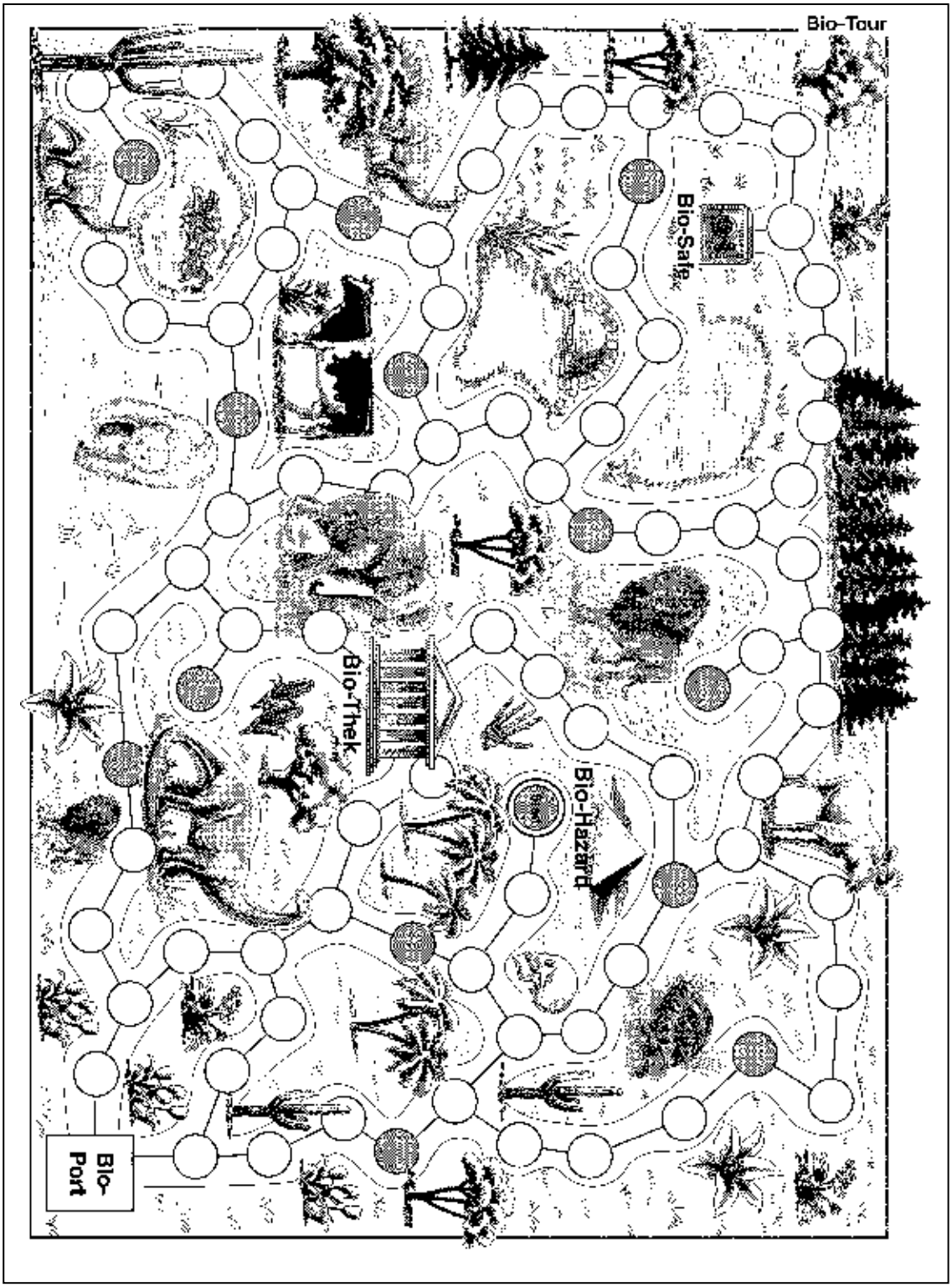


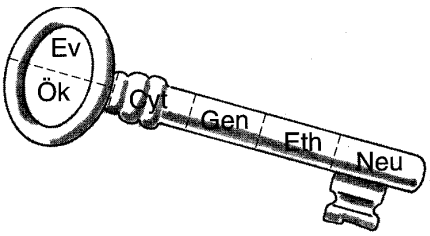
4.7 Trimino

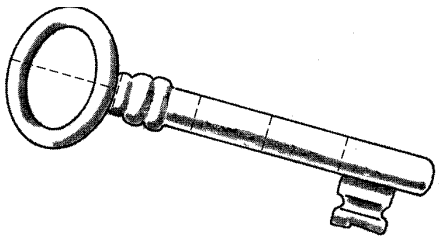

humming bird
horny bill
archaeopteryx
grandgrandgrandfather
calcareous shell
yolk
chalaza
unable to fly
penguin
great cresled grebe
saurus
quacking
ancestry
ducks
common swift
owl
pellets
synanthropic animal
blackbird
woodpeckers
sticky tongue
migratory bird
swallow
oil gland
nightingale
cloaca
feathers



4.8. Board game: Biotour







4.9. Making predictions in an exam

Arranging the experiment: two foliage leaves, e.g. lilac, are fastened on the ends of two drinking straws that have been stuck together with a thread. The bottom side of one leaf is thinly coated with Vaseline. With the help of a third thread the drinking straw is then fastened to a stand. After these "scales" have been brought to a balance, a screen is placed in front of it.

worksheet:

„Leafy scales"

Prediction of observation:

- ☐ the leaf with the thin coat of vaseline on its bottom side is going to sink
- ☐ the uncoated leaf is going to sink
- ☐ none is going to sink

Give reasons for your prediction:

Observation:

Critical comparison between prediction and actual observation:

Example 1
"The uncoated leaf is going to sink"

Reason: "The uncoated leaf can absorb $C0_2$ ⇨ photosynthesis is possible ⇨ $C0_2$ is bound materially ⇨ more weight. The coated leaf cannot absorb anything through its holes ⇨ no absorption of $C0_2$ ⇨ no weight is gained."

Observation: "The leaf with a thin coat of Vaseline is heavier after the experiment."

Critical comparison: "As the leaf has been pulled from the plant, no transport of water into the leaf takes place. As a result not enough water is available for photosynthesis. At the same time water evaporates."

Example 2
"The leaf with a thin coat of Vaseline on its bottom side is going to sink."

Reason: "By coating the bottom side with Vaseline the openings are closed. Water can probably not evaporate easily?! In the other leaf the existing water evaporates. that's why it becomes lighter."
Observation: The leaf with the Vaseline has sunk."

Evaluation:
The results are collected and evaluated by the teacher. The evaluation includes the prediction, but more emphasis is put on the reason and the formulation of the observation and particularly the critical comparison between prediction and actual observation.

In the following discussion a few facts were clarified:

- that Vaseline on the bottom side of the lilac leaf closes the existing openings,
- that gaseous substances are exchanged via these openings,
- that by far more water vapour is emitted than $C0_2$ is absorbed and this leads to a loss of mass within a very short time,
- that only the rising or sinking of one side of the scales can be observed but not an increase or loss of weight.

4.10. Assessing questions instead of correcting answers

Concept: In ecosystems substances involved in reconstruction and deconstruction processes continually circulate in a cycle. The energy needed for the impetus is continually supplied.
<+>: questions fit the concept; <–>: questions don't fit the concept

	Questions	
-	1	What form of energy is the cycle supplied with?
+	2	In how far do reconstruction and deconstruction processes depend on each other?
+	3	Is there a single cycle in an ecosystem?
+	4	Do all elements in an ecosystem circulate at the same speed?
+	5	What happens to the energy that has been supplied?
-	6	What size is the primary production in an ecosystem?
-	7	In how far is an ecosystem stable?
-	8	How can the amount of substances be measured?
+	9	What happens if no energy is absorbed?
-	10	How many substances circulate in an intact ecosystem?
+	11	Why can the cycle proceed consistently although constantly something is added (energy)?
+	12	Which substances are reconstructed, which are deconstructed?
+	13	Why can't plants exist on their own in an ecosystem?

-	14	Does the relationship between producer and consumer remain always the same in an ecosystem?
-	15	Which are the most important metabolisms in an ecosystem?
+	16	Is every life-form included in such metabolisms?
-	17	How do plants absorb minerals?
-	18	What cycles are there?
+	19	What can the metabolism be disturbed by?
-	20	How can the balance in an ecosystem be re-established?
+	21	What role do animals ((consumers) play in a metabolism?
+	22	Can the metabolism in an ecosystem be called a real cycle?
-	23	How does man influence metabolisms?
+	24	How does energy make substances circulate?
-	25	How is energy absorbed?
-	26	What factors influence an ecosystem?

4.11. Maths test: compulsory and voluntary exercises

5th form:

a) Determine the point of intersection of two lines represented in parameters.
b) Convert the equation of the lines into the normal form and then determine the point of intersection.
synthesis: modifying work plans

6th form:

a) A right-angled triangle. a = 5, α = 22,62°;work out b, c and β!
b) In a right-angled triangle the difference of the lengths of the sides amounts to 7, an acute triangle to 67,38°. Work out the length of the hypothenuse.

7th form:

a) Derive the derivative of the function $f(x) = x^2$ using the definition of the derivative!
b) Derive the derivative of the function g(x) = 1/1-x from the definition of the derivative!
synthesis: deducing new relationships

7th form:

a) Calculate the cubic function with the high point in the origin and the point of inflection W(1/-2)!
b) Deduce a formula for the elevation of the inflection tangent of a cubic function.
synthesis: constructing generalizations

7th form:

a) Solve the following equation about complex numbers by calculation, if 1 is known to be the solution: $x^3 .3x^2 + 4x .2 = 0$

b) Add, subtract, multiply and divide the unreal solutions with from with and by each other.

synthesis: rearranging isolated facts in a new way

8th form:

a) Calculate the volume of the feeding dish that is caused by the area rotating around the x-axis, limited by the graph.

b) Deduce the formula for the volume of a sphere, by understanding it as a solid of revolution!

matrix

Method	**What is being checked**	**Suitable for**		**Comment**	**Sources**
		Subject	**Year**		
Everything depends on exact definitions and good explanations					
On the trail of a fact detetcive game	Expert knowledge exact formulation	All	5-12	Pupils find this method difficlut	Högermann Ch.
Taboo		All	5-12	Knowledge is being revised; ability to express oneself is being stimulated	Andreas B., Gregersen P.
Seeing connections					
A net of terms	Understanding connections	All	5-12	Working with cards is essential	Behrendt/Häußler/Reger
Putting terms into order		All	5-12	Cooperation in groups can be trained here	Thanhoffer M.; Reichel R.; Rabenstein R.,
Theses-salad		All	9-12	-	Vohryzka M.
Disaster meeting	Applying knowledge, cross-curricular knowledge	All	9-12	A group discussion leader is advisable	Salomon G.
Revision cards	Understanding a certain subject matter and integrating it into a network	All	5-12	Can be carried out easily	Kiss A.

Method	What is being checked	Suitable for		Comment	Source
		Subject	Year		
Working with questions					
Bio? Logical! Checking knowledge without arousing fear	Current knowledge	All	5-12	Checking what has been learnt without arousing fear	Pinter W.;
Assessing questions instead of correcting answers	Basic understanding of scientific concepts	All	8-12	Asking „correct“ questions is in the foreground of all of this teaching phase	Kattmann U.
Working out a test on one’s own	Knowledge, posing questions	All	6-12	Pupils can show what they are good at	Holub S.
Asking questions about a text	Text comprehension, posing questions	All	5-12	Pupils correct each other	Witschel E.
Wh-questions	Approaching factual texts	All	5-12	Pupils present their knowledge	Rampillon U.
AHA-questions	Open questions/open points	All	5-12	Teacher gains insight into „problem areas“ of a certain subject-matter, relaxed way of revision	Kiss A.

Method	What is being checked	Suitable for		Comment	Source
		Subject	Year		
Working with drawings					
Fantasy animal	Ability to apply what has been learnt	Biology	5-12	Suitable for other subjects if modified accordingly	Holub P
Team drawings	Ability to apply what has been learnt, the ability to optimize a product in a team of 2 or 3	Biology, Physics, Chemistry, Geography	5-8	The teacher can observe, assist, ask questions and assess students' knowledge by means of the drawings	Holub P.
Pictures in the mind	Conceptions of a certain topic	Biology, Physics, Chemistry, Maths	5-12	Pupils can realize how a conception changes during a teaching unit	Gropengiesser H.
Games					
Trimino	Expert knowledge	All subjects	5-8	The puzzle can both be used as a method of checking knowledge and a game in open or self directed learning	Göser B., Stökler D.
Pupils produce a simple board game	Expert knowledge Ability to cooperate in a group	All subjects	5-8	The board game can both be used as a way of checking knowledge and as game in open or self directed learning	Göser B., Stökler D.
An advanced board game „Bio-Tour“	Expert knowledge	Biology	9-12	Revision of a certain subject-matter using technical terminology	Roschek U.

Method	What is being checked	Suitable for		Comment	Source
		Subject	Year		
Miscellaneous					
Hold a 1 or 2-minute talk	Knowledge of a limited subject matter	All	5-12	Suitable for students that hesitate to speak in front of large audiences, also serves as speaking exercise	Witschel E.
Making predictions in an exam	Applying knowledge that has been gained so far in order to understand a new situation (an experiment)	Biology, Physics, Chemistry	6-12	Takes long, but very interesting	Gropengiesser H.
Applying physical laws	To what extent can physical laws be applied with simple means	Physics	5-8	Very popular with younger pupils.	Holub P.
Obligatoray and voluntary exercises in Maths tests	Expert knowledge by reproducing and using creativity	Maths All subjects with written tests	9- 12	Mathematically less gifted pupils can reach a sufficient mark without stress, more talented pupils can show their creativity and ability to connect what they have learned.	Gröbner P.