Evo Edu Outreach (2009) 2:136–140
DOI 10.1007/s12052-008-0095-y

REPORTS FROM THE FIELD

Teaching Evolution in Primary Schools: An Example in French Classrooms

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Published online: 19 November 2008

Abstract Teaching evolution in primary schools is important for spreading evolutionary knowledge and scientific methodology. Through constructing simple interrelationship trees, pupils gain scientific knowledge, scientific methodology, and argumentation skills. Activities conducted in French primary schools are described in this paper.

Keywords Education · Evolution · Primary schools · France

Biological evolution is a complex concept that requires gathering relevant data, and teaching it in primary schools can be quite difficult. On one hand, this subject always raises passionate questions; on the other hand, primary school teachers are not always aware of the different facets of the subject. Moreover, every teacher in charge of the teaching of sciences to young pupils is confronted by various questions concerning the origin of life, the origin of human beings, and their evolution. What kind of answers can the teacher offer?

Let us consider the various attitudes a teacher could have:

1. Give no answer? This is not the job of a teacher.
2. Forget or elude? Neither is this the job of a teacher.
3. Say "It is very complicated, we will cover it later"? Nor is this a teacher's job.
4. Explain? Explain, of course, again and again.

But these explanations must be appropriate to the audience, especially taking into account the age of the pupils. In this paper, we would like to present an approach to teaching biological evolution which we and numerous colleagues have led with young French pupils (aged 4 to 11 years old). The various exercises associated with this approach are available in French for teachers on the website of the Ecole des Sciences (Bergerac, France; http://www.perigord.tm.fr/~ecole-scienc/pages/activite/monde_vivant/Telechargements/SoMod.htm). Some documents have been translated into English, Spanish, and Breton.

Teachers can ask four main questions about the teaching of evolution in primary schools:

1. Do we have to talk about evolution?
2. Do we have to talk about evolution mechanisms?
3. Do we have to talk about the structure of evolution?
4. Do we have to talk about the theory of evolution?

French national curricula are very clear about these points. Evolution mechanisms will be treated in secondary schools in reference to natural selection, genetics, and historical works of Darwin (1859) with finches (genus *Geospiza*) or Kettlewel (1955, 1973) with peppered moths (*Biston betularia*) (see Grant and Wiseman 2002 for a report). Discussion of scientific theories is not among the objectives of the teaching of sciences in primary schools. But, little by little, constructing embedded groups of animals on the basis of what they possess corresponds to: (1) what pupils can do, (2) what is indicated in curricula,

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and (3) what researchers in systematics do. In this way, pupils not only gain scientific knowledge but learn scientific methods as well.

Examples of Activities

Activity 1

The following activity has been conducted several times with 4- to 5-year-old pupils (cycle 1). Pupils worked on the hand, exemplifying the articulation of their body, by singing songs and manipulating toys. The pupils were particularly sensitive to the function of their thumb, which is necessary to handle the tools they use at school. Next, seven organisms (Fig. 1) are shown to them: a woman, a snail, a monkey, a turtle, a horse, and a lion.

The teacher asks: Which one among them has hands with a thumb?

Answer: The woman and the monkey.

Teacher: Let's color their hands in pink on the drawing.

Pupils color the hands on the drawings.

Teacher: can you see other things on the other animals which group them?

Hair, grouping lion, horse, woman, and monkey.

Fours limbs, grouping lion, horse, woman, monkey, and turtle.

Mouth, grouping lion, horse, woman, monkey, turtle, and snail.

Pupils color these features on the drawings with different colors. Figure 2 shows the four colored limbs on a large common picture after individual work. The teacher can draw a group including all the organisms that share this particular feature (Fig. 2).

Little by little, guided by the teacher and by reflexive observation of feature distribution among organisms, pupils construct a classification of seven species based on what they share and not on what they have or what they do not have. They practice modern systematics, phylogenetics whose purpose is to reconstruct the historical framework of the evolution of organisms. Moreover, they have used the same methods that researchers in laboratories use with other data (genetics, DNA sequences, and so on), and so are introduced to scientific methods: the use of data and arguments. Two of the major objectives of this activity are to construct embedded groups and to show that the human species is an animal species—a peculiar species, but an animal species, more closely related to the monkey than to the turtle. Moreover, this point is not asserted, it is shown and demonstrated.

Activity 2

With older, 6- to 8-year-old pupils (cycle 2), the same kind of work is initiated, but groups can be drawn on figures and be named: primates, mammals, vertebrates, and animals. Moreover, the inclusions of groups can be shown (Fig. 3). A scientist might observe that the used features are not exactly the ones defining the groups; the presence of four limbs is not a synapomorphy of vertebrates. But, in this activity, we are in a teaching mode; pupils are going to learn about methods. Detailed comparative anatomy, presence of bone or neural crests, is not a primary school objective.

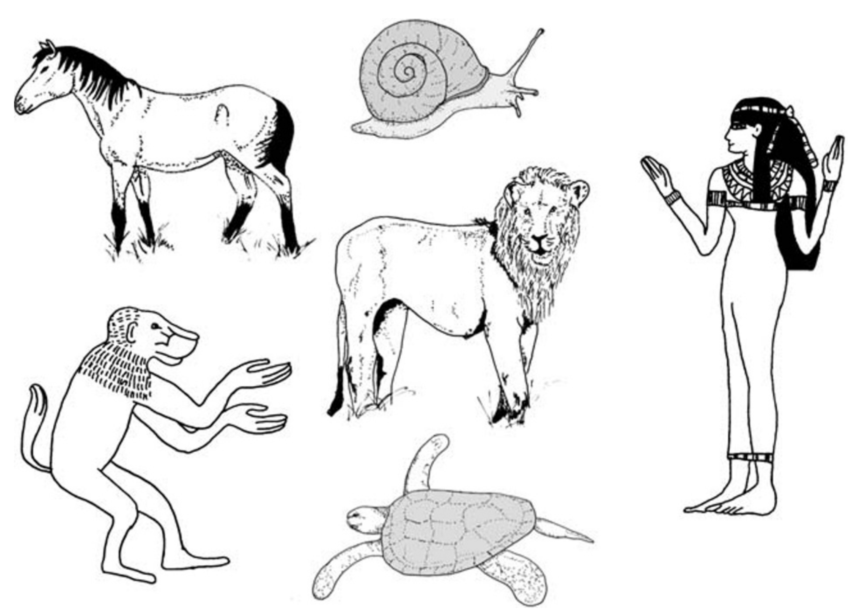

Fig. 1 Plates of organisms provided to pupils

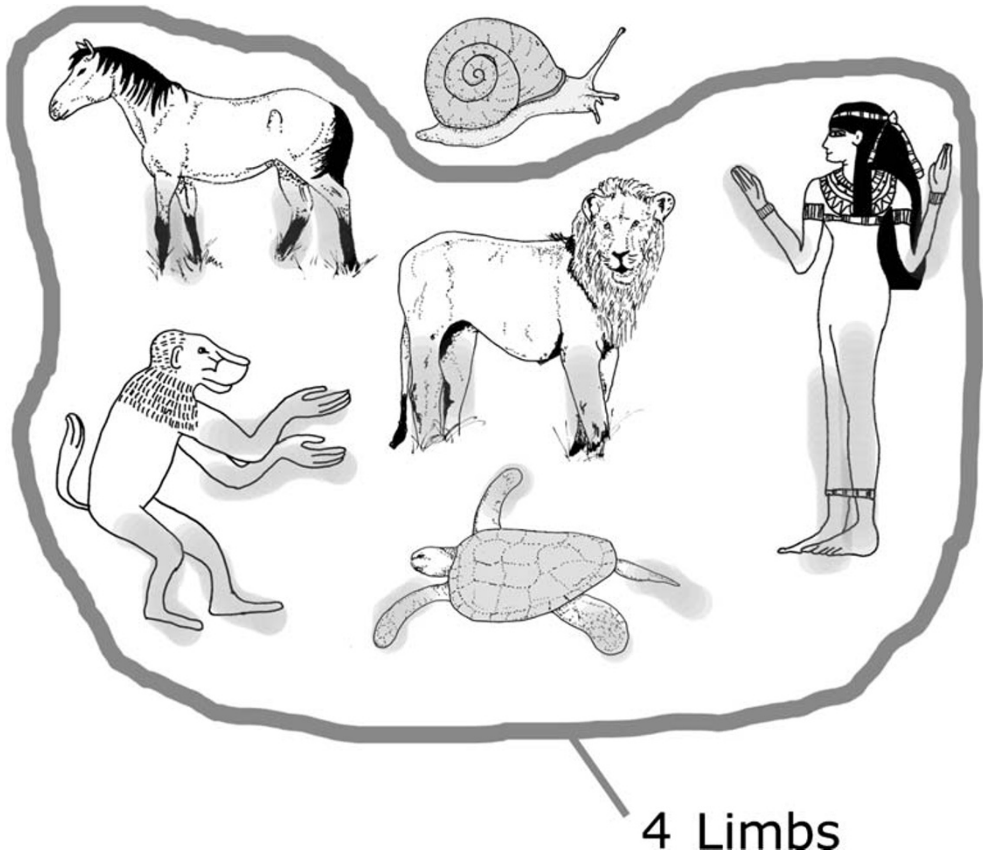

Fig. 2 Activity led by pupils of cycle 1. See text for details

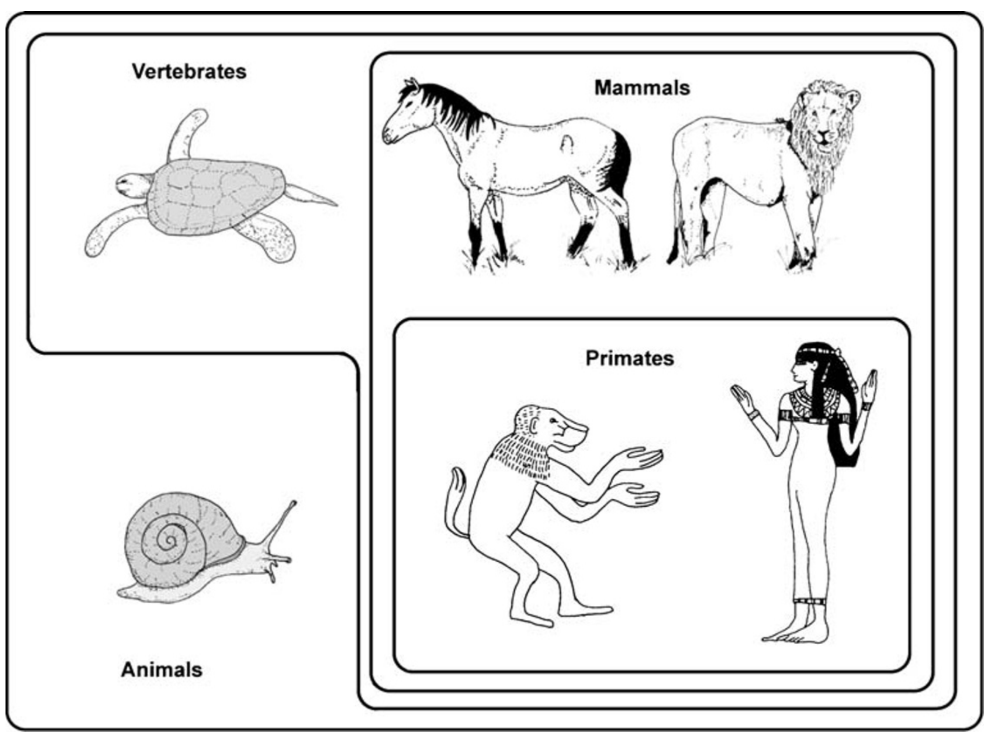

Fig. 3 Activity led by pupils of cycle 2. See text for details

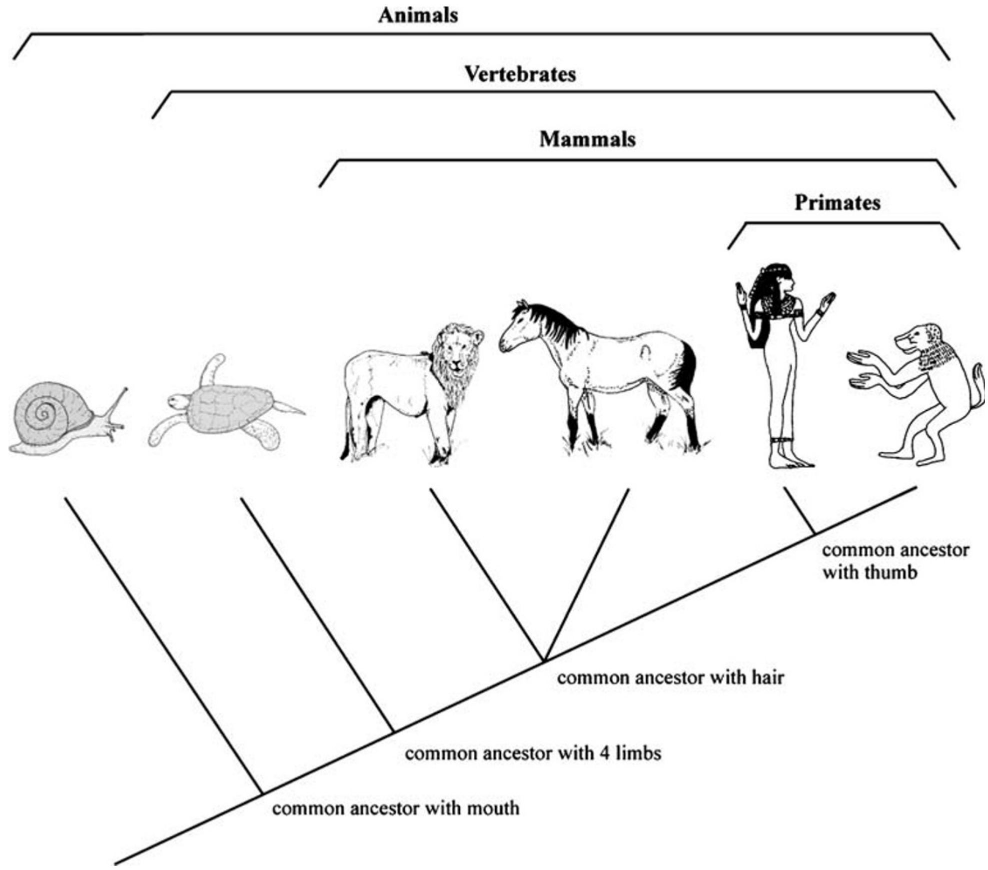

Fig. 4 Activity led by pupils of cycle 3. See text for details

Activity 3

With even older, 8- to 11-year-old pupils (cycle 3), an interrelationships tree (Fig. 4) can replace groups, where nodes are explained by the existence of common ancestors. The common ancestor of the monkey and the woman is more recent that the common ancestor shared with the lion and horse. Thus, little by little, the pupils discover the principles of evolution and modern systematics.

Chanet and Lusignan (2007) provide 14 activities of this kind (Table 1). This approach is not completely original, as other authors describe similar activities (Chanet 1997, 2000; Wilgenbus et al. 2002; Lecointre 2004). But the diversity presented by these two authors (Table 1) is a way

Table 1 List of activities proposed by Chanet and Lusignan (2007)

Item	Organisms	Level of difficulty
At the farm	Duck, goat, dog, rooster, goose, cow, horse, rabbit, cat, pig	Cycles 2 (with fewer animals) and 3
In the forest	Badger, stag, squirrel, fox, boar, owl	Cycle 2
Savanna's wildlife	Ostrich, giraffe, zebra, gnu, lion, cheetah, antelope	Cycle 2
In the mountains	Weasel, wolf, marmot, ibex, chamois, chough	Cycle 2
In the arctic	Cod, tern, razorbill, beluga, whale, polar fox, polar bear, seal	Cycles 2 and 3
In the garden	Snail, tit, butterfly, grasshopper, mole, slug	Cycles 2 and 3
Pond	Frog, freshwater mussel, crayfish, dragonfly, mosquito	Cycle 3
At the fishmonger	Dogfish, trout, salmon, sole, plaice, mackerel	Cycle 3
On the seashore	Periwinkle, scallop, crab, mussel, anemone, limpet, sponge	Cycle 3
At the time of dinosaurs	Ammonite, ichthyosaur, diplodocus, tyrannosaurus, dimetrodon, archaeopteryx	Cycle 3
On the walls of the caves	Bison, reindeer, lion, horse, aurochs, woolly rhino	Cycles 2 and 3
Coral reef	Lionfish, turtle, man, spiny lobster, shark, coral, shrimp, humphead wrasse, mantis shrimp	Cycle 3
On the Nile shores	Crocodile, ibis, hawk, cow, baboon, jackal, woman	Cycle 3

Cycle 2 6- to 8-year-old pupils, *Cycle 3* 8- to 11-year-old pupils

to attract primary school teachers to teaching scientific classification and evolution in classrooms.

Classifying animals can be viewed as an old-fashioned exercise. But this kind of activity, where, little by little, pupils reconstruct interrelationships trees, is a way to sow the seeds not only of evolutionary knowledge but of scientific methodology as well. While grouping species based on what they have (i.e., features), students introduce themselves to argumentation, to reasoning, that is to say, to science. Moreover, they learn to recognize nonargued, made-up stories.

One last experiment has been tried with 10- to 11-year-old pupils, on the confrontation of "intelligent design" texts versus simple scientific texts about peppered moths. Pupils had to choose between natural selection and the "invisible hand" of an almighty designer (http://www.perigord.tm.fr/~ecole-scienc/pages/activite/monde_vivant/Telechargements/Seance_ID.pdf). Then, a stone and piece of wood were thrown in a basin in the classroom: the stone sank and the wood floated. "Wouldn't there be an "invisible hand" that makes the stone sink and the wood float?" was asked of the pupils. Their first reaction was laughter. Then, a simple epistemological discussion was held with them to differentiate faith and argumentation supported by facts and experiments. Pupils, when led to compare such a conclusion to the texts about peppered moths, concluded that one of the explanations—the one with the "invisible hand"—was not a scientific one: belief is different from science. Therefore, teaching about biological evolution in primary schools can be a tool to spread scientific knowledge and methods among young pupils.

Acknowledgements We express our deepest thanks to Dominique Baron (IUFM, Brest, France) and to the various teachers who have experimented on and improved these activities with their pupils: E. Baron, M. Cachorro, C. Dessertenne, E. Duverneuil, J.-M. Feuillé, J.-L. Lamaurelle, M. Lusignan, and N. Mouillac. We are indebted to Niles Eldredge (American Museum of Natural History, New York, USA) who promoted and encouraged the publication of this work.

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