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EXAMINING HOMOLOGOUS STRUCTURES

BACKGROUND INFORMATION

It should come as no surprise that identical twins look alike. After all, they have identical genes. Other siblings, although less alike, often look similar because they have the same parents and can share many of the same genes. More distant relatives, such as cousins, also can show obvious family traits because they can share some genes that have been passed on from their common ancestors. All living organisms carry within their bodies traces of the history that links them to their ancestors. The more distant the common ancestor, the fewer traits individuals share. Evidence of this phenomenon can be seen in homologous structures. These are structures that develop from the same body parts but have been altered as an adaptation for a particular organism. In this laboratory investigation, you will examine some of the evidence.

PROBLEM

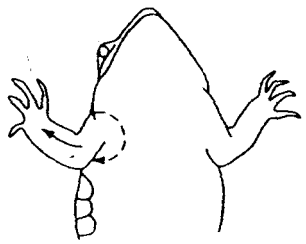
How do homologous structures support the theory of common descent?

MATERIALS *(per group)*

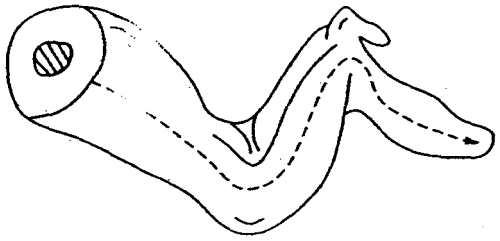
preserved frog	dissecting pan
chicken wing	scalpel
human skeleton (model or chart)	scissors
	forceps

PROCEDURE

1. Put a preserved frog in a dissecting pan. Using your scissors, cut the skin around the base of the frog's arm where it joins the body. See the accompanying figure. Then grasp the cut edge of the skin with forceps and pull it down the arm until the skin is removed. The skin should come off the arm easily.



2. Pull the frog's arm up toward the head. Use your scissors to cut the muscles around the base of the arm. When you have completed your cut, the bones of the arm and shoulder should be visible. Pull back on the arm. The arm should come loose from the shoulder, but you may have to use your scissors to cut the connections that hold the arm in place.
3. With your scissors, cut the ends of the muscles away from the bone on the severed frog arm. Use your forceps to peel the muscles away from the bones. Remove as much of the muscles from the frog's arm as you can. Then, using a scalpel, gently and carefully scrape the bones clean. **CAUTION:** *Use care when using a scalpel. Always cut or scrape away from your body.*
4. Draw a diagram that shows the arrangement of the bones in a frog's arm.
5. Put a chicken wing in a dissecting pan. Use your scissors to cut the skin toward the wingtip. The dotted line in the accompanying figure indicates where you should cut. Using the forceps, remove all the skin from the chicken wing.



6. Carefully cut the muscles away from the bones using your scissors. With a scalpel, carefully scrape the bones clean. **CAUTION:** *Use care when using a scalpel. Always cut or scrape away from your body.*
7. Draw a diagram that shows the arrangement of the bones in a chicken wing.
8. Use the model or chart of the human skeleton to draw the arrangement of the bones in the human arm.

OBSERVATIONS

1. How many bones did you find in each of the limbs?

2. In what ways are the structures of the limbs similar?

3. In what ways are the shapes of the bones similar?

ANALYSIS AND CONCLUSIONS

1. List some functions of each of the three different limbs you have examined.

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2. Even though the limbs of these organisms are very different in outward appearance and function, their internal structure is remarkably similar. How can you explain this observation?

3. From an evolutionary standpoint, what would it mean if these bones were very different in structure?

CRITICAL THINKING AND APPLICATION

1. How can you explain the fact that there are more structural similarities between a bird's wing and a whale's flipper than between a bird's wing and an insect's wing?

2. The external form of a whale looks very similar to that of a fish. The skeleton of a whale, however, is more similar to that of mammals than it is to a fish. How can this be explained?

3. Divide the following animals into groups based on similarities and differences. Explain why your grouping could reflect their ancestry: cat, coyote, dog, frog, horse, lion, tiger, toad, wolf, zebra.

4. A protein similar to the mammalian hormone prolactin is found in amphibians and birds. In amphibians such as newts, it causes the animals to seek water as they do when they lay eggs. In birds, such as pigeons, it causes them to regurgitate material from the crop to feed their young. Mammals respond to prolactin by producing milk. How does the theory of common descent explain these similarities?