Reportedly, a single population with only eight plants exists next to an ORV trail in West Virginia. Each account includes a species description and natural history, significance of the species, historical perspective, current trends, management, prognosis and recommendations.

The appendices remain largely the same, but with updated names and addresses. Smaller type in this section accommodates the same bulk of data in fewer pages—a good idea. The price has increased from the original $24.95 of the 1985 edition to $39.95 (for all three volumes). Wildlife management professionals and conservationists will not be disappointed with this volume. Teachers may look twice at the price tag before checking it out at the local library.

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Projector Center

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Morphogenesis of the Cauda Equina

William R. Belzer

During the third or fourth month of human gestation, the elongation of the fetal spinal cord lags behind that of the growing vertebral column (Streeter 1919; Langman & Woerdman 1978).

As a result of this disproportionate growth, the lower region of the vertebral column is gradually vacated by the caudal end of the spinal cord. This caudal outdistancing by the vertebrae moves the intervertebral spaces (through which the spinal nerves emerge from the vertebral column) from their original positions. Consequently, the lower lumbar vertebrae of infant and adult humans are devoid of a spinal cord.

As a result, the vertebrae now enclose the displaced caudal nerves that originate from the spinal cord and were dragged downward by their intervertebral spaces in the elongating vertebrae. This bundle of nerves, descending through the vacated lumbar vertebrae, has been named the cauda equina because of its resemblance to the bundle of hairs in a horse's tail.

Understanding the anatomy of the cauda equina and its embryonic development is useful to students of human anatomy, particularly health-allied majors, because it is in the region of the cauda equina where cerebrospinal fluid is commonly collected (Williams & Warwick 1975).

The selection of this region for insertion of a needle to withdraw cerebrospinal fluid for diagnosis (the "lumbar tap") helps to minimize the risk of neural injury. This is because there is no spinal cord here to puncture, and the nerves of the cauda equina are mobile enough to slip to the side out of harm's way as the needle advances into the space.

A clear mental image of the morphogenesis of the cauda equina is a difficult portrait to achieve with words, and drawing a sequential series of diagrams on the board consumes an unjustifiable amount of lecture time for such a simple point.

I therefore developed a schematic diagram (see transparency master) of the sequence of events. An overhead transparency of the figure is projected onto a screen; each student was previously given a duplicate of the diagram to obviate wasting class time to copy it.

The concept can thereby be communicated effectively in a very short time, allowing the lecture to quickly move on to more intricate concepts that can benefit from extra lecture time. You are welcome to use the accompanying transparency master to prepare student copies and your own overhead transparency to facilitate your lecture on this process.

References

Langman, J. & Woerdeman, M.W. (1978). *Atlas of Medical Anatomy*. Philadelphia: W.B. Saunders & Co.

Streeter, C.L. (1919). Factors involved in the formation of the filum terminale. *American Journal of Anatomy, 25*, 1–11.

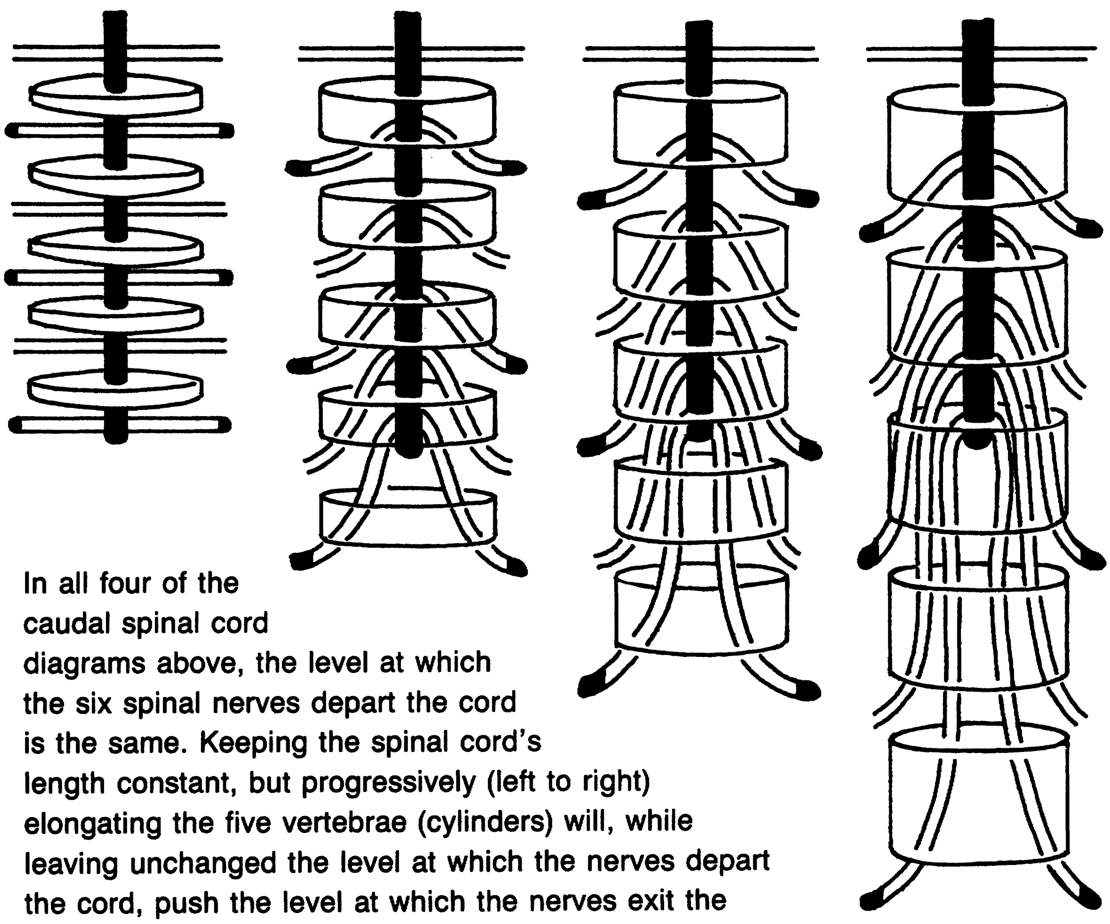
Williams, P.L. & Warwick, R. (1975). *Functional Neuroanatomy of Man*. Philadelphia: W.B. Saunders & Co.

The Projector Center department presents ideas for improved and innovative educational uses of audio-visual devices. Also, full-page transparency master drawings of important organisms or biological ideas are included. Biology teachers are encouraged to machine copy these drawings to produce their own transparencies for use with overhead projectors.

Ideas are always needed for the Projector Center. Ideas for innovative science teaching uses of A-V devices and drawings for transparency masters should be sent to **Charles Barman, ABT Projector Center Department Editor, 902 W. New York St. Indianapolis, IN 46223.** Please send an original plus 3 copies of all submissions. Full credit will be given to authors of all ideas or drawings published.

William R. Belzer teaches human anatomy and physiology and pathophysiology courses at Clarion University—Venango Campus, 1801 W. First St., Oil City, PA 16301. He is currently completing a program begun with the help of a Title II EESA grant that allows school teachers to use the college's videomicroscopy instrumentation to prepare videotaped instructional aids for use in their classrooms. Belzer received his Ph.D. in Biology from the University of Pennsylvania in 1970, and before going to Clarion taught at Ft. Lewis College in Durango, CO, and Cottey College in Nevada, MO. He has published numerous articles and presented papers at NABT and NSTA conventions. A member of six professional organizations, including NABT, Belzer belongs to 13 environmental organizations and has served as a volunteer naturalist for a desert ecology program for the Tucson (AR) Public School system.

MORPHOGENESIS OF THE CAUDA EQUINA (Horse's Tail)



In all four of the caudal spinal cord diagrams above, the level at which the six spinal nerves depart the cord is the same. Keeping the spinal cord's length constant, but progressively (left to right) elongating the five vertebrae (cylinders) will, while leaving unchanged the level at which the nerves depart the cord, push the level at which the nerves exit the vertebral column (via the intervertebral spaces) lower and lower. During embryonic development, essentially this same process is occuring because the vertebrae grow more than the spinal cord. The last lumbar vertebrae, therefore, enclose no spinal cord; they house only the bundle (horse's tail) of spinal nerves as seen in the extreme right diagram (hence the relative safety of a lumbar tap).

TRANSPARENCY MASTER