

Supplemental Material

CBE—Life Sciences Education

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Table S1: Number of students and courses providing written data for RQ2.

Institution and Course	Version of Item	Beginning	End
CC B			
Non-majors Phys A	Blood flow	18	12
R1 A			
Non-majors Phys A	Blood flow	113	77
Majors Intro Bio A	Blood flow	115	105
Majors Intro Bio A	Phloem sap flow	117	130
Upper Division Phys A	Phloem sap flow	47	44
Upper Division Phys B	Phloem sap flow	37	
Upper Division Phys C	Blood flow	44	45
R2 B			
Non-majors Phys A	Blood flow	315	242
Upper Division Phys A	Blood flow		43
R1 C			
Majors Intro Bio A	Blood flow	158	91
R1 D			
Upper Division Phys A	Blood flow	61	64
Upper Division Phys B	Blood flow	25	29

Figure S1: Description of the course sequence of biology and allied health majors at two institutions. Arrows indicate the time points for data collection. Numbers within the arrow denote the number of students interviewed. Within a course, the same students were interviewed at both time points.

Year	Freshman/Sophomore			Junior	Senior
	↓4↓		↓5↓	↓5↓ ↓5↓	↓5↓
4-yr A Biology Majors	Intro Bio I: Ecology and Evolution	Intro Bio II: Cell and Molec.	Intro Bio III: Plant & Animal Physiology	300-level Physiology	400-level Plant or Animal Physiology
	↓3↓	↓3↓		↓5↓	↓5↓
4-yr A Pre-Allied Health Majors	Elementary Human Physiology	Anatomy*		Patho-physiology	Care in Illness
	↓5↓	↓7↓	↓6↓		
CC A Biology Majors	Intro Bio I: Cell and Molec.	Intro Bio II: Animal Phys., Evolution	Intro Bio III: Plant Phys., Ecology		
	↓1↓	↓2↓	↓1↓		
CC A Pre-Allied Health Majors	Human Anatomy & Physiology I	Human Anatomy & Physiology II			

*Anatomy can be taken before or after Human Physiology at this institution.

Figure S2: Assessment items used in the short-answer data collection for RQ2 with three tubes, instead of the five tubes used in interview data collection for RQ1.

Blood flow item

A scientist is studying blood flow in the aorta of three different animal species; a zebra, a camel, and an elk. She found that the composition of the blood was identical in each animal as well as the diameter of their aortas, but the rate of blood flow through the aorta was different. The scientist measured the following pressures at the beginning (i.e., ascending aorta) and near the end (i.e., abdominal aorta) of the aorta.

Blood vessel	Start pressure	End pressure
Zebra	106	102
Camel	93	91
Elk	83	75

Which animal has the greatest flow rate (L/min) of blood through the aorta?

- a) Zebra
- b) Camel
- c) Elk

Explain why the animal you selected has the greatest flow rate (L/min) of blood through the aorta.

Phloem sap flow item

A scientist is studying sap flow in phloem tubes in three different tree, an American beech, a white oak, and an American chestnut of similar size and age. She found that the composition of the sap was identical among the trees as well as the diameter of their phloem tubes, but the rate of sap flow through the phloem tubes was different. The scientist measured the following pressures at the top (i.e., in the tree crown) and near the bottom (i.e., the base of the trunk) of each phloem tube.

Phloem tube	Start pressure	End pressure
Beech	0.60	0.35
White oak	1.20	1.00
Chestnut	0.90	0.80

Which tree has the greatest flow rate (L/hour) of sap through the phloem tube?

- a) beech
- b) white oak
- c) chestnut

Explain why the tree you selected has the greatest flow rate (L/hour) of sap through the phloem tube.