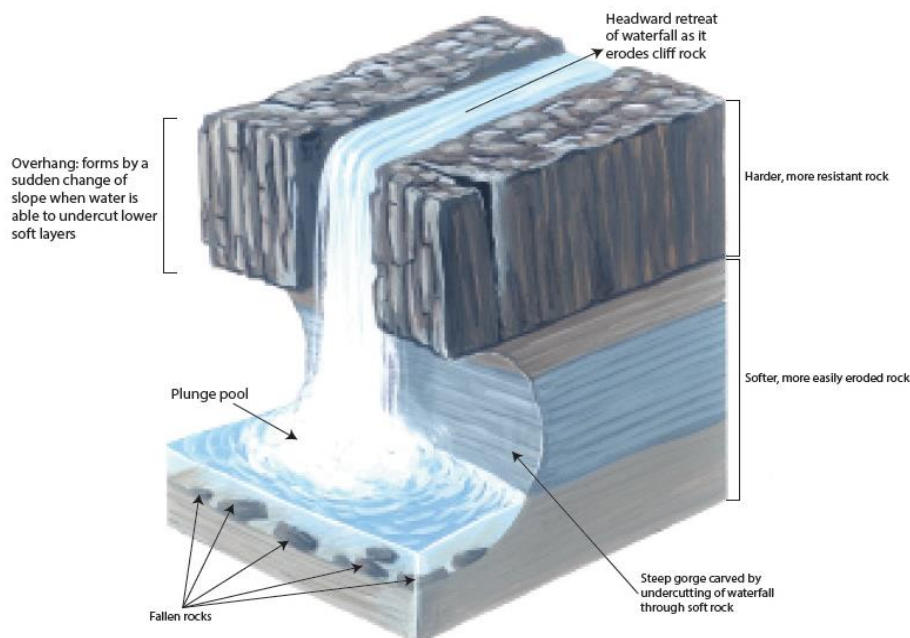


## Teaching an active learning course in Geomorphology

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A number of studies have demonstrated that active learning practices enhance information retention by students (Yuretich et al., 2001; NTLI, 2005) and contribute to development of valuable soft skills. Accordingly, we adopted an active learning approach in our development of a new geomorphology course for upper division undergraduate and graduate students at Stony Brook University. In the course, we promote inquiry-based learning, communication and listening skills, and concept synthesis through weekly discussion, activities and assignments. Distinctive aspects of the course mechanics include: (a) student use of concept sketches (Reusser et al., 2012; Johnson and Reynolds, 2017) to demonstrate relationships between landforms and processes (b) student-led workgroup activities in the lab or field followed by presentations on their findings, (c) interactive, class-led discussion of lecture notes for the weekly topic, instead of faculty lecture, and (d) beginning and end quizzes, some of which use a two-stage cooperative approach, where students take the quizzes individually and then as a group (Yuretich et al., 2001). Many of the strategies we used were based on ideas published by the Science Education Resource Center (SERC) at Carleton College (<http://serc.carleton.edu>)

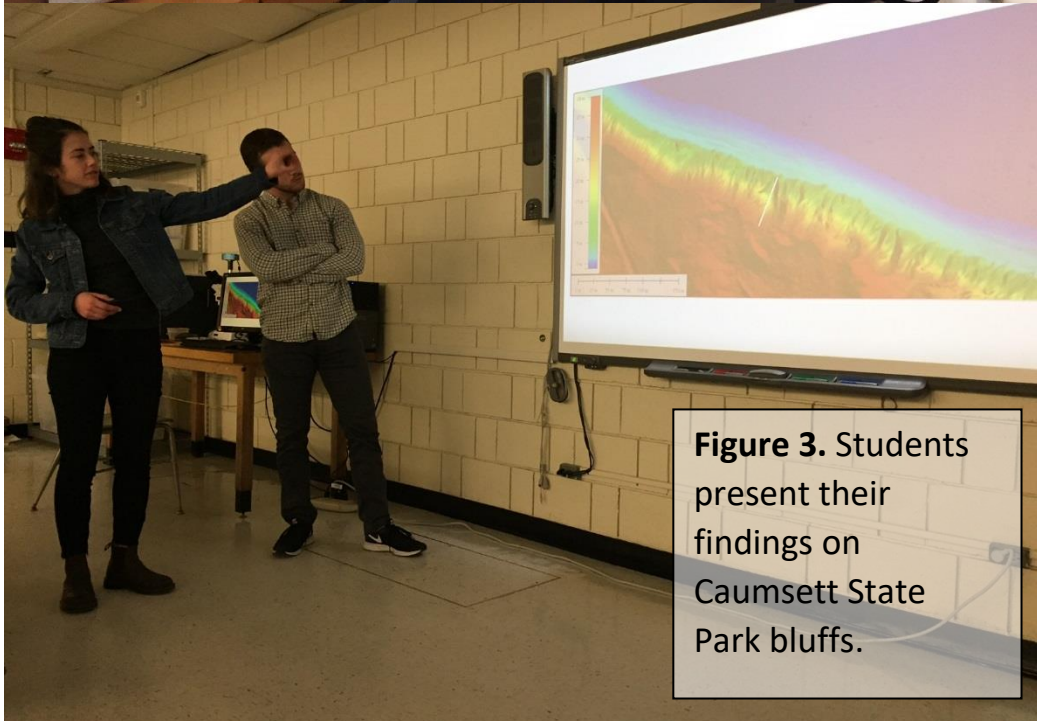
Concept sketches: In geology, concept sketches are annotated diagrams, maps, or figures that show interrelationships between features and processes associated with geologic landforms. Construction of a concept sketch promotes connection of features and processes, mastery of geologic concepts, and communication skills. In our course, we utilized concept sketches both as a form of teaching and assessment, where students incorporated concept sketches into their workgroup presentations (**Figure 1**), field reports, and end quizzes.



**Figure 1.** For the first concept sketch assignment, we had students annotate an image that we provided to them. In later assignments, students had to both draw and annotate.

Workgroups: At the beginning of the semester, students were divided into two groups of four students each; the makeup of each group was assigned by the instructors and stayed the same throughout the semester. Typically, students worked together on field or in-class lab exercises (**Figure 2**), and provided oral presentations as a group that summarized their findings (**Figure 3**). Working in groups promotes communication, leadership and team-building skills.

**Figure 2.** Students use LIDAR data to evaluate the development history of bluffs at Caumsett State Park.



**Figure 3.** Students present their findings on Caumsett State Park bluffs.

Interactive, class-led discussion: In no instance did either instructor stand in front of a group of students, lecturing. Rather, students and instructors took turns explaining each slide in the set of lecture notes prepared by one of the instructors (**Figure 4**). We found that this greatly increased duration of attention spans, and prevented students from becoming passive observers. Compared to typical lecture-based courses, students raised many more questions and all were active participants in discussion.

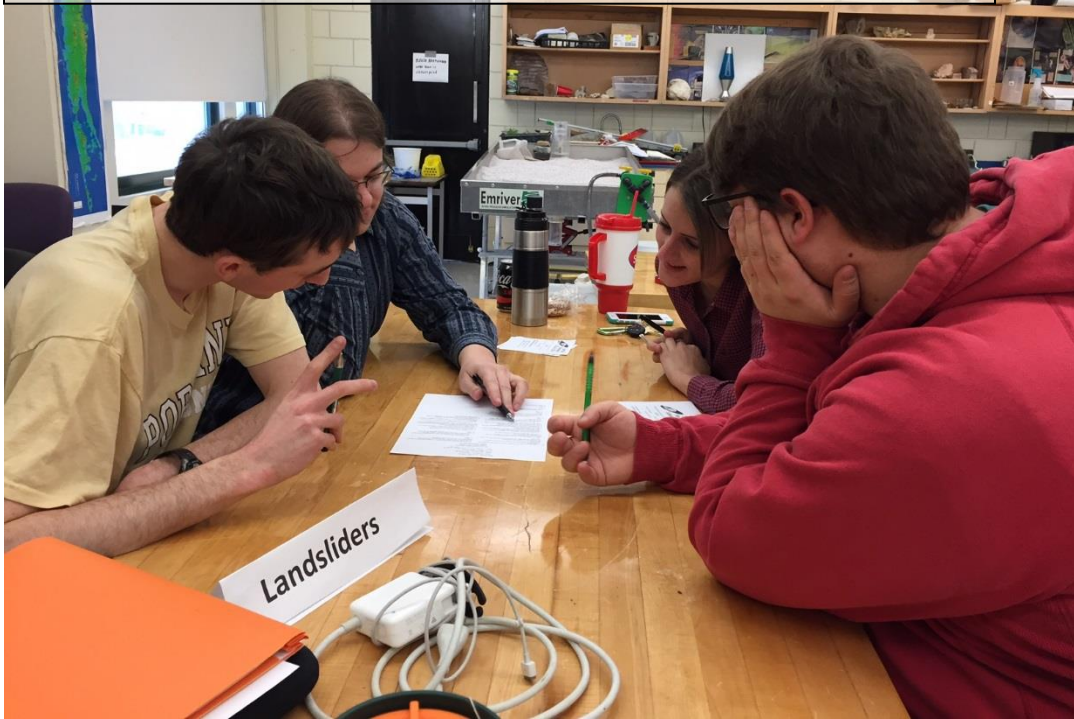
**Figure 4.** A student takes a turn talking about a slide from the lecture notes.



Beginning and end quizzes: Quizzes were administered at the beginning and end of every class period. The beginning quiz was mostly based on the reading assignment, which encouraged students to come prepared for class. A two-stage cooperative approach was utilized, in which students first took the quiz individually, and then took the quiz again as a group (**Figure 5**). Each person's grade was an average of the individual and the group grade, unless the individual grade was <60%, in which case the student's grade was the individual grade only. The cooperative approach allowed students to identify misconceptions and work together to arrive at a consensus. The end quiz was based on the day's activities, and usually took the form of an individual concept sketch. In addition to concept reinforcement, end quizzes encouraged students to stay for the duration of the class meeting and fully utilize the allotted class time.



**Figure 5.** Students take the beginning quiz as a group.



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