How-To-Do-It

Helping Students Understand Physiological Interactions

A Concept Mapping Activity

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One of the more difficult aspects of teaching anatomy and physiology is helping students understand physiological interactions among organ systems of the body. Generally speaking, students have far fewer problems learning (and comprehending) anatomical relationships than they experience with physiological relationships. Even though textbooks and teachers often use themes such as homeostasis to provide some integrative continuity, the unfortunate fact of life is that tradition and logistics usually dictate a system-by-system approach to course sequencing that encourages conceptual compartmentalization by students.

In general, anatomical relationships may be described as hierarchical or "vertical" (body-system-organ-tissue-cell), while physiological relationships are more typically propositional or "horizontal." This view of the conceptual organization of the subject matter corresponds closely with two learning processes, progressive differentiation and integrative reconciliation (Ausubel, Novak & Hanesian 1978). In progressive differentiation, an original concept meaning becomes more precisely delineated as new information, new cases, exemplars and exceptions are learned. Integrative reconciliation occurs when concepts, perhaps originally perceived as unrelated or even conflicting, become unified into a more holistic meaning.

Concept Mapping as a Teaching/Learning Strategy

Concept maps are heuristics for graphically representing hierarchies and propositional relationships within systems of related concepts (Ault 1985; Novak 1980, 1981; Stewart, Van Kirk & Rowell 1979). A variety of teaching/learning applications have been described for both teacher-made and student-made concept maps. However, increasing emphasis has been placed recently on concept mapping by students, a process oriented form of instruction. Novak and Gowin (1984) supply explicit strategies for introducing and executing student concept mapping activities at a variety of grade levels.

Unfortunately, teachers may perceive full-fledged concept mapping activities to be too time-consuming for real classroom use, particularly if students are altogether unfamiliar with the technique or if concept mapping is not likely to be used throughout the course or in other courses. Make no mistake about it: concept mapping is not an easy task initially, and it can be very time-consuming. On the other hand, concept mapping is a powerful technique; it is an ideal way to stress conceptual organization and integration; and, its visual nature is inherently superior to verbal ways of organizing information (outlining or listing).

A "Complete the Map" Activity

The activity described here was developed to address these two problems: (1) poor student understanding of physiological interactions and (2) the time-consuming nature of concept mapping. Additionally, this activity can be used to help prepare students to produce their own concept maps. Like other concept mapping activities, this one is also useful for end-of-unit or end-of-course review.

Basically, a concept map for the subject matter is prepared by the teacher. A copy of this map then is made using only vertical (or hierarchical) propositions and linking lines. Horizontal integrative links are omitted. Since I use this activity mainly as an end-of-course summative review, the example given in Figure 1 is quite broad. However, more specific maps might be used for within-unit formative evaluation or for making transitions between units as well. Figure 2 provides an example of a more specific map.

Students are instructed to add lines linking the concepts in the lowest level of the map. These propositional lines are numbered, and explanatory statements—essentially expanded propositional labels—to justify each linkage are supplied on separate pages. An example line and statement should be provided on the map worksheet to make these directions clear.

I have found, of course, that students are unlikely to complete and return an activity unless they know (or believe) that the material will be graded. Scoring this activity is really quite simple. From the original teacher-made map, a base number of linking propositions can be determined, and a point value for each linkage can be calculated. Students then receive a set number of points for a valid, adequately justified linking line placed on their maps. Obviously, considerable variability will be evident among students' justifications for the linking lines. Numerous different valid explanations for the same linkage should be expected in a typical class. This is, of course, good evidence of meaningful learning, and it obligates the teacher—and the class—to conduct a full discussion of the activity.

Additionally, some linkage justification may represent research developments not reflected in the textbook, perhaps not familiar to the teacher. Thus, the activity becomes a forum for emphasizing on-going developments in biology. Students who supply "state of the art" explanations reflect their own high level of motivation and should be encouraged. Teachers may want to ask students to supply reference citations for their justifying statements.

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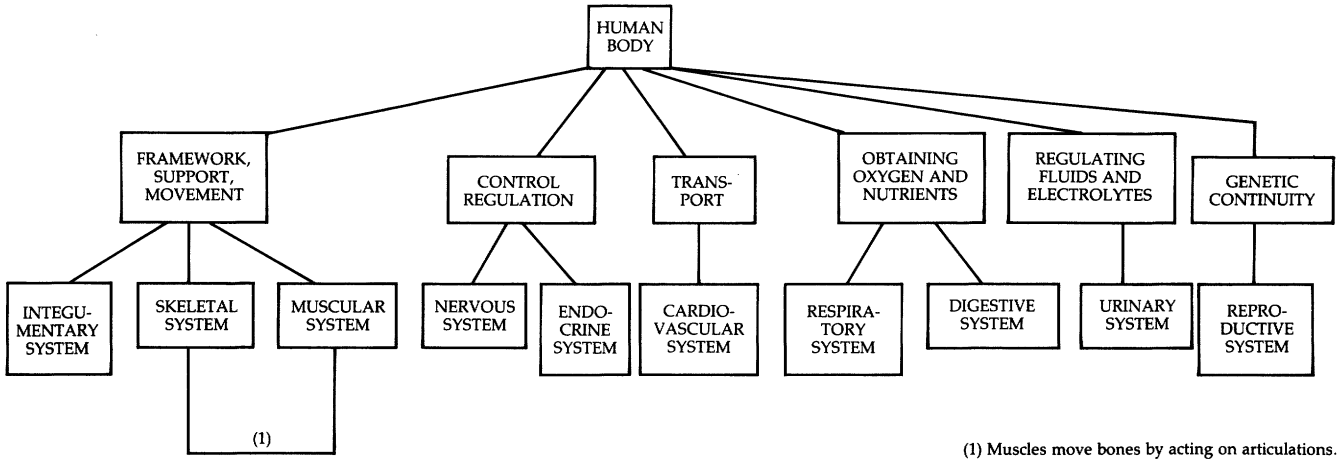

Figure 1. Concept map worksheet for end-of-course review in anatomy and physiology. An example linkage is provided and number-coded, and an explanatory statement is provided. Students add as many other linking lines and statements as they can provide.

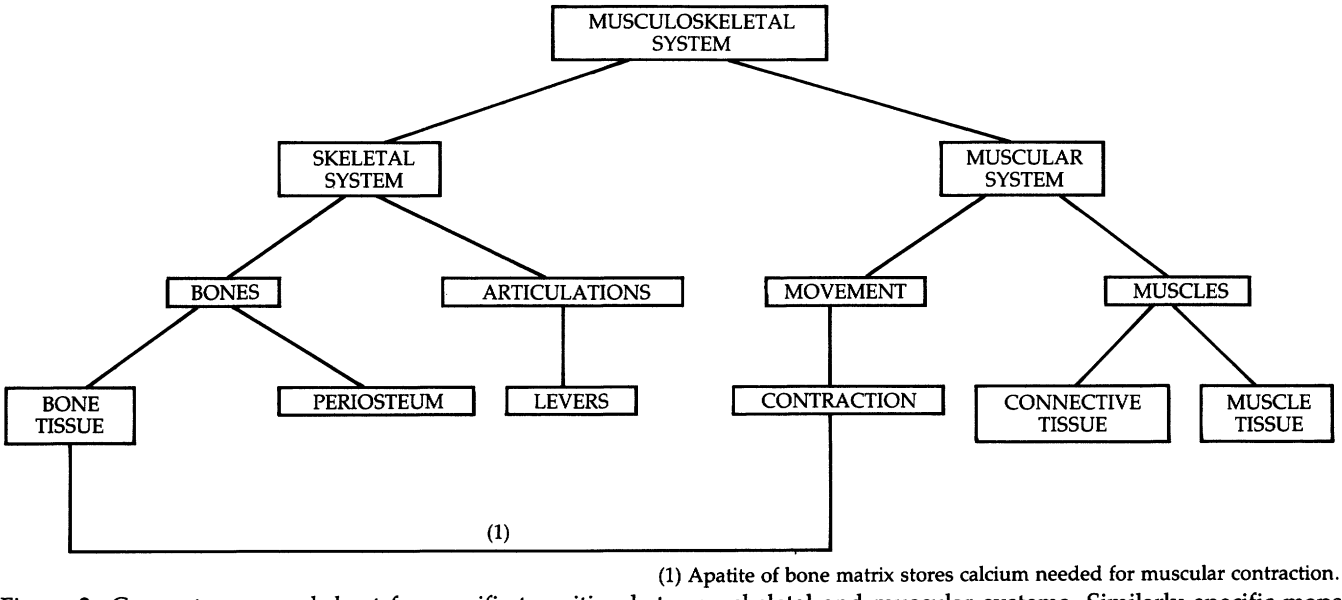

Figure 2. Concept map worksheet for specific transition between skeletal and muscular systems. Similarly specific maps could be used for within-unit formative evaluation.

This simple activity—along with subsequent classroom discussions—is a good way to emphasize interrelationships in human anatomy and physiology, and it provides a good final review for a course or course sequence. It is not nearly as time-consuming as a "from scratch" concept mapping activity, and it can be used to introduce students to the technique. The activity can also be repeated, once at the beginning and once at the end of a course, to evaluate changes in understanding and perceptions. This is interesting not only to teachers but to students.

Although the examples given here are intended for use as end-of-course and between-unit review activities for human anatomy and physiology classes, the basic idea easily could be modified for many other applications. By starting with an original concept map, teachers could develop similar activities for end-of-unit or within-unit evaluation or for other biology courses.

References

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