USC Viterbi

SHINE

Summer High School Intensive in Next-Generation Engineering

Civil Engineering Workshop with Ashrant Aryal And College Personal Essay Workshop with Megan Herrold

Time	Location	
9:30am:	Megan to tell students of their group in MCB 101	
9:35-11:05am	Group 1 w/Ashrant in MCB 101	Group 2 w/Megan in MCB 102
10 minute break		
11:15am - 12:45pm	Group 2 w/Ashrant in MCB 101	Group 1 w/Megan in MCB 102
12:45pm	LUNCH	

	Stay in MCB 101	Report to MCB 102
1	Katelyn Sulett	Achintya Pinninti
2	Luke Harris	Noah Shen
3	Tianhao Wei	Saul Droutman
4	Ameyalli Hill	Pearson Mewbourne
5	Max Edelstein	Angel Trujillo
6	Matthew Burke	Dhruv Aggarwal
7	Michael Kim	Abhinav Buddhavaram
8	Pratham Gandhi	Rayan Singh
9	Justin Jang	Alec Bernardi
10	Junzhe Huang	Ishaan Chandra
11	Mena Hassan	Ipek Goktan
12	Rachel Lobl	Bryant Huang
13	Alejandra Felix	Daniel Chung
14	Jaylene Lopez	Sarah Shintani
15	Jaya Hamkins	Jingyu Yan
16	Samuel Parra	Nova Dea
17	Marco Valadez	Jacklyn Oldoerp
18	Elizabeth Kim	Sarah Burke
19	Andrew Sung	Jordan Jaross
20	Jason Song	Arnav Nayudu
21	Riya Ranyan	Cassandra Jeon
22	Irie Cooper	Jehyeok Heo
23	Alexandra Fodannovski	Jennifer Gipson
24	Jiwoo You	

8/1: Poster Session and Certificate Ceremony

1:30 – 4pm: Poster and Presentation Session

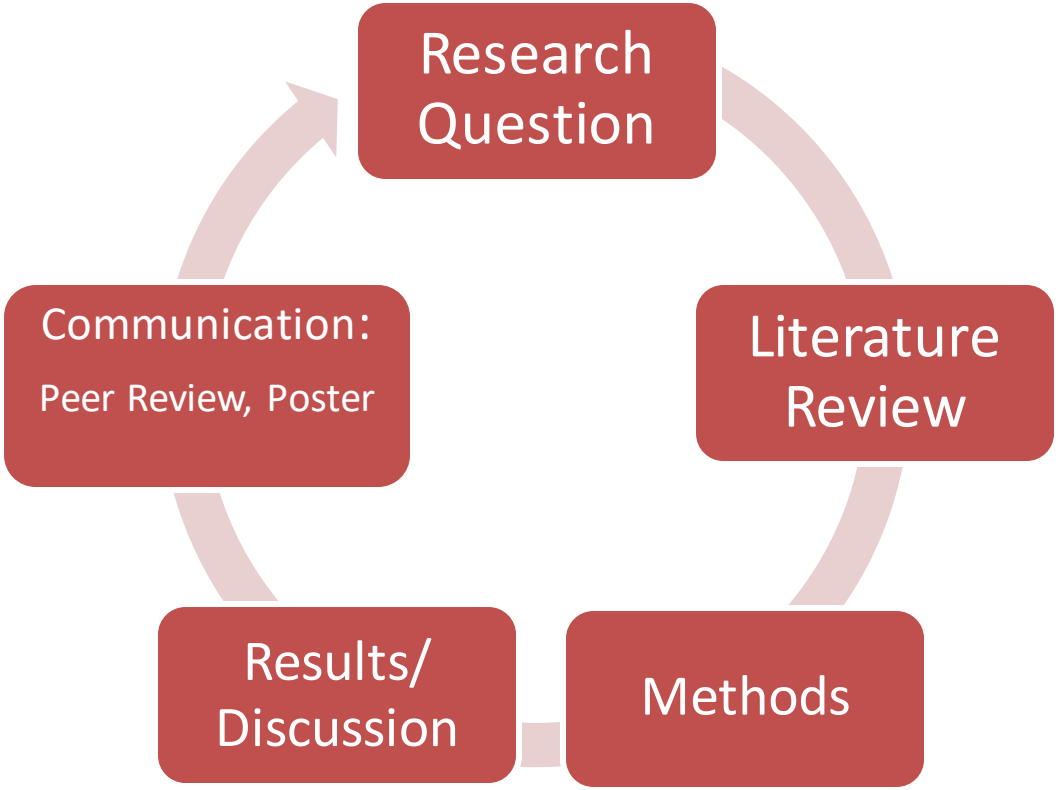
- **Poster Location: MCB Lobby**
- **Presentation Location: MCB 101, with the west wall open**
  - 1:30 – 2:15 pm: Biomedical and Chemical Engineering Presentations
  - 2:15 – 3 pm: Robotics Presentations
  - 3 – 3:45 pm: Materials Science, Electrical and Civil Engineering Presentations
  - 3:45 – 4:30 pm: Environmental and Aerospace Engineering Presentation

3:30 – 4:30pm: Light refreshments
Location: MCB Lobby

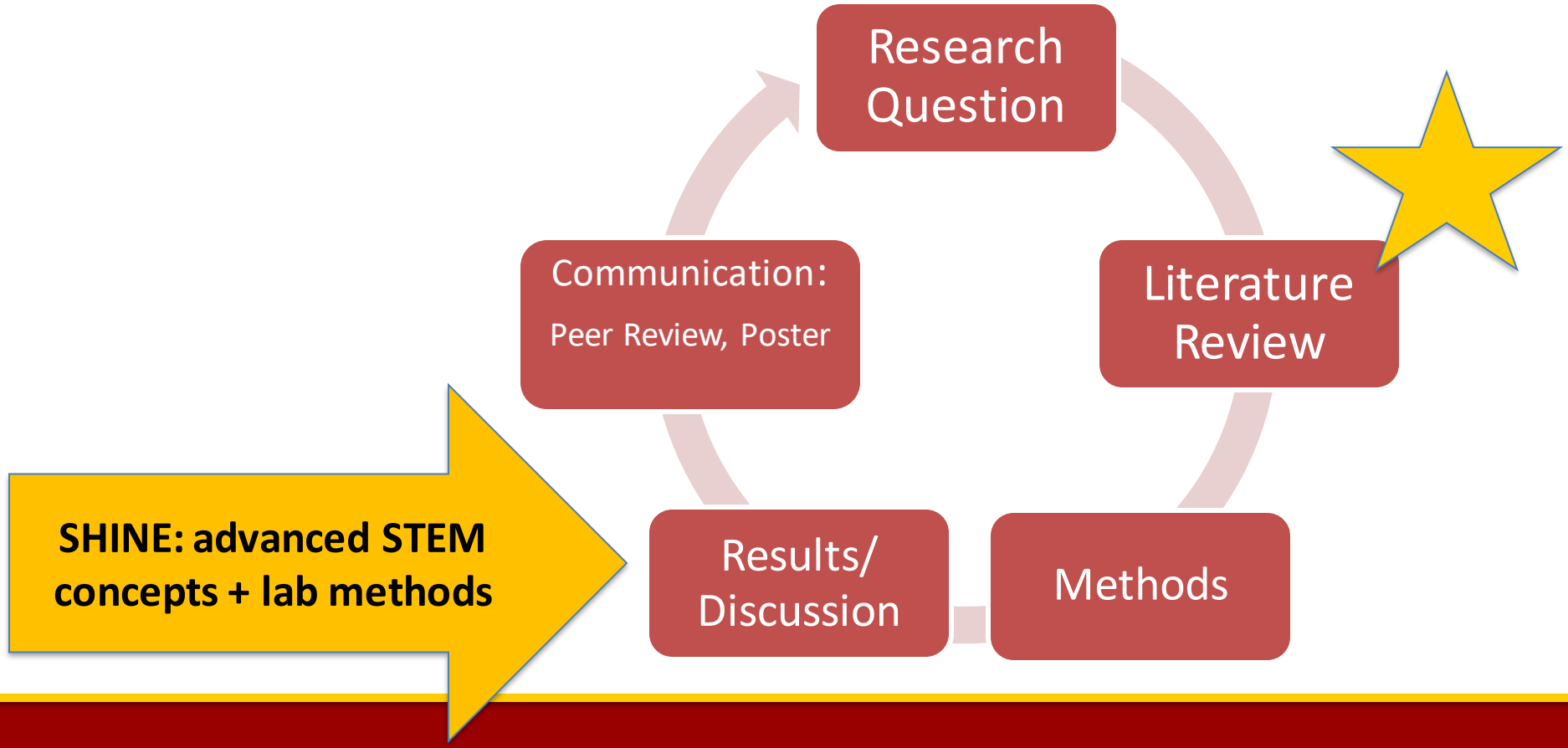
4:30 – 5:30pm: Certificate Ceremony
MCB 101 wall comes down, but more chairs in lobby space
Location: MCB 101

Time to start reflecting on what you've gained here at SHINE.
What have you realized about yourself & research?
What is left undone? Where will this take you next?

Where we started is where we finish:



Where we started is where we finish:



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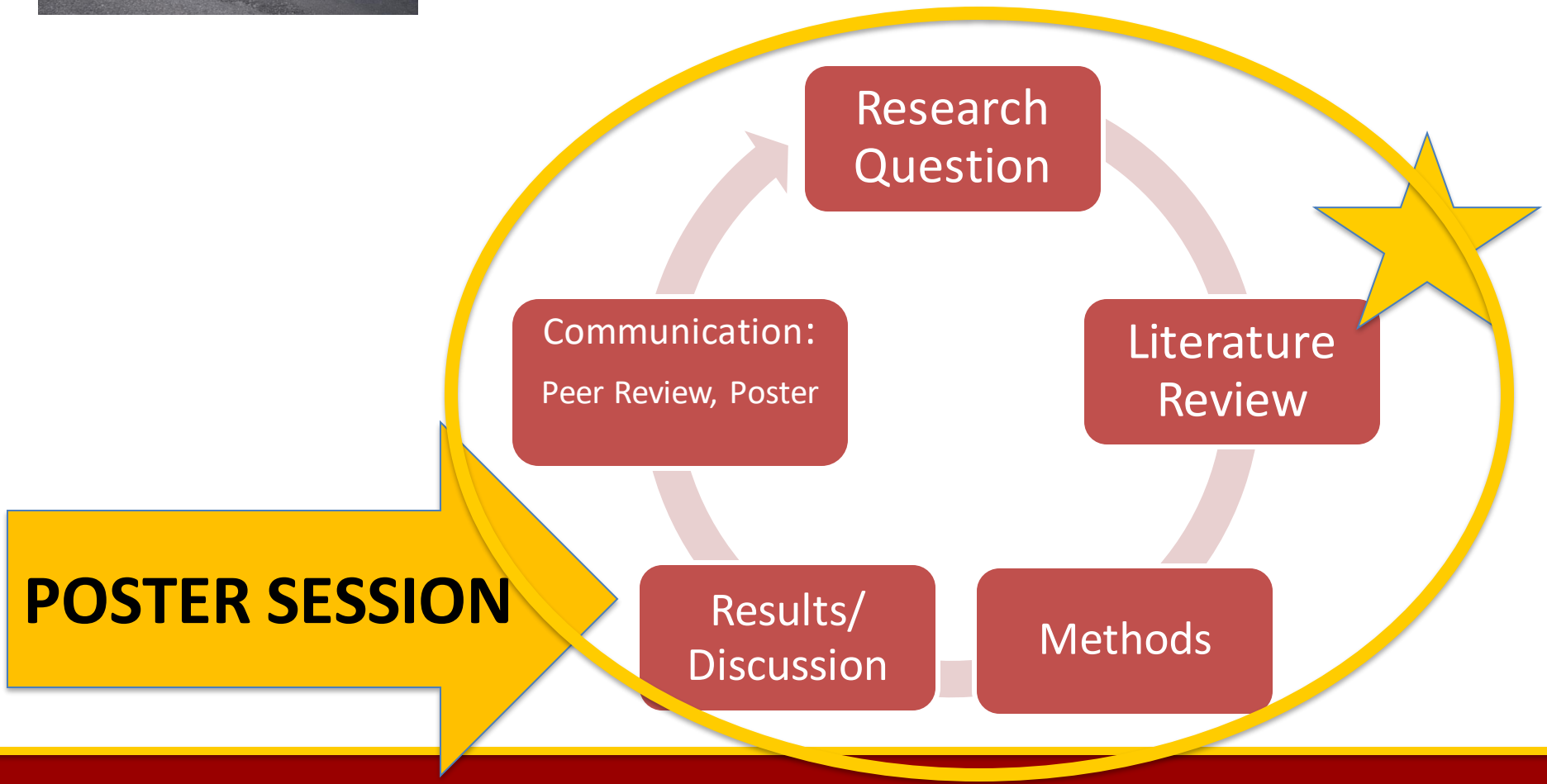
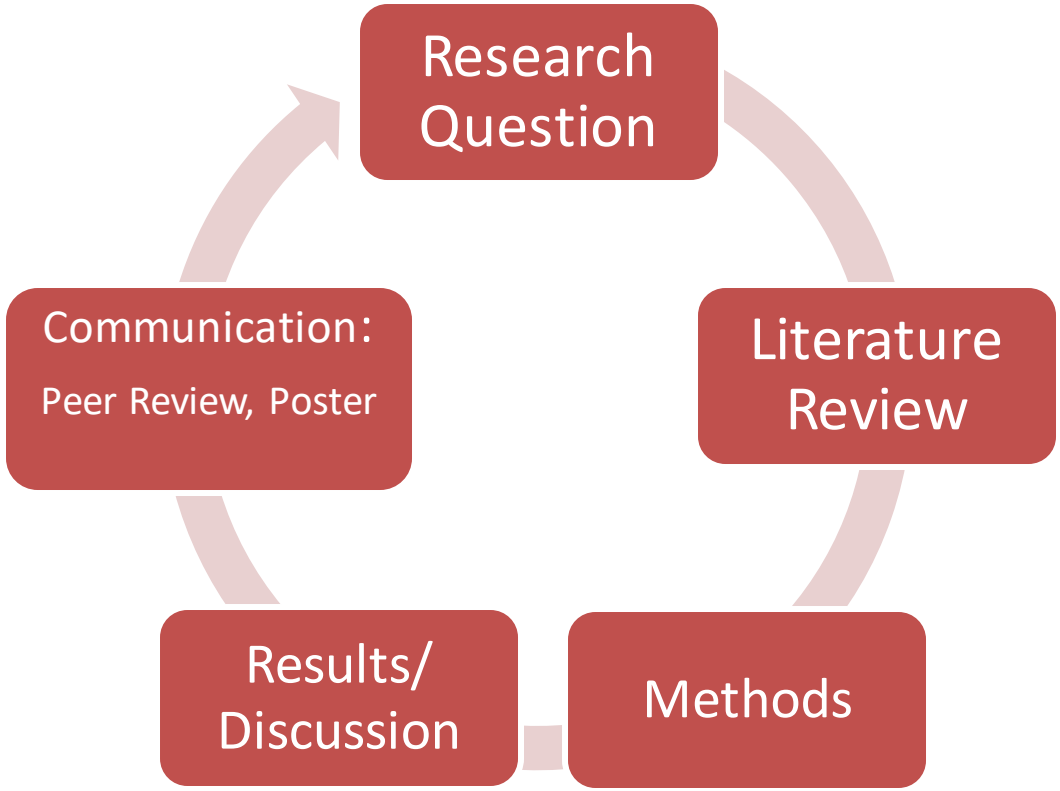


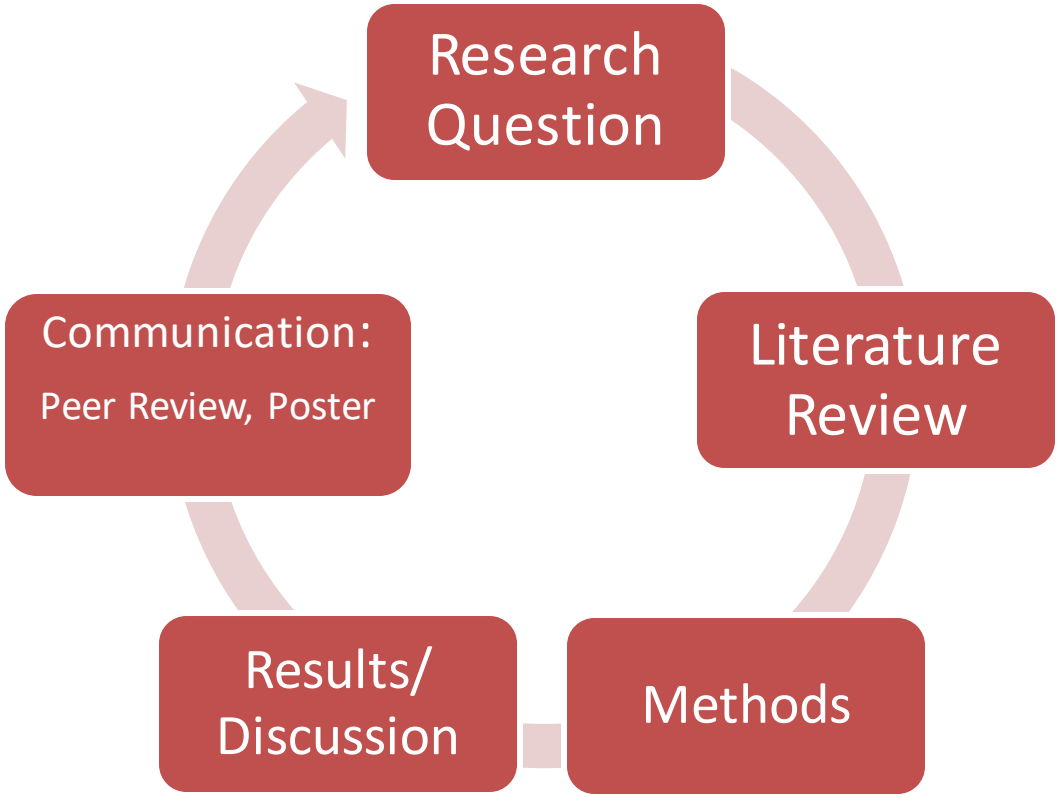
Where we started is where we finish:

What else is different ?



Do you see how research produces knowledge and social benefits:

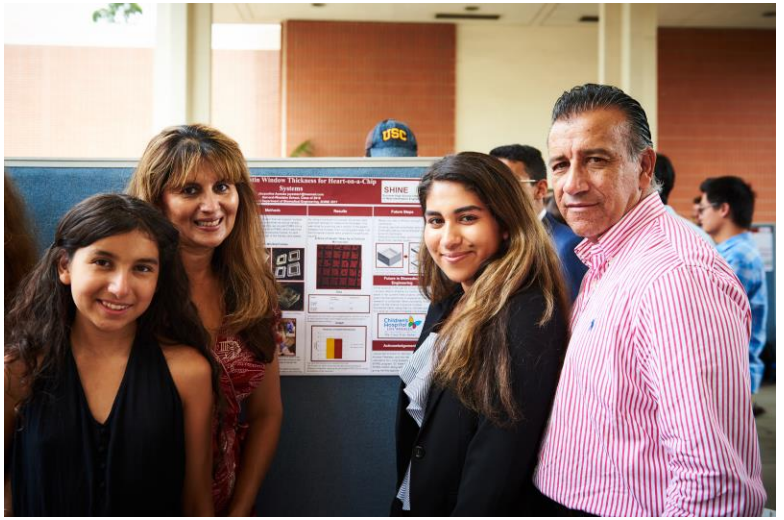
- detection and treatment of diseases, etc.
- jobs, grants, businesses, patents, etc.
- **How has it helped you know yourself?**

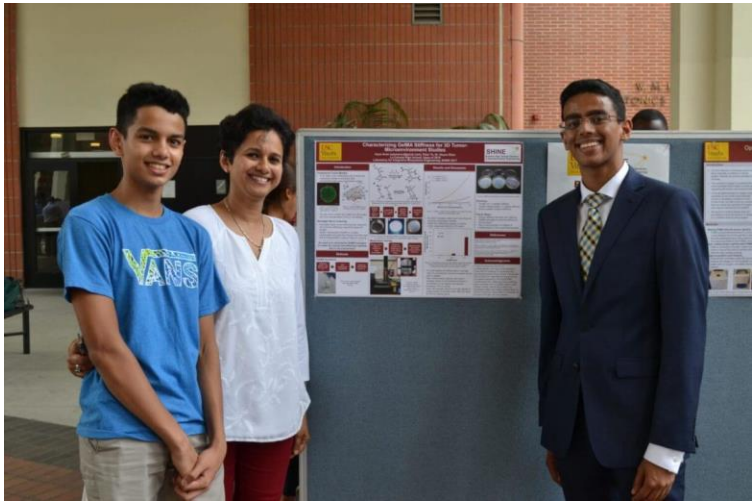


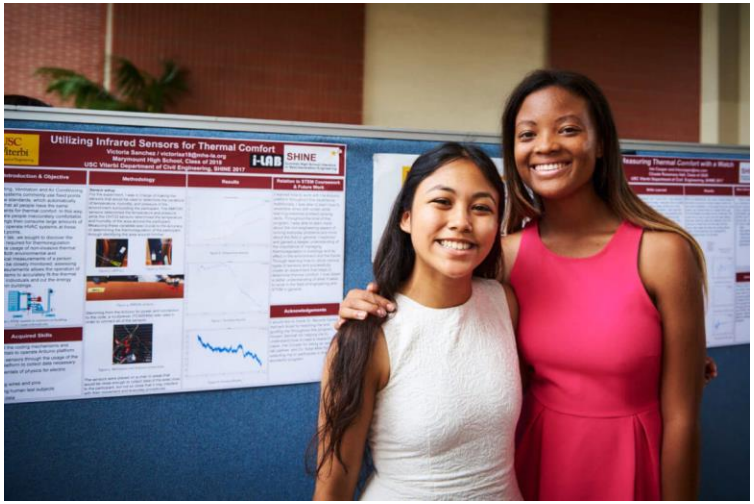
Do you see how research produces knowledge and social benefits:

- detection and treatment of diseases, etc.
- jobs, grants, businesses, patents, etc.
- **How has it helped you know yourself?**

It's the narrative you tell about yourself now!






Utilizing Infrared Sensors for Thermal Comfort
SHINE

SHINE MCB Set up
from 1:30 – 4pm

West Patio of MCB

Built-in table

6

6: Robotics
- 6a B.Huang & I.Cooper
- 6b R.Lobl & I.Goktan

7

7: Robotics
- 7a M.Hassan & C.Jeon
- 7b J.Huang & I.Chandra

8

8: Robotics & CS
- 8a R.Ranjan
- 8b J.Jang & A.Bernardi

Wall open

5

3-5: BME & Chem
- 3a N.Dea & S.Parra
- 3b J.Hamkins & J.You
- 4a J.Yan & J.Gipson
- 4b J.Lopez & S. Shintani
- 5a A.Fidanovski & D.Chung
- 5b A.Felix & J.Heo

9

9-12: Aerospace & Electrical
- 9a D.Aggarwal & M.Burke
- 9b M.Kim & J.Jaross
- 10a J.Song & A. Buddhavaram
- 10b R.Singh & P.Gandhi

4

10

3

101
Chairs set up in here.
West wall open.

102
We do not have this room

- 11a T.Wei & A. Nayudu
- 11b J.Oldoerp & L.Harris
- 12a M. Valadez & N.Shen
- 12b A.Pnninti & K.Sulett

1-2: Environmental & MS & Civil
- 1a A.Sung & M.Edelstein
- 1b A.Trujillo & P.Mewbourne
- 2a S.Burke & E.Kim
- 2b S.Droutman & A.Hill

1

2

11

12

McClintock

1:30 – 4pm: Poster and Presentation Session

- **Poster Location: MCB Lobby**
- **Presentation Location: MCB 101, with the west wall open**
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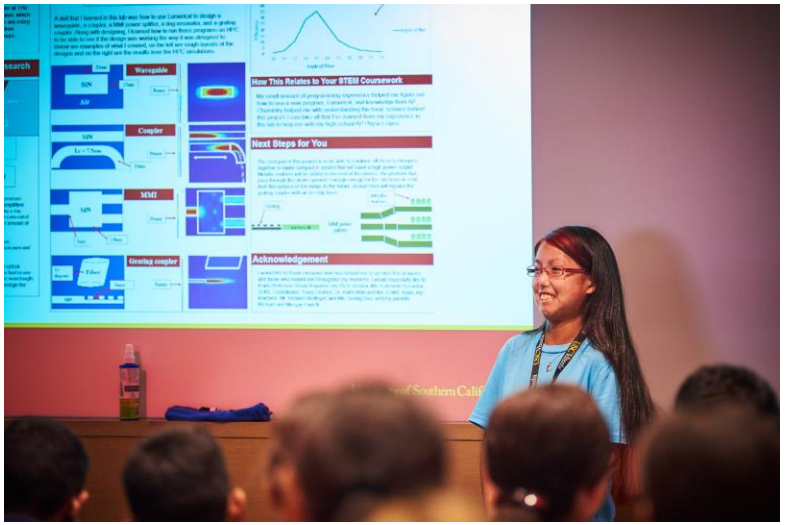

The Certificate Ceremony!

4:30 – 5:30pm: Certificate Ceremony
MCB 101 wall comes down, but more chairs in lobby space
Location: MCB 101

The SHINE Team is compiling all your posters as ppt. files AS WE SPEAK

Practice Session: Poster Presentations
Reminder: Poster Presentation Rehearsal on 7/31/19 in MCB 101

Development of Multi-Electrode Neural Probes for Rat Hippocampal Recordings

Leo Siow, siowleo@yahoo.com
Glen A. Wilson Class of 2016
University of Southern California, Department of Biomedical Engineering

USC Viterbi School of Engineering

SHINE Summer High School Intensive in Next-Generation Engineering

Introduction

The primary purpose of MEMS is to engineer extremely miniscule technology, which can be implemented in the medical field. Our research objective strives to fabricate a neural probe designed to observe the neural networks responsible for the formation of memories in the hippocampus. The process to create a device capable of recording electrical signals within a rat's brain is a long and complex one. First, we created brain probes using the process of photolithography. We designed and fabricated flexible, multi-electrode Parylene probes to record spikes from the Cornu Ammonis (CA) areas CA1 and CA3 and the Dentate Gyrus (DG) regions of rat hippocampi. This array of eight, custom made, flexible neural probes with eight recording sites per probe, targets particular hippocampal cell layers. The array also enables long-term hippocampal recordings of rats as they interact with complex, environmental spatial cues. The flexibility of the probes enables better integration with surrounding brain tissue and less micro-damage to nearby neurons when compared to damage caused by metal microwires to neurons. Since the probes are flexible, they must be temporarily stiffened in order to insert into brain tissue. Our research utilizes a block of a biocompatible adhesive, Polyethylene Glycol (PEG), to temporarily decrease the effective length of the probes, enabling them to penetrate brain tissue. In parallel to helping to develop an effective insertion technique, I designed and fabricated a printed-circuit board to connect the electrical traces on our probe to the appropriate electrical recording system.

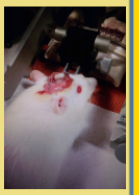

Figure 1: Probe insertion into live rat. *Photo credit: Jamie Chen*

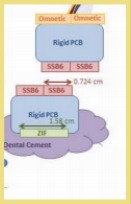

Figure 2: Electrical connection scheme from traces on probes to electrical recording system. *Photo credit: Ahuva Weltman.*

Objectives

1. Fabricate flexible neural probes:

- Inserting probes is a traumatic event for the brain, which causes a scar and dead zone to form around the recording sites and limits the probe's ability to obtain neural signals.
- Using a more flexible material, rather than the traditional metal substrates, attenuates this damage.
- We use Parylene, a USP Class VI material that is flexible and micromachinable to construct the devices.

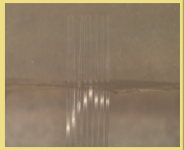

Figure 3: Released parylene C coated probes. The probes are flexible and prone to physical deformation. Acetone was applied for easier removal from wafer. *Photo credit: Leo Siow*

2. Test various techniques to provide temporary stiffness to neural probes:

- Flexible probes must be temporarily stiffened during insertion in order to penetrate brain tissue.

3. Design a printed-circuit board to connect probes to electrical recording system:

- We will be using software to design our printed-circuit boards, which will be part of our electrical connection scheme.

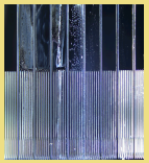

Figure 4: Unreleased sham probes on silicon wafer. The probes are flexible and made of Parylene. *Photo credit:: Leo Siow*

Research Process

Neural Probe Fabrication:

- Probes were microfabricated by using photolithographic techniques. (Fig. 5)
- Parylene served as the base substrate and insulation layer for our devices.
- Platinum electrode recording sites, traces, and contact pads will be lithographically patterned on top of the base layer using e-beam deposition at a thickness of 2,000 Å, followed by lift-off.
- Electrodes and contact pads will be subsequently exposed by DRIE and the probes will be cut out from the substrate.

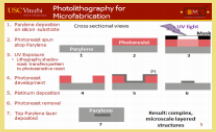

Figure 5: Step-by-step process of photolithography. The alignment step; was noted as the most difficult step. *Photo credit: Ahuva Weltman*

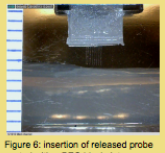

Figure 6: insertion of released probe coated with a PEG block into agarose gel. This is one of many trials. *Photo credit: Ahuva Weltman*

Optimizing Insertion of Probes into Brain

- Temporary stiffening techniques range from coating probes with a dissolvable, biocompatible stiffener to using microwire scaffolds to support the probes during insertion.
- We explored the use of Polyethylene Glycol (PEG) blocks to temporarily stiffen flexible probes during insertion into brain phantom gel (Fig. 9).
- The process of creating these PEG blocks involved the use of molds made from polydimethylsiloxane (PDMS) cut-outs. We used a three-layer mechanism, with the first layer as a base. The second layer served as a proprietor for our insertion tool (black rectangular object). The third layer contained an opening for the PEG to be poured into.
- In collaboration with the Berger lab, we inserted our sham probes into the rats. First, these rats were ensured to be sterile and clean. Next, we applied anesthesia to the rat with the correct quantity, to ensure the rat will have a painless experience.
- The sham probes were carefully positioned above the proper insertion zone.
- We used dental cement to secure the probe in place. When we retracted our insertion apparatus, the probe would remain robust and secure. The procedure was concluded to be successful, as the probes inserted properly without fail.
- A vivisection was performed to drain the blood by flushing formaldehyde through the rat's body, known as a perfusion.

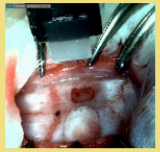

Figure 7: Insertion of our probe into a live rat. Probe was positioned carefully above insertion zones. We were careful to avoid contact between the insertion tool and cranium. PC: Ahuva Weltman, Leo Siow

Figure 8: Our insertion setup. Insertion apparatus and camera were positioned to record live insertions. PC:Leo Siow

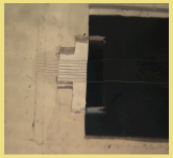

Figure 9: One of our PEG block models. We desired a slower melting rate for the PEG, thus we attempted to split the block into thirds. PC: Ahuva Weltman

Fabrication of PCB for Electrically Connecting Probes to Neural System:

- Eagle was used to develop printed-circuit boards and molds for our device. We used Eagle to create multiple parts for our device. This includes schematics, devices, symbols, and packages.
- After we complete all elements of our design, we will send the file to a fabrication house. The fabrication house uses our file to create a printed-circuit board, which will be used in our device to encode the memories from a rat into data readable by computers.

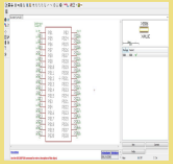

Figure 10: Schematic on Eagle software. Often the first step in fabricated a PCB. Thirty-four pins are visible in the diagram. which will eventually become a SSB6 plug. *Photo credit: Leo Siow*

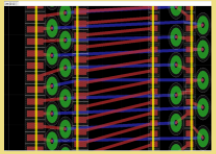

Figure 11: A broad view of a ZIF to SSB6 connector. Many traces are drawn. Interestingly, none of them are intersecting, due to the creative connection scheme in which both sides of the board is utilized. *Photo credit: Ahuva Weltman*

Relativity to My STEM Coursework

The research we did at the lab involves heavy use of theoretical knowledge to comprehend. For example, when we were exploring different options of inserting our probes into the brain phantom gel, we came up with the possibility of utilizing magnetism. Background knowledge from my Advanced Placement physics class provided valuable insight. Without this knowledge, I would not have been able to communicate with my fellow peers in the lab. In addition, our lab group wanted to find the force of insertion of the probe. Again, my experience from Advanced Placement physics provided me the ability to suggest mechanics-based solutions to the given problem. Such solutions included the use of the impulse-momentum formula, as well as Newton's second law. The scientific method was also presented to me at a higher level. Overall, my research abilities were greatly enhanced and also increased in formality. In high school, this will give my lab reports an edge compared to my other peers. The scientific integrity of my lab report will increase, due to the overlapping factors between high school and university science. Overall, my background knowledge from high school courses was beneficial in my participation.

Future of Project

The device will undergo many revisions, particularly to perfect the electrodes and traces. After the device is successfully fabricated, it will be tested on a live rat. The device is expected to analyze brain waves and neuron firing in the rat's hippocampus. This beneficial data will contribute to the study of the formation of memories in the brain. Eventually, if the project proves to be efficient, there is a possibility of commercialization. This may benefit millions of lives, including but not limited to, people who suffer from Alzheimer's disease. Other memory-related disorders may also be treated with this device.

Acknowledgements

Dr. Ellis Meng, Ahuva Weltman, David King, Huijing Xu, Craig Timms. Dr. Katie Mills, Luping Wang, Biomedical Microsystems Lab, Kenny Chan

USC Viterbi School of Engineering

University of Southern California

College Personal Statement Workshop

Adapted from The College Essay Guy

- Values
- Objects/Images
- Narratives

Values

- o community
- o inspiration
- o money
- o intellectual status
- o financial gain
- o laughter
- o serenity
- o physical challenge
- o responsibility
- o competition
- o career
- o fame
- o working with others
- o freedom
- o security
- o strength
- o self-control
- o self expression
- o stability
- o art
- o autonomy
- o risk
- o balance
- o self-discipline
- o courage
- o family
- o empathy
- o working alone
- o humility
- o efficiency
- o intensity
- o health and fitness
- o meaningful work
- o my country
- o challenges
- o commitment
- o leadership
- o helping others
- o influence
- o wit
- o success
- o patience
- o listening
- o diversity
- o love
- o fast-paced work
- o nutrition
- o competence
- o practicality
- o creativity
- o excitement

What is your #1 Value?

- Why?
- What is it about this value that makes it so meaningful?
- How does this value manifest in your life?
- OR: does this value resonate with what major/career path you want to pursue?

Object/Image

- Think of an object/image you associate with your Value
  - Something specific, concrete
- Why are these connected?
- Explain this connection in a story
  - Is this a BIG story or a little story?

Story Structure

- Decide if you need to go in depth, or montage

Going Deep? --> Narrative Structure

Adapted from Story Structure (used in most movies)

- Status Quo
- Inciting Incident/Status Quo Change
- Raise the stakes
- Moment of Truth
- Outcome/New Status Quo

Going Wide? --> Montage Structure

Many stories, images, moments tied together with common theme

- Find a focusing lens. A metaphor that can bring a lot of disparate aspects of you together to present yourself as a thoughtful, cohesive person.

Reminders:

- Poster Presentation Rehearsal on 7/31/19 in MCB 101 from 11:30am – 2pm

- SHINE Poster Session and Certificate Ceremony on 8/1/19 – Starts 1:30pm
  - Please be in MCB lobby by 1:00pm to set up.

RSVP for Poster Session!! Consult with your parents, RSVP here:

http://bit.ly/SHINE19-Posters

!!!HAPPY BIRTHDAY!!!

!!!Cassandra!!!