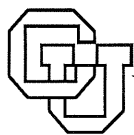


The Keys to the Animal Kingdom

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Abstract. We present a math lesson in which second through sixth grade children build and use a small animal key. The lesson promotes important classification skills and also has connections to other areas of the curriculum such as library research and literature. Students with internet access can also connect to a site on the world wide web to let them explore a large version of the animal key.

Props:

- one completed animal key for the teacher to use (**Figure 1**)
- one blank animal key for each child (**Figure 2**)
- three “strips of eight animals” (from **Figure 3**) for each child
- pencils, scissors and glue

The Keys to the Animal Kingdom

"I am an animal—can you guess who I am?" In the second-grade classroom, every child's hand was raised high to answer my question. "I'll answer questions," I explained, "but I'll only answer 'yes' or 'no'."

Hannah pointed to the litter of stuffed animals that was congregating under the blackboard. "Are you one of those animals?" she asked. Yes, I was. The congregation had a wide variety: brontosaurus, blue whale, kangaroo, rabbit, goldfish, horse, brown bear, and parrot. More questions followed:

"Do you have four legs?" Yes.

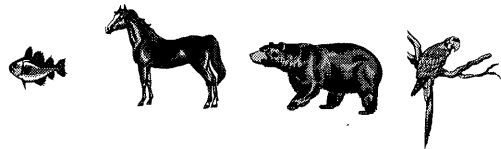


"Do you growl?" No.

"What noise do you make?" I can't answer that one. I can only say "yes" or "no"!

"Do you eat grass?" No.

"Are you brown?" No.



"Do you have long ears?" No.

"Do you live underwater?" Yes.

"Are you gold colored?" Yes. This answer caused major excitement. Everyone wanted to ask the next question, but it was Brady's turn. "Are you the goldfish?" he asked. That was right.

The children played the game with me one more time, and then I turned the tables. "I'm leaving the room," I said. "You all have to agree on one of the eight animals. When I come back, I'll ask questions to figure out who you are." I'm not quite sure how they reached a consensus while I was away, but when I returned, there were conspiratorial smiles all around.

“Are you sometimes a pet?” I asked. Mark laughed and said no.

“Are you bigger than a truck?” Anne admitted that she was.

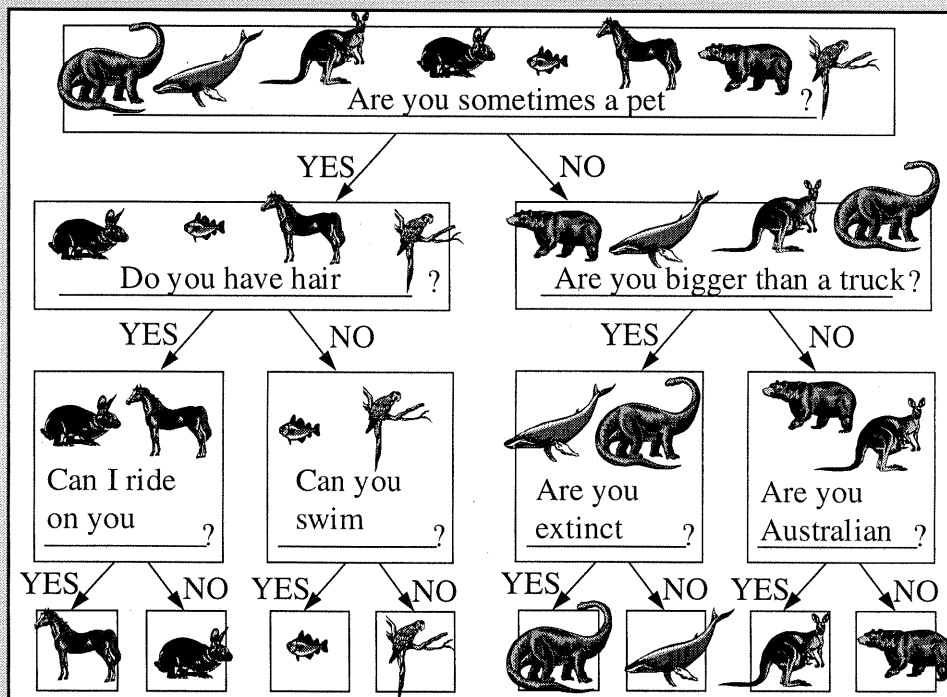
“Are you extinct?” Ben wasn’t sure what that meant, but when I explained he said yes, he was certainly extinct.

“I guess the brontosaurus.” And I was right.

The children were amazed. How’d you guess so quickly? Is it a trick? Were you listening outside the door? “It’s not a trick,” I said, “and I wasn’t listening by the door, but I do have something to help me. I produced a large sheet of paper, and the children crowded ‘round to see what it was.

The paper was an animal key for our eight animals (see **Figure 1**), similar to the keys that naturalists use to classify real animal or plant species. I explained how I used the key in the game. At the top of the key is a box with all eight animals and the question “Are

Figure 1. The First Example of an Animal Key



you sometimes a pet?" This is a good question because half of the animals answer "yes" and half of them answer "no." So, whichever answer is given, the search has been narrowed to just four possibilities. The four "yes" animals (rabbit, goldfish, horse, parrot) are in a box on the left, and the four "no" animals (brown bear, whale, kangaroo, brontosaurus) are in a box on the right. Each box in the animal key has a question to divide the group of animals in half. The questions are asked, and the path is followed down the tree until you reach the right animal.

Once the children saw how the animal key worked, they all wanted to have a go at using it. "Alright," I agreed, "but there's one condition. You have to make your own animal key from these animals, with your own questions..."

How the Children Make the Animal Keys

The above description shows how one of us taught a group of second-grade students about animal keys. We've used a similar approach in classes from second to sixth grade, and in our classes for preservice and inservice elementary school teachers (who like animals and games as much as children). Once the children were ready to make their own animal key, we handed out copies of a "blank key." (See **Figure 2**.)

With a blank key in hand, each child is told to write a question that four animals will answer "Yes" and four will answer "No." After a child writes a question in the top box, the teacher can check the question and give the child one strip of paper cut from **Figure 3**. The child cuts out the animals and pastes them into "Yes" box or the "No" box underneath the question.

(Text continued on page 7)

Figure 2. A Blank Animal Key

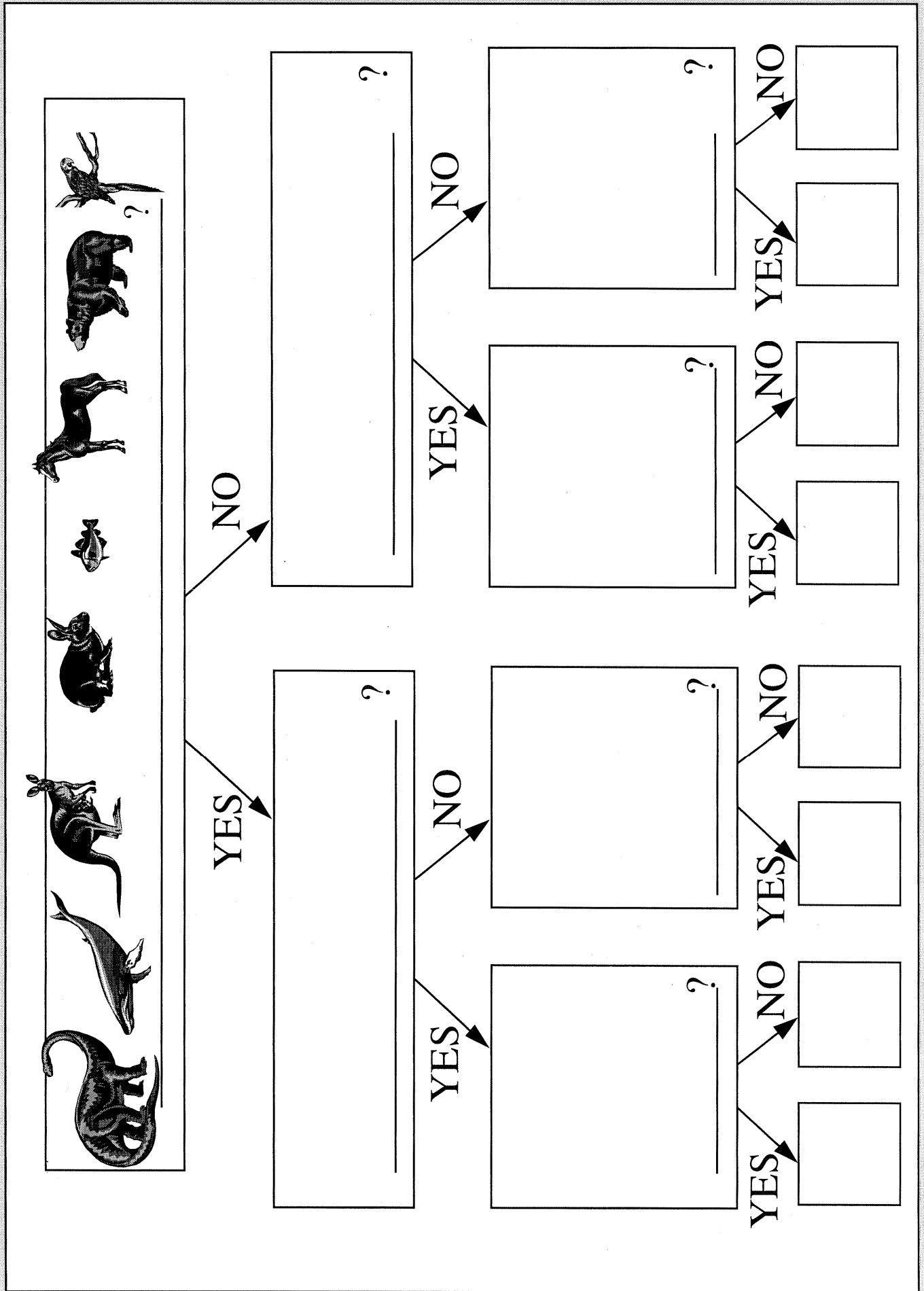
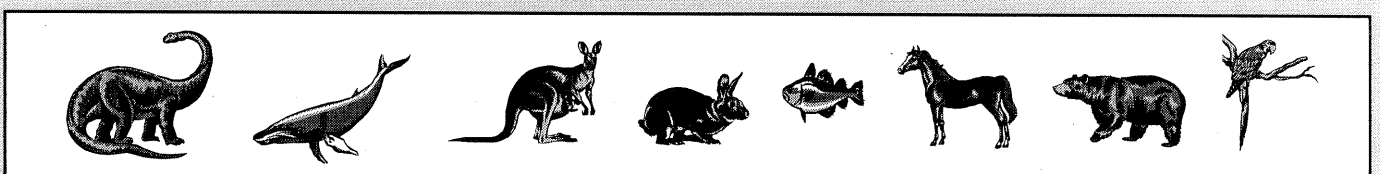
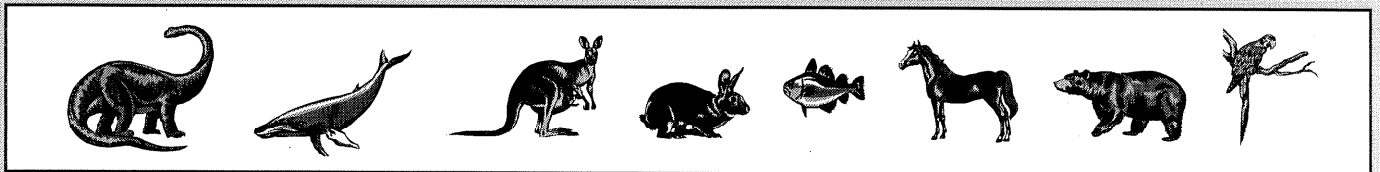
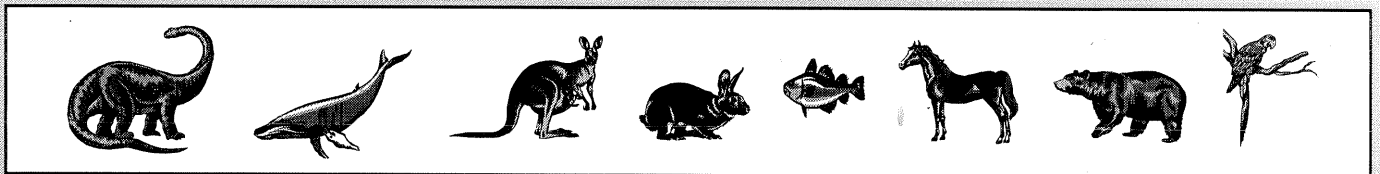
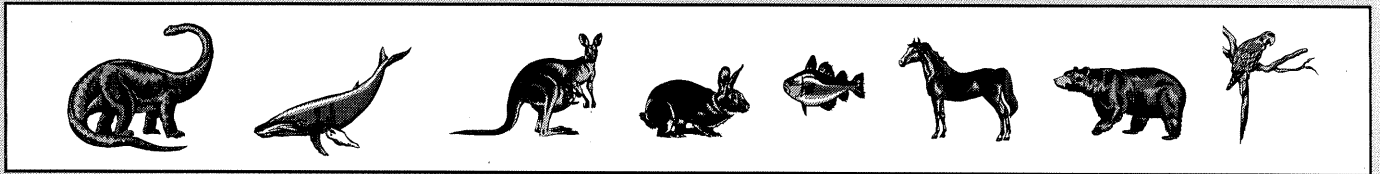
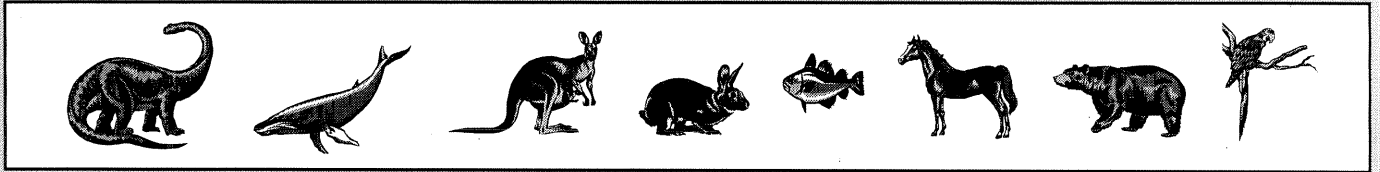
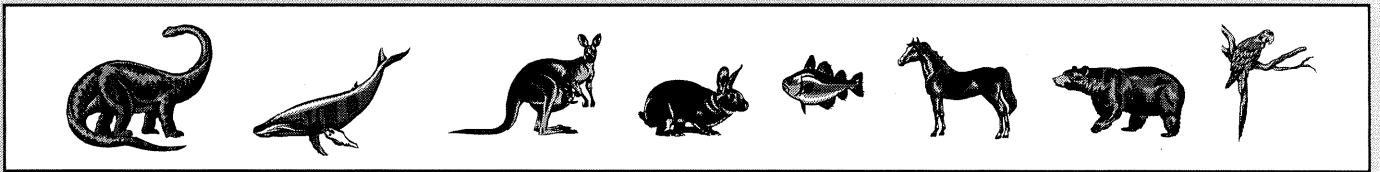
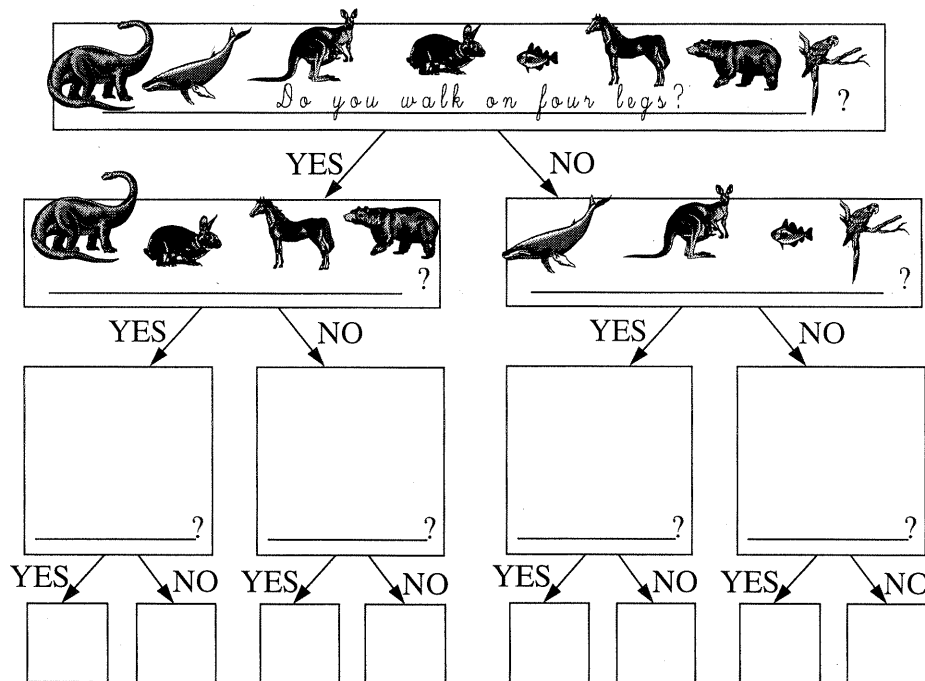


Figure 3. Strips of Animals.

Cut each strip individually, and hand them out one strip at a time. Each student needs three strips in all.

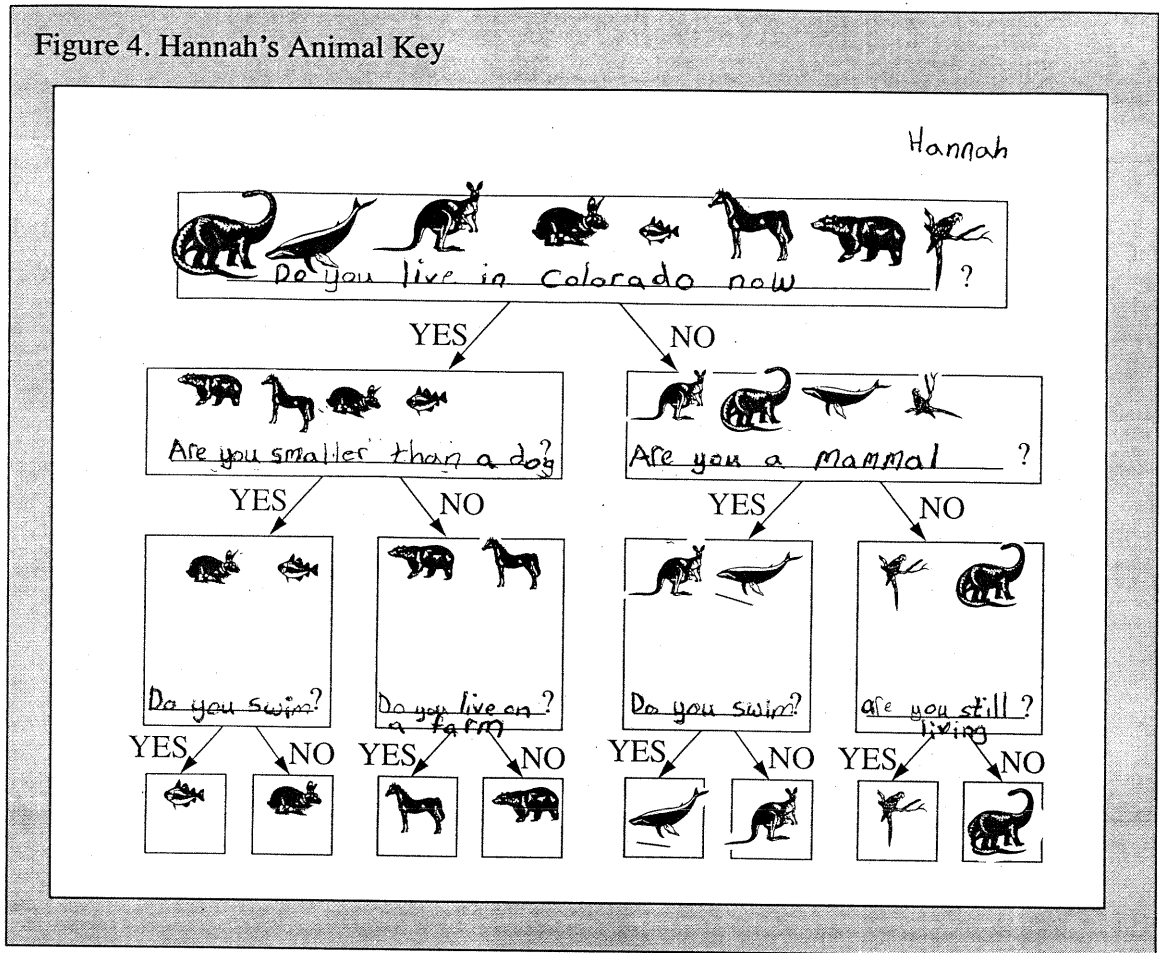


At this point, a child's work might look like this:



Next, the child must write a question in each four-animal box (at the second level of the key). Each of these questions should divide the four animals into two that say “Yes” and two that say “No.” Once these second-level questions are in place, the child can be given another strip to cut up and paste into the next level. The child comes up with four more questions for this level, then cuts and glues one more copy of the animals into the boxes at the bottom. One child's result is shown in **Figure 4**. All that remains is for the children to play the game with friends—and perhaps to generate some interesting connections to other areas of the classroom.

Figure 4. Hannah's Animal Key



Connections to Other Areas

The main purpose of this lesson is to develop the ability to classify objects according to similar characteristics. That's important enough by itself, but classification skills also are an important prerequisite for a child's acquisition of abstract concepts of numbers and sets (Moser 1992). Some other connections to the curriculum are listed here:

Library research and literature. The exercise can lead to some interesting questions about animals. What's the difference between hair and fur? Do horses have fur? Do whales have hair? What is a mammal? Do bears eat grass? What animals are extinct? Why? Some answers can be found with library research, and literature may also be brought into the discussion. (Walt Morey's *Gentle Ben* is a brown bear who devours tender

grass shoots with gusto.) Classes with an internet hook-up might conduct their research on the internet. An interactive version of the animal-guessing game is also available on the internet (See Main 1996).

Tables. With eight animals, the animal key needed three questions to identify an animal. Advanced students may wonder how many questions are needed if there are more animals. Four questions are enough for 16 animals. Five questions can handle 32 animals. Students can make a table to show how many animals can be handled by a given number of questions. They may be surprised to find out that twenty questions are all that's needed for a million animals.

Naturalists' keys and other objects. The students may also enjoy seeing more complicated keys that are used by naturalists to identify flora and fauna. Three such books are listed in the references below.

Elsewhere in the curriculum, students can make keys to identify other objects other than plants and animals. One of our preservice teachers had her students make a key where the objects were the nine planets. In this case, the top level of the key had nine objects, an odd number. Therefore, the top-level question can't divide the objects exactly in half, but the question should try to put four items on one side and five on the other.

Lead-in to halving, logarithms and exponents. Even second-grade students can see the importance of dividing the animals in half with each question. The "dividing in half" results in reaching the answer quickly. Because of the division by two at each level, n questions will handle 2^n animals. Equivalently, we can say that the number of questions needed to handle A animals is about $\log_2 A$. This could be a good lead-in to the topic of exponents and logarithms. These are concepts that are not usually taught in the elementary grades, but they could be introduced.

Classification Skills for Younger Children. We have taught this less with children as young as second grade. But even younger children will benefit from developing classification skills through similar techniques such as Elizabeth Miller's lesson on sorting and classifying by attributes (Miller 1996).

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Acknowledgments

Images are used with permission of the copyright owner, New Images Technologies, Inc. Thanks to Sally Stevenson for welcoming us and our lesson into her classroom. Thanks also to our student teachers who tried the lesson in the field, and suggested collections of animals that worked well.