Anatomy In Action: Incorporating 3D Printing in Pre-Collegiate Anatomy Education

Beshoy Tawfik, Sam Dancis, Angelique Dueñas
University of Colorado Pre-Health Scholars Program

University of Colorado **Anschutz Medical Campus**
CU Pre-Health Scholars Program

Background and Objective:

The CU Pre-Health Scholars (CUPS) Program is an academic enrichment program for underserved high school students who are interested in healthcare and STEM-related professions. Part of the program's curriculum includes an anatomy course that aims to prepare students for the rigor of undergraduate anatomy education while inspiring interest in healthcare-related fields of study.

To increase student engagement, the anatomy curriculum was redesigned to incorporate the use of 3D printed anatomic models. In the redesigned Anatomy in Action Curriculum, students have a hands-on experience of discovering the relationship between structure and function by learning to 3D print anatomic structures in addition to more traditional lecture-based teaching.

Methods:

- 3D printing activities were chosen to engage students' visuospatial abilities by manipulating anatomic structures during the modeling process and after the model was printed.
- Funding was acquired to build a 3D printing lab which included five Prusa 3D printers (Figure 1).
- PrusaSlic3r software was used in the modeling process and open source online libraries of printable anatomic structures like Embodi3D were used. Models were also made using real imaging studies.
- Throughout the academic year, students attended monthly anatomy lectures, learned the basics of 3D modeling, and practiced printing models. Students then participated in an intensive six-week course during the summer (Table 1).
- Students worked in groups to choose a topic of interest and 3D printed a model that required mastery of anatomic principles to create (Figure 2).

Figure 1. Prusa i3 MK3 3D Printers in the CUPS 3D Printing Lab.

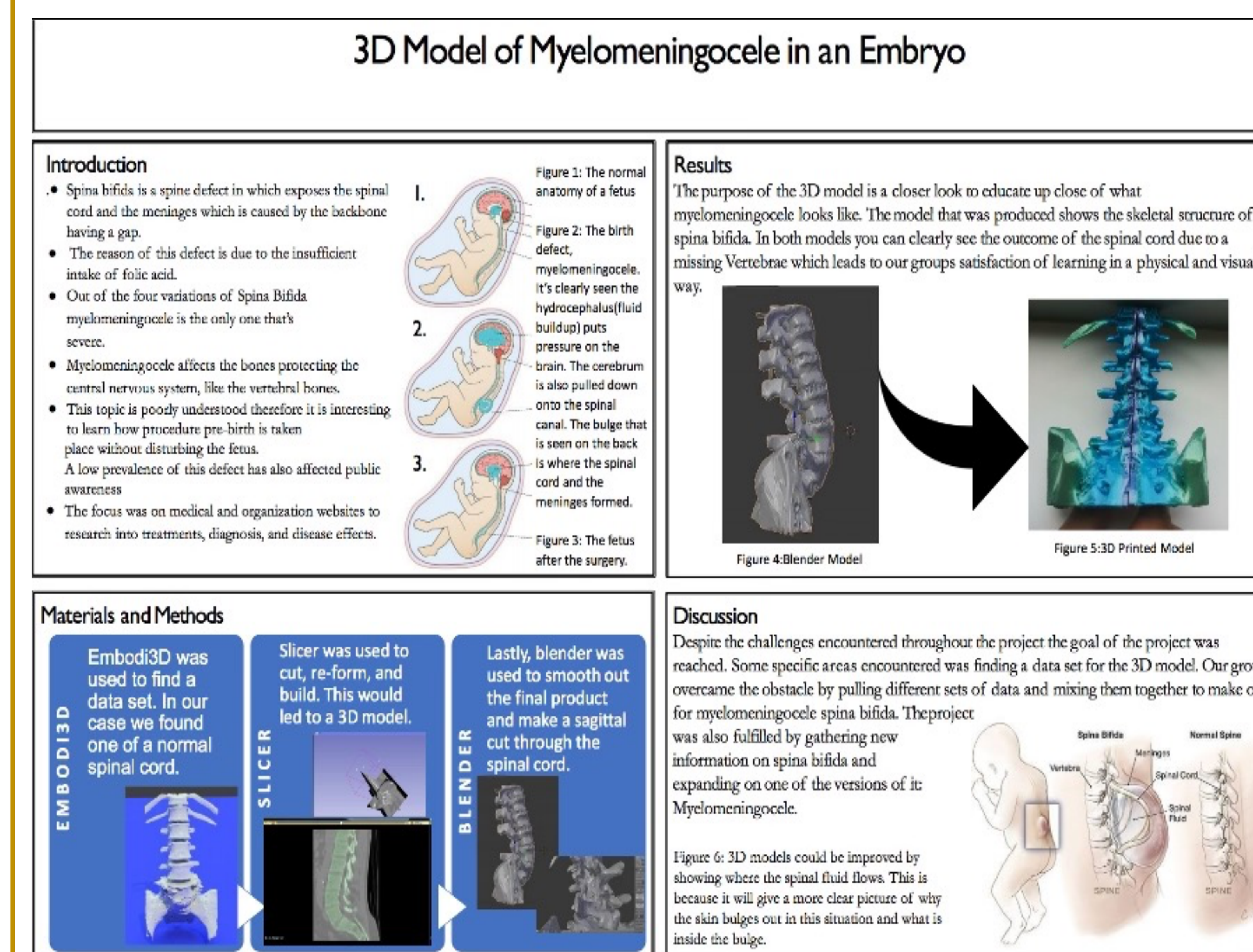
Table 1. Outline of the CUPS Summer Curriculum.

Week	Description
1	Body Structure and Organization Refresher Lectures Introduction to Summer Projects and Groupwork
2	Building and Manipulating Models Activities Literature Search Thorax and Cardiovascular System Lectures Introduction to Medical Imaging Lectures Slic3r Workshops and Troubleshooting Modeling Resources and Mentor Check-In
3	Abdomen and Digestive System Lectures Cadaver Lab Visit 3D Printing Workshop Group Activities Literature Search Digital Modeling Group Activities
4	Nervous System Lectures Cadaver Lab Visit Modeling Resources and Mentor Check-In 3D Printing Activities
5	Pelvis and Urogenital System Lectures Modeling Resources and Mentor Check-In 3D Printing Activities
6	Modeling Resources and Mentor Check-In 3D Printing Activities Final Presentations

Results:

Students printed their project-specific model and created a research poster which they presented at the CUPS Symposium during the final week.

Figure 2. Example of a student research poster modeling myelomeningocele in an embryo.



Summary/Conclusions:

- Both students and program leadership reported increased student engagement following adoption of the new curriculum.
- 3D printing has many applications within medical education and can be successfully integrated in a multimodal approach to pre-collegiate anatomy education.

Acknowledgments: The University of Colorado Office of Inclusion and Outreach; The CU Master of Science in Modern Human Anatomy Program