TABLE 1

Curricular materials and performance over the assessment cycles.

Assessment cycle		Year 0	Year 1	Year 2	Year 3	Year 4
Number of students (N)		73	83	83	85	70
Curricular material						
Primary research article and group worksheet		Yes	Yes	Yes	Yes	Yes
Study guide (see Online Appendix)		Yes	Yes; revised	Yes; revised	Yes; revised	Yes
3D physical models		No	In lecture	In lecture	Physical models or picture with instructor in discussion	With instructor in discussion; additional scaffolding before and during discussion
WNT puzzle interactive activity		No	In discussion	In discussion	In lecture, revised	In lecture
Exam questions (see Online Appendix)		Yes	Yes	Yes	Yes; revised	Yes
Assessments						
SALG survey		No	No	Yes (98% of students responded)	Yes; revised questions (100% of students responded)	No
Average semester exam score (%)		80.5	75.6	74.9	78.5	83.1
% of Students demonstrating basic understanding of β-catenin and WNT signaling learning objectives		17	43	43	79	89
3 Elements of student answers that demonstrated a deeper level of understanding: include details related to 1. β-catenin phosphorylation state., 2. of β-catenin interaction with GSK., 3. whether β-catenin is in the cytoplasm or nucleus.	Includes at least one (%)	41	67	75	92	91
	Includes at least two (%)	7.6	22	33	38	58
	Includes all three (%)	0	2.4	5.1	9.4	11

TABLE 2

Analysis of open-ended SALG question responses and representative student quotes from Year 3.

Question prompt	Analysis of responses mentioning WNT curricular tools	Representative student responses
What tools, activities, and resources most helped you understand the genetic basis of disease?	11.2% of students specifically mentioned the 3D model, or model picture, was helpful. 15.7% of students rated the WNT signaling puzzle activity was helpful. No students indicated negative impressions about the 3D WNT model or puzzle activity.	"The activity analyzing different situations where various genes of proteins in the WNT/APC signaling pathway are mutated (and knowing what regions of interaction the mutations were in) helped to elucidate the role that the gene plays in protein function, and subsequently, disease."
Please comment on how the above Biocore 587 class activities and resources helped your learning of the genetic basis of disease.	25.8% of students specifically mentioned the WNT signaling activity was helpful. 8% of students specifically mentioned the 3D models were helpful. No students indicated negative impressions about the 3D WNT model or puzzle activity.	"I hope to continue using models and doing activities similar to the puzzle activity, because these concepts helped me make a mental image of beta-catenin as a protein and the WNT pathway under different scenarios. It was easier for me to visualize these concepts when I had something tangible." "The interactive class activities of the WNT puzzle pathway and visualization of the possible binding sites for APC and TCF4 on Beta-catenin helped me to understand the functional properties of the proteins and how it correlated to the phenotypes." "The models helped me picture in 3D how beta catenin interacts with other molecules and how a mutation in one part of beta-catenin could render the protein inactive or allow it to become an oncogene."

Note. Year 3 is when the interactive WNT pathway activity occurred in lecture and 3D physical models or pictures of models were used in discussion sections.