ISSN 1648-3898

# PUPILS' MISCONCEPTIONS ABOUT MAMMALS

**Milan Kubiatko, Pavol Prokop**


**Abstract.** *A misconception about animals has been reported in various research reports on the pupils of all age groups. However, deeper study on the children's concepts about mammals has never been conducted. This study suggests the ideas about mammals put forward by the children aged from 10 to 15. A questionnaire with 35 multiple choice and open - ended questions were administered to 468 children from 6 elementary schools in Slovakia. The children's ideas were examined in five dimensions (animal classification and phylogeny; food; foraging strategies; parental care; senses, morphology and anatomy). Serious misconceptions about mammals across all age groups were found out. Our data provides direct implications for teaching biology.*

**Key words:** *age, animals, misconception, mammals, pupils*.

**Milan Kubiatko**
*Comenius University, Slovakia*
**Pavol Prokop**
*Trnava University, Slovakia*

## Introduction

Pupils construct their knowledge through interaction with the environment, and mostly based on an intuitive approach (Lazarowitz & Lieb, 2006). Biology education should provide pupils with knowledge and skills that help them to understand everyday life in nature. The importance of biology education currently increases either due to the strong impact of modern technologies on everyday life of all people (Lappan, 2000) or due to the increase of environmental problems that negatively influence people lives. However, children's understanding of several important biological topics often differs from those of scientists. These differences in children's concepts are well known as misconceptions (see Fisher, 1985). The misconceptions are pervasive and resistant to change through conventional teaching approaches (Trowbridge & Mintzes, 1985). Several research reports show that the distribution of misconceptions is not restricted to the young children but even to the students in high schools and colleges (Ryman, 1974a, 1974b; Trowbridge, Mintzes, 1985, 1988; Chen, Huang, Wang 1994; Lazarowitz & Lieb, 2006). For example, Chen and Ku (1998) were interested in aboriginal children's conceptions of animals and animal classification. They found out that aboriginal children assigned the concepts like 'move, eat, and attack' to animals. The typical examples of animals

for aboriginal children were lions, tigers and elephants. Similar findings were provided by Huang (1996) who asserted that movement is a typical characteristic of an animal. Chen and Ku (1998) and Tema (1989) found that children had anthropocentric feelings. The children have made comparisons such as 'unlike human', 'can not talk', 'very cute' etc. with humans. Research on children's concepts about animal classification showed that pupils of all ages including biology major college students often classified crawfish as a vertebrate (Trowbridge and Mintzes, 1988) or thought that penguin was a mammal (Kellert, 1985; Trowbridge and Mintzes, 1985, 1988; Braund, 1991; Prokop, Kubiatko, & Fancovicova, accepted manuscript) perhaps because it lived in the sea like large marine mammals (Trowbridge & Mintzes, 1988; Kattman, 2001). Turtles and reptiles are typically misclassified as amphibians (Yen et al., 2004) or invertebrates (Braund, 1998).

The alternative conceptions about animals were typically measured by such simple tasks as 'circle the animals that have a backbone…' (e.g. Trowbridge & Mintzes, 1988). However, current research of Prokop, Kubiatko & Fancovicova (accepted manuscript) found that using multiple questions on the same animal could show contradictory results. They asked children aged from 7/8 to 14/15 to make a circle about various animals and found that about 40 % of all children incorrectly classified a penguin as non-bird species. However, follow up questions revealed that 56% of the children thought that a penguin does not lay eggs but bears chicks as mammals do. Moreover, the majority (75 %) of the children thought that penguin's body was covered with hair or uncovered skin. The data indicates that misconceptions could be largely camouflaged by the definitions children are taught at school and a simple question can hardly uncover children's concept about an animal. Thus, a series of additional questions (Ozay & Oztas, 2003) or interviews (Braund, 1998) could lead to different in-depth results. Moreover, no systematic research on children's ideas about mammals has been conducted yet.

Biology as a school subject is tought separately from chemistry and physics in Slovakia. The biology curricula are the same in all schools: fifth-formers are taught botany, sixth-formers - zoology, seventh-formers - human biology, eighth-formers – geology. The courses on palaeontology and biology are mixed and mostly focus on ecology in form 9. Thus, Slovakian pupils should have a broad knowledge of morphology and systematic and habitat use of common animals including both vertebrates and invertebrates after leaving form 6 (age 11/12).

The aim of our study was to find out: 1) What are the pupils' misconceptions about mammals in elementary school? 2) How the misconceptions about mammals change from form 5 to form 9?

**Methodology of Research**

The questionnaire about the children's concepts of mammals consists of 35 open - ended and multiple choice questions. The multiple choice questions included 2, 3, 4 or 5 possibilities, but only one choice was correct. The questionnaire was submitted to a panel of experts in zoology (two professors of zoology from different universities) and two biology teachers in order to maintain validity of the questionnaire. All the questions criticized were improved or excluded from the final version. The questions were subdivided in five categories: 1. Animal classification and phylogeny; 2. Food; 3. Foraging strategies; 4. Parental care; 5. Senses, morphology and anatomy. We coded every answer correct (1) or incorrect (0) or examined and grouped all the answers from the open-ended questions. At the end of the questionnaire, the children were asked for basic information such as sex, age and form.

The questionnaires were administered to six typical elementary schools in Slovakia. The questions were answered by the pupils from forms 5 (n = 83), 6 (n = 86), 7 (n = 112), 8 (n = 86) and 9 (n = 101). 468 completed questionnaires were received. The age of pupils varied from 10 to 15. The number of boys (n = 229) and girls (n = 239) was similar.

We used the Pearson Chi - square ($\chi^2$) statistics to evaluate the distribution of pupils'

responses. This test is based on measure of real differences between real frequencies in the contingent table and the expected frequencies. The age - related differences were also calculated using the Pearson Chi-square test ($\chi^2$). The Chi-square analysis may report relatively small percentage differences as being statistically significant, although such differences may not necessarily be educationally significant or of practical importance. Therefore, we decided to calculate age-related trends following Skamp, Boyes and Stanisstreet (2004). If the Chi-square value was statistically significant ($p < 0.05$), if the direction of the trend was consistent (ether increasing or decreasing), and if there were at least three percentage points between each of the eight grade levels, the data would be described as showing an age-related trend. If the Chi-square value was not statistically significant or if the direction of the trend was inconsistent (for example, increasing then decreasing) then the data would be described as not showing an age related trend.

On the measure of reliability of the questionnaire, Cronbach's alpha calculation was used. The values of Cronbach's alpha close around 0.7 or higher generally indicate that results are consistent (Nunnaly, 1978). The statistic characteristics n - number of cases, X – average and SD - standard deviation were used in the text.

**Results of Research**

Based on the distribution of correct and incorrect responses, we found out that the maximum number of points acquired from the questionnaire was 34 (i.e. highest success) and the minimum was 8 (i.e. lowest success). The total average score was X = 22.84 and SD = 4.22. The value of Cronbach's alpha was 0.67. This indicates that the questionnaire is marginally reaching an appropriate reliability. The Cronbach's alpha of Trowbridge and Mintzes's (1988) research instrument was found to be 0.5 which suggests that our questionnaire have satisfactory reliability.

The descriptive statistic for the mean success that pupils acquired from the questionnaire is shown in Table 1.

**Table 1. Basic statistic of questionnaire categories.**

| Category | Number of questions | N | X | SD |
|---|---|---|---|---|
| Animal classification and phylogeny | 7 | 468 | 4.2 | 1.51 |
| Food | 9 | 468 | 6.46 | 1.45 |
| Foraging strategies | 3 | 468 | 2.01 | 0.77 |
| Parental care | 4 | 468 | 2.49 | 1.01 |
| Senses, morphology and anatomy | 10 | 468 | 6.61 | 1.44 |

The highest mean score was found for the Food and Senses, morphology and anatomy categories. In contrast, the behavioural categories like Foraging strategies and Parental care of mammals were relatively less understood.

We found a statistically significant effect of age on the mean score from categories Animal classification and phylogeny, Food and Parental care. More details are shown in Table 2. As shown in Figure 1, the mean score obtained per each category was relatively stable and failed to show great differences between several age groups. The categories in which the relationship between age and the mean score reached statistical significance (see above) also showed a very slight increase in the mean score as the pupils' age increases. Moreover, the oldest pupils showed a mostly decreasing trend in the mean score relatively to the younger learners.

ISSN 1648–3898

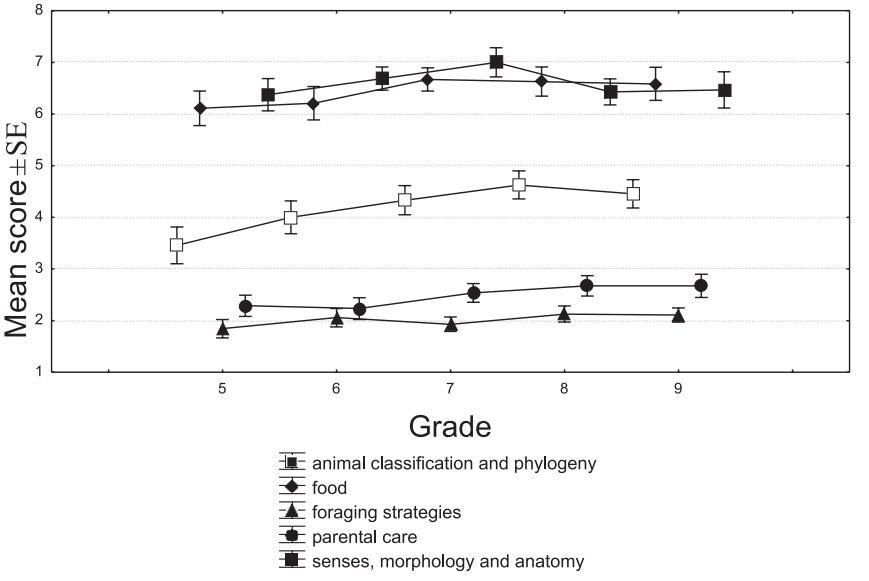


**Figure 1. The average number of points obtained by the students for individual categories.**

**Table 2. The values of Pearson Chi-square ($\chi^2$) between age and answers success.**

| Category | Pearson chi - square | p |
|---|---|---|
| Animal classification and phylogeny | 68.2* | 0.00066 |
| Food | 61.09* | 0.01750 |
| Foraging strategies | 15.5 | 0.41578 |
| Parental care | 42.84* | 0.00215 |
| Senses, morphology and anatomy | 57.42 | 0.10143 |

* $p < 0.05$

*Animal classification and phylogeny*

The majority of the children incorrectly thought that dinosaurs were closely related to mammoths (51 %) and whales (8 %) rather than birds (41 %). The mean success of the pupils from each grade on this item is shown in Figure 2.

Most of the children were correct (91.8 %) that whales did not lay eggs although relative fewer children knew the same about bats (77.3 %). Also, 64.3 % of the children correctly knew that the platypus lays eggs. The platypus was most frequently misclassified with birds (30.5 %), but the majority of answers were correct (56.2 %). 337 children in total (72 %) were right that the whale is a mammal and 156 children (33.3 %) incorrectly thought that the penguin was a mammal. A doe was 200 times misclassified with a roe-deer.

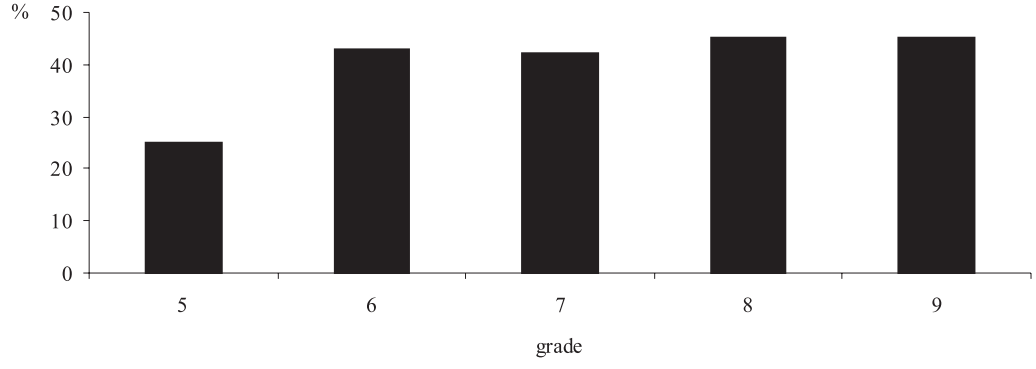


**Figure 2. The percentage of the pupils correctly thinking that a dinosaur is phylogenetically relative to birds rather than a mammoth or whale.**

*Food*

The majority of the children (80 %) knew that food of the young dinosaurs was eating plants. The similar question was about the young whales but only 52.4 % of the respondents knew that they suck milk. The others marked that food of the young whales is plankton. Also, 82 % of children knew that a hedgehog feeds on insects and earthworms, and only 17 % of children showed food of the hedgehog as fruit and vegetable. The rest of the children thought that the hedgehog feeds on garbage. The majority of the children (78 %) wrote an incorrect answer for the food of a wild swine. These children wrote that the wild swine is a phytophagous animal. The relative success of individual grades on this question is provided in Figure 3.

Most of the answers for the food of an elephant were correct that the elephant is a phytophagous animal (66.5 %). Other children showed that elephants are omnivorous animals. A similar proportion of correct answers was found in the case of food of bats (69.2 %). The most frequent misconception was blood as a food of bats which was shown by 30 % of the children. Also, the majority of the children knew why the beaver gnaws trees (90 %). The reason is teeth's corrosion, building of barriers and trees are source of food for the beaver. A similar amount of children knew that the wolf is a carnivore (91 %). Over 90 % children knew that the squirrel makes supplies of food for winter.

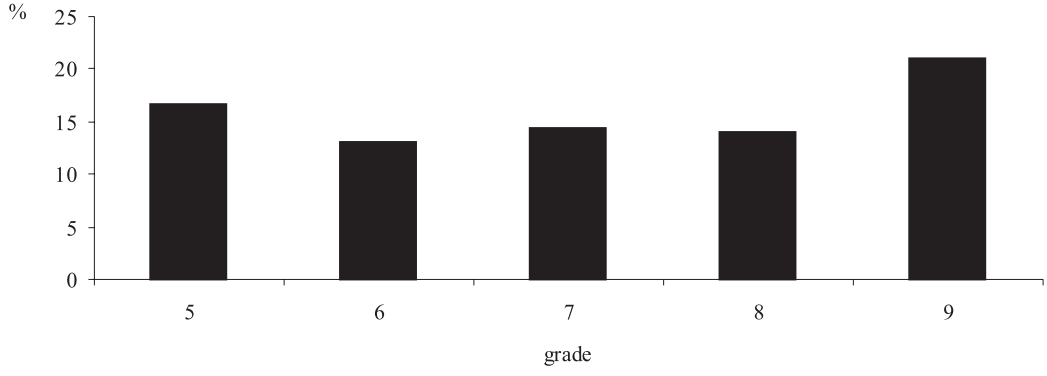


**Figure 3. The percentage of the pupils that correctly knew that a wild swine is a omnivorous animal.**

ISSN 1648–3898

*Foraging strategies*

The majority of the children (91 %) knew that the wolf hunts in groups. Other possibilities were: a fox, a bear and a lynx. The lynx was the most frequently marked for an animal, which hunts in groups (nearly 5 %) The most frequent misconception about foraging strategy of a lynx was that the lynx observes his prey from the shelter (31.4 %) but the majority of answers (i.e. that lynx hunts in groups) were correct (63.2 %). Only 47.4 % of the children correctly knew that lions usually hunt in groups. The most frequent misconception was that the lion observes the prey alone from the shelter (48.3 %). The rest of the pupils showed that lions hunt in pairs. The relative success of individual grades on this question is shown in Figure 4.

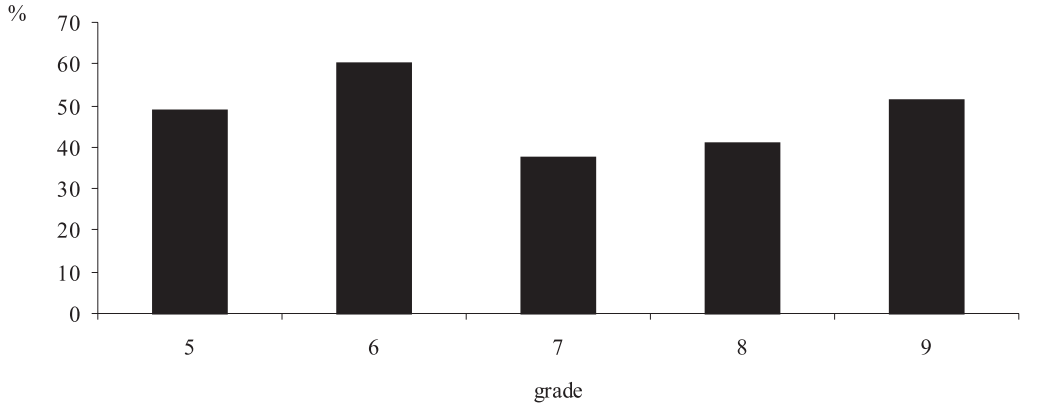


**Figure 4. The percentage of the pupils that correctly knew that the lion hunts in groups.**

*Parental care*

The majority of the children (65.4 %) knew that the squirrel raises its young in the nest in treetops. The other 31.2 % of the children incorrectly thought that squirrels" young do not need parental care. More than 41 % of the children were incorrect that both parents take care of the young deer but about half of the answers showed that the female takes care of the young deer which was the correct answer (55 %). The majority of the children knew that young wild swines are raised by the female (72 %). Less children were aware of biparental care in wolves (57 %), but instead thought that only the female wolf takes care of young wolves. The relative success of individual grades on this question is shown in figure 5.

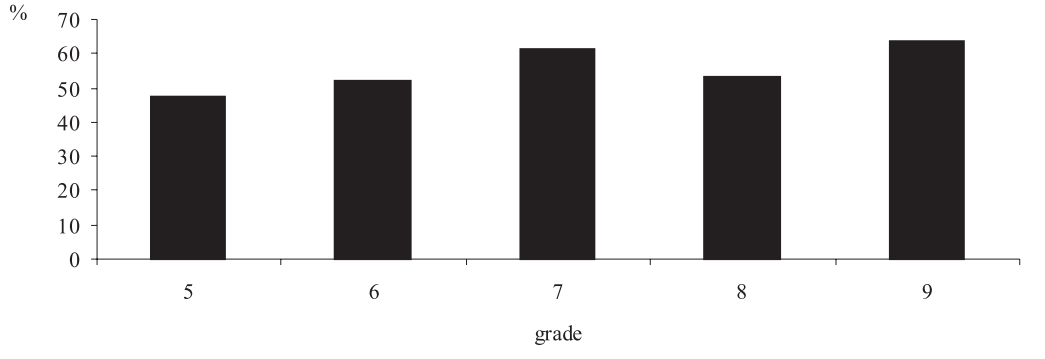


**Figure 5. The percentage successfulness of the pupils that correctly knew that young wolves are taken care by both parents.**

*Senses, morphology and anatomy*

The majority of the children (95 %) answered correctly that the spines of the hedgehog serve for protection against enemies. A similar amount of the children (98 %) knew that bats fly during the night. Only about half of the pupils were right that brown bears overwinter because of lack of food. The most frequent misconception for bears overwintering was cold and exhaustion. Nearly 84 % of the pupils knew that deers use antlers for fighting against rival males. A total of 150 children (32 %) marked an ear as the most developed sense of a mole, but the majority of the answers were correct (62.6 %) that the most developed sense is touch. Nearly 62 % of the children were not sure that a horse steps on the whole foot while walking. Other pupils answered correctly that the horse steps on the last phalanxes of his foot. Nearly 67 % of the pupils had misconceptions about dolphin's breathing. Only one third of the pupils knew that dolphins breathe with lungs. Nearly 25 % marked that dolphin breathes with branchias. The possibility that dolphins breathe by lung sacs was marked by 26.5 % of the children. The rest of the children wrote that dolphins breathe with air sacs.

The children had great misconceptions about the contents of camel's hump. Nearly 80 % answered that water is in the camel's hump. Only 20 % of the children answered correctly that the hump contains a fat. The relative success of individual grades on this question is shown in Figure 6.

More than 95 % of the children knew that the function of the kangaroo's pouch is carrying the young. Similarly, a high amount of children (86 %) was aware of the function of the rhino's horn, which serves for fighting.

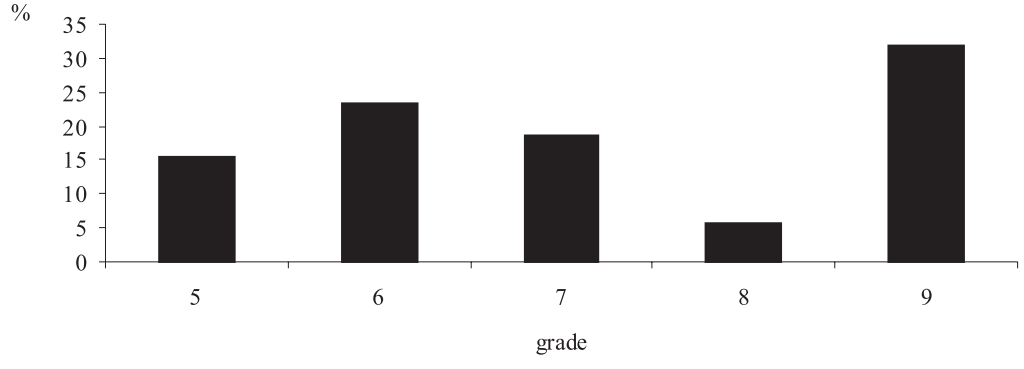


**Figure 6. The percentage of the pupils that correctly knew that the camel has the fat in her hump.**

**Discussion and conclusion**

This study showed that Slovakian elementary school pupils had serious problems with several common mammals with other animals (see Kellert, 1985; Trowbridge & Mintzes, 1985, 1988; Braund, 1991, 1998). Moreover, the follow up questions showed that although most of the pupils were aware that a whale is a mammal, they were less sure that whales suck milk or feed on plankton. These findings are in line with our current research focused on the children' concepts about birds (Prokop, Kubiatko & Fancovicova, acceptted manuscript) and support a necessity of using the multiple questions focused on the same topic rather than using a simple question. Moreover, these data have direct implications for biology practise and can be applied internationally.

Why are there the misconceptions about common mammals among the pupils of various ages? Several reasons can be applied here. First, it might be caused by the teachers that are more interested in 'modern' biology topics like microbiology, genetics or virology and zoology could be considered relative less interesting. This is, however, unlikely, because Slovakian biology teachers

consider zoology most interesting relative to biology of other grades (Prokop & Chuda, unpublished data). Another possibility is that the pupils are relatively less interested in biology of mammals. This possibility is also less likely, because our current research shows that Slovakian children greatly favour zoology relative to other biology topics (P. Prokop, G. Tuncer, & J. Chuda, unpublished manuscript), although the preference of mammals relative to other animals is less clear. Considering the fact that the pupils of various age groups are mostly keep mammals as pets (e.g. Kidd & Kidd, 1985; Prokop, Prokop, & Tunnicliffe, submitted manuscript) the misconceptions about mammals seem to be less likely linked with pupils' inadequate interest in animals.

A simple classification of animals following their habitat (Kattmann, 2001) may explain the pupils' difficulties with dolphin breathing or food of whales. These large mammals live in the sea like fishes that breathe with gills and feed on plankton. Thus, habitat of animals seems to be a more important criterion than taxonomy for school age pupils (Kattmann, 2001) and large mammals are simply considered to fishes (Natadze, 1963; Kellert, 1985; Trowbridge & Mintzes, 1988; Berthelsen, 1999). Another problem can be semantic similarity between some mammals and fishes. For example, a whale is 'velryba' which means 'big fish' in Slovak language. Similar problems are discussed in Trowbridge & Mintzes (1988) but they do not explain the problem with classifying dolphins or bats because their names are semantically totally dissimilar.

Another important issue that emerged from the pupils responses are culturally transferred myths about some animals. Especially in the case of bats pupils usually wrote that the food of bats is blood (it was not specified if human blood or blood of other animals) and they consider bats bad for other animals. Bat folklore goes back many centuries. Aesop, in several of his fables, personified bats as unscrupulous liars, manipulating other animals. In their art, the ancient Mayans of Central America heralded bats as gods of darkness and the underworld. In the 16th century, English poet John Heywood wrote that 'these creatures that fly like birds, bite like beasts, hide by day and see in the dark can surely be neither flesh, nor fowl'. The role of myths in the pupils' ideas about animals remains to be therefore seriously investigated.

The design of the natural science course based on the living organism concept in our elementary schools begins with the most abstract class of living organism, followed by the subclass concept of 'animal' and 'plant', and then the even lower class concept of 'mammal', 'bird', 'fish' and 'insect'. From the constructivistic perspective, learning is an active process, whereby learners take information from the environment and construct personal interpretations and meaning based on prior knowledge and experience (Fraser & Tobin, 1998). This implies that the mental conceptions of the younger children, yet little affected by formal school science learning, are highly influenced by the personal ideas and experiences they construct about the world. We conclude that teachers should teach more about such exotic mammals as the camel, rhinoceros, and the platypus and use as many examples as possible (Trowbridge & Mintzes, 1988). The first hand experiences with animals should enhance pupils' interest (Lindemann-Matthies, 2005; Žoldošova & Prokop, 2006) and factual knowledge about animals (Inagaki, 1990; Prokop, Prokop, & Tunnicliffe, submitted manuscript). We therefore propose that activities with animals through formal or informal learning have significant potential for improving pupils' knowledge about animals.

**References**

Animal search: is it a mammal? (2006). Available on the Internet at: http:// www.thelearningfederation.edu.au/ tlf2 /show Me.asp?nodeID=851 (06-10-2006).

Berthelsen, B. (1999). Students' naive conceptions in life sciences. *MSTA Journal*. Vol. 44, No. 1, pp. 13 – 19.

Billeh, V. Y. I. (1969). *Cultural bias in the attainment of concepts: the biological cell by elementary school children*. (Doctoral Dissertation, the University of Wisconsin). University Microfilms. Xerox Company, Ann Arbor, Michigan.

Braund, M. (1991). Children's ideas in classifying animals. *Journal of Biological Education.* Vol 25, No. 2, pp. 102 – 110.

Braund, M. (1996). Snakes can't have backbones - can they? *Primary Science Review.* Vol. 44, No. 1, pp. 20 – 22

Braund, M. (1998). Trends in children's concepts of vertebrate and invertebrate. *Journal of* of different cultural backgrounds. *Dissertation Abstracts*. Vol. 35, No. 8, 5146A.

Chen, S. H. (1983). A study on children's acquisition of scientific concepts: analysis of scientific concepts in revised elementary school natural science courses and the factors influencing their acquisition. *Hua Shih Journal*. Vol. 14, pp. 218-298.

Chen, S. H. (1987). A study of children's conceptual development concerning the human body. *Journal of National Hualien Teachers College*. Vol. 1, pp. 419-530.

Chen, P. F., Huang, S. J. & Wang, K. H. (1994). A study of preservice teachers' alternative concepts of animal classification. *Journal of Science Education*. Vol. 5, No. 1, pp. 75-94.

Chen, S. H.; Ku, C, H. (1998). Aboriginal children's alternative conceptions of animals and animal classification. *Proceedings of the National Science Council*. Vol. 8, No, 2, pp. 55 – 67.

Fraser, B. J., & Tobin K. (1998). *International Handbook of Science Education.* Dordrecht, The Netherlands: Kluwer.

Huang, D. S. (1996). A study of children's conceptions of life, animals and plants as well as their alternative conceptions. *Proceedings of the National Science Council Part D: Mathematics, Science and Technology Education.* Vol. 6, No. 1, pp. 39 – 46.

Inagaki, K. (1990). The effects of raising animals on children's biological knowledge. *British Journal of Developmental Psychology.* Vol. 8, No.1, pp. 119–129.

Kattmann, U. (2001). Aquatics, flyers, creepers and terrestrials – Students' conceptions of animal classification. *Journal of Biological Education.* Vol..35, No. 3, pp. 141-147.

Kellert, S. R. (1985). Attitudes toward animals: Age-related development among children.
*Journal of Environmental Education.* Vol. 16, No. 3, pp. 29–39.

Lappan, G. (2000). A vision of learning to teach for the 21st century. *School Science and Mathematics.* Vol. 100, No. 6, pp. 319–325.

Lindemann-Matthies, P. (2005). "Loveable" mammals and "lifeless" plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education.* Vol. 37, No. 6, pp. 655–677.

Myths and Misconceptions. (2006). Available on the Internet at: http://wildlife.state.co .us/Wildlife Species/Profiles / Mammals/BatsofColorado/Myths+and+Misconceptions.htm (06-10-2006)

Natadze, R. G. (1963). The mastery of scientific concepts in school. In B. Simon & J. Simon (Eds.), *Educational Psychology in the USSR*. London: Routledge & Kagan Pau

Nunnaly, J. (1978). *Psychometric theory.* New York: McGraw-Hill.

Özay, E., & Öztas, H. (2003). Secondary students' interpretations of photosynthesis and plant nutrition. *Journal of Biological Education.* Vol. 37, No. 2, pp. 68–70.

Prokop, P., Kubiatko, M., Fancovicova, J. Why do cocks crow? Children's concepts about birds. *Research in Science Education*. accepted for publication. DOI: 10.1007/s11165-006-9031-8

Prokop P, Prokop, M., Tunnicliffe, S. D. Effects of keeping animals as pets on children's concepts of vertebrates and invertebrates**.** *International Journal of Science Education.* submitted.

Ryman, D. (1974a). Children's understanding of the classification of living organisms. *Journal of Biological Education*. Vol. 8, pp. 140-144.

Ryman, D. (1974b). The relative effectiveness of teaching methods on pupils' understanding of the classification of living organisms at two levels of intelligence. *Journal of Biological Education*. Vol. 8, pp. 219-223.

Skamp, K., Boyes, E., & Stanisstreet, M. (2004). Students' ideas and attitudes about air quality. *Research in Science Education.* Vol. 34, No. 3*,* pp. 313–342.

Tema, B. O. (1989). Rural and urban African pupils' alternative conceptions of "animal". *Journal of Biological Education*. Vol. 23, No. 3, pp. 199-207.

Trowbridge, J. E. & Mintzes, J. J. (1985). Students' alternative conceptions of animals and animal classification. *School Science and Mathematics*. Vol. 85, No. 4, pp. 304-316.

Trowbridge, J. E. & Mintzes, J. J. (1988). Alternative conceptions in animal classification: A cross-age study. *Journal of Research in Science Teaching*. Vol.25, No. 7, pp. 547-571.

Yen, C. F., Yao, T. W., & Chiu, Y. C. (2004). Alternative conceptions in animal classification focusing on ampibians and reptiles: A cross-age study. *International Journal of Science and Mathematics Education.* Vol. 2, No. 2, pp. 159–174.

Lazarowitz, R. & Lieb, C. (2006). Formative assessment pre-test to identify college students prior knowledge, misconceptions and learning difficulties in biology. *International Journal of Science and Mathematical Education.* Vol. 4, No. 4, pp. 741 – 762.

Žoldošova, K., Prokop, P. (2006). Education in the field influences children's ideas and interest toward science. *Journal of Science Education and Technology*. Vol. 15, No. 3, pp. 304 – 313.

ISSN 1648–3898

**Резюме**

# НЕПРАВИЛЬНЫЕ ПРЕДСТАВЛЕНИЯ УЧАЩИХСЯ В ОТНОШЕНИИ МЛЕКОПИТАЮЩИХ

**Милан Кубятко, Павол Прокоп**

Статья посвящена выяснению отношений школьников к млекопитающим в процессе изучения курса «зоология» в школьном образовательном учреждении Словакии. Сама проблема идентификации человеком животных, особенно млекопитающих, актуальна, поскольку и сам человек относится к этому классу (сем. люди). Важно установить не только отношения учащихся к животным, но и понять, что лежит в их основе.

Был использован опросник составлен из 35 вопросов. В исследовании принимало участие 468 учеников (229 мальчиков и 239 девочек). Эмпирические данные были собраны из 6 школ разных городов Словакии. Было установлено, что ученики имеют ошибочное представление о классификации, экологии и анатомии млекопитающих. Мнения учеников были класифицированы на пять основных категорий (класификация млекопитающих, питание, поиск пищи, морфология и анатомия, забота о питомцах). Ошибочные представления учеников установлены по всем категориям. По результатам исследования представлена дисскусия о путях усовершенствования процесса обучения биологии.

**Ключевые слова:** ошибочные представления, млекопитающие, обучение биологии.

*Received 23 October 2006; accepted 05 February 2007*

***Milan Kubiatko***

PhD. student at Department of Didactics in Sciences, Psychology and Pedagogy, Faculty of Natural Sciences, Comenius University,
Mlynska dolina CH – 2 , 842 15 Bratislava, Slovakia.
Phone: + 421261296348
E-mail: mkubiatko@centrum.sk
Home page: https://www.fns.uniba.sk/~kubiatko

***Pavol Prokop***

Lecturer assistant at the Trnava University, Department of Biology, Faculty of Education, Slovakia and researcher in SAS (Institute of Zoology, Slovak Academy of Sciences, Dśbravskį cesta 9, 845 06 Bratislava, Slovakia)
Priemyselna 4, PO Box 9, 918 43 Trnava, Slovakia.
Phone: + 421335516047
E-mail: pavol.prokop@savba.sk
Home page: http://pdfweb.truni.sk