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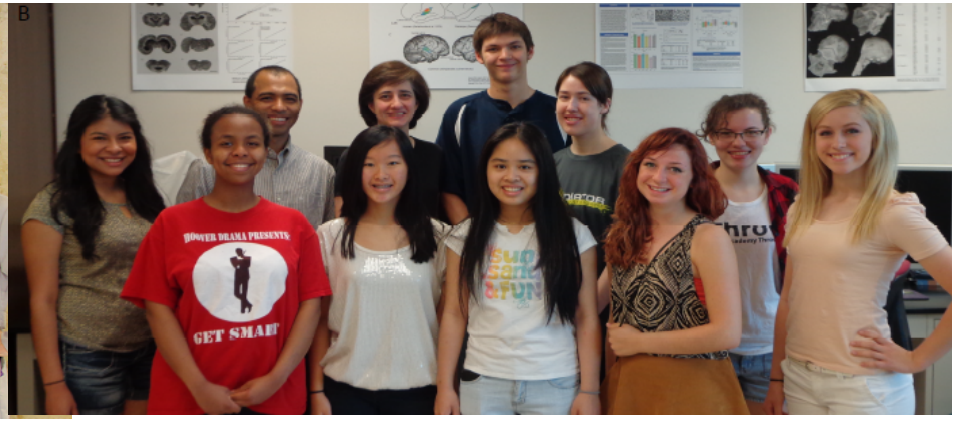
CENTRAL CAMPUS HEALTH SCIENCES

Community Engaged Scholarship: A Research Orientation Module in Comparative Neuroanatomy



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Department of Anatomy
The Evolving Brain Laboratory
Des Moines University

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Objectives

1. Provide an overview of Community Engaged Scholarship. What are the benefits and challengers to engagement? Why does STEM education matter?

2. Introduce you to the partners in our existing collaboration:

3. Provide an overview of the Research Orientation Module in Comparative Neuroanatomy and the Canine Brain Project as a model of community engaged scholarship. --- Student makeup and recruitment, Curriculum (Morphology, Behavior, Evolution – Community), Outcomes

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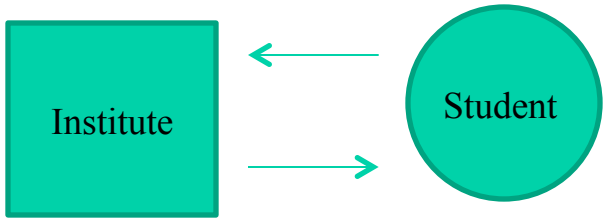
What is Student Engagement?

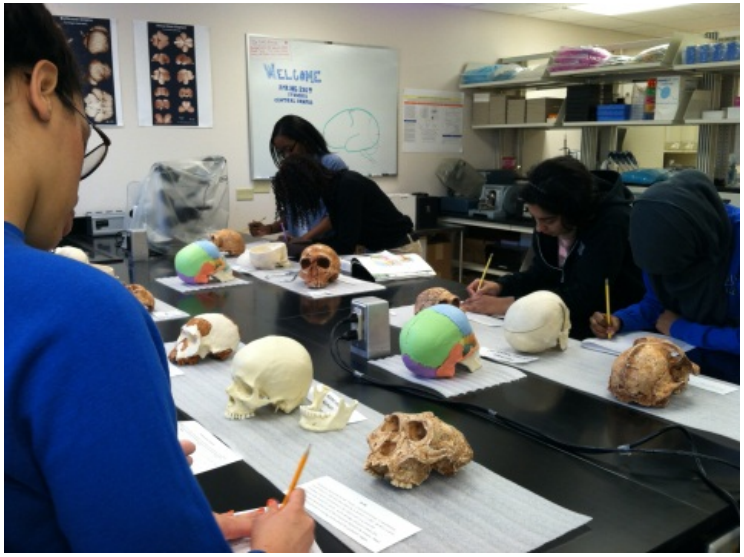
Engagement is the **quality of effort** a **student** puts into *educationally* ***purposeful activities*** *that* ***contribute*** *directly* ***to desired outcomes***" (Astin, 1993; Pascarella & Terenzini, 1991 from Hu & Kuh, 2002, 555).

Engagement is **a mutual relationship** between the student and the institution.

A student must be engaged, but the **institution must be engaged back** by creating **inclusive** and **affirming environments**, student-faculty contact, active and collaborative learning opportunities, and clear expectations (Wolf-Wendel, Ward, & Kinzie, 2009).



Engagement is a two way street. Institutions must engage students for students to be engaged.



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Why is Engagement important?

Engaged students gain more from college.
Students who are engaged get more out of the college experience in terms of learning and development than students who are not engaged or minimally engaged.
(Kuh et al., 2000; Pace, 1990b; Pascarella and Terenzini, 1991 ; Hu & Kuh, 2002)

Engagement contributes to retention.
Students who participate in extra-curricular activities, inter-collegiate sports, ROTC, campus employment, and undergraduate research projects with a professor are less likely to drop out than students who are not engaged (Astin,1984).

Engagement increases student success.
Institutions that provide engagement opportunities that integrate academic, social, and personal support such as summer bridge programs, mentoring, and student organizations create environments in which students are more likely to persist and graduate (Tinto, 2001).

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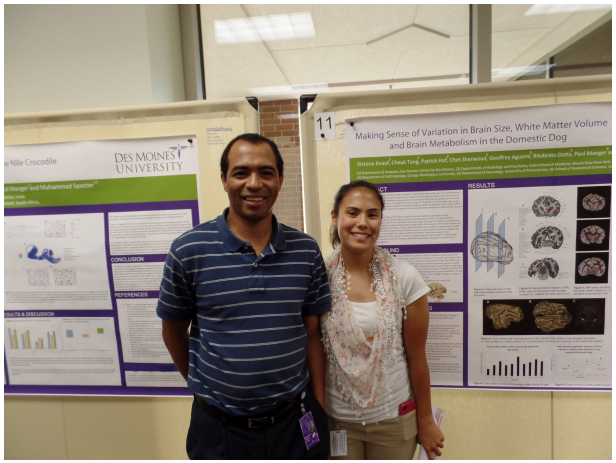
Why is Engagement important?



Engagement prepares you for the real world. Participating in internships or projects, for example, makes students more marketable to employers because of the leadership skills they develop during the experience. (Maskooki, Rama, & Raghunandan, 1998; Perry, 1989; Raymond, McNabb, & Matthaei, 1993; Knouse & Fontenot, 2008)

According to the National Association of Colleges and Employers, the top five skills sought after by employers when hiring students out of college are all related to the type of skills students can gain from an engagement experience like working in teams and problem solving. (NACE, 2013)

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What are the challengers to Engagement?

What about the disengaged or under-engaged student?

Astin (1984) refers to needing a "**hook**" to stimulate students to get involved in engagement experiences.

Remember, that if you build it, they might not come. Engagement opportunities need to be communicated far and wide beyond the engaged student pool, and students must see the value in the engagement. We must do more than just make students aware of engagement; we must create a means for students to have an emotional connection with engagement. (Vergara (2014)

Would they attend an event if a friend were going or if they cared about the event's purpose? What connects students to their own engagement?

The most engaged students tend to be:

- **Women**
- Full-time students
- Students living on campus
- Students who start and graduate from the same institution
- **Students in learning communities**
- International students
- **Students with diversity experiences**

(Kuh, 2003)

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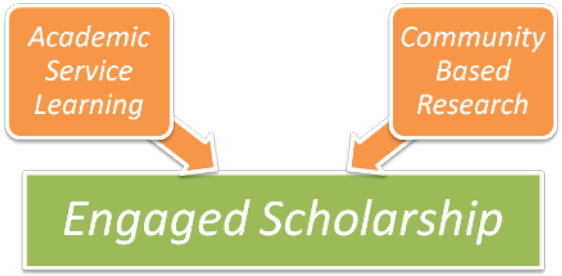
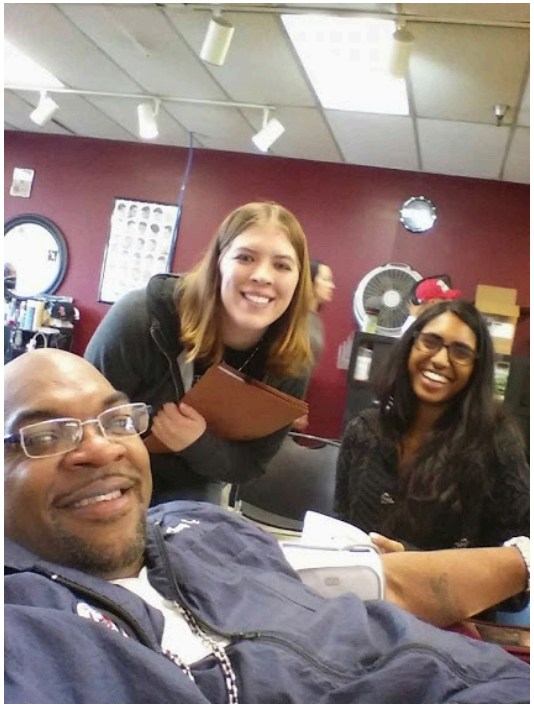
What is Community-Engaged Scholarship (CES) ?

Is scholarship that puts the academic resources of the university to work in solving pressing public problems and thereby contributing to the public good.



Academic Service Learning:
Courses that link the classroom and community through hands-on, experiential education that is transformative: - promote the interrelationship of teaching, research and service. Develop/ translates academic knowledge, critical thinking, and community engagement into civic responsibility, Foster mutually beneficial collaborations or promote positive social change

Community-Based Research:
Research projects undertaken by faculty and students in collaboration with community organizations that respond to community-identified needs, promote civic engagement and enrich the scholarship of the institution.



Calleson., et al 2005.

BUILDING THE MODEL

Des Moines University

Community Partner

Research foot soldiers

Real world opportunities

Community links

NEEDS?

NEEDS?

Collaboration with Community Partner

Select a framework for engagement → Use the framework to design the engagement practices → Encourage students to participate in engagement opportunities → Assess the developmental outcomes of student engagement

DMU Student Engagement

NEEDS?

NEEDS?

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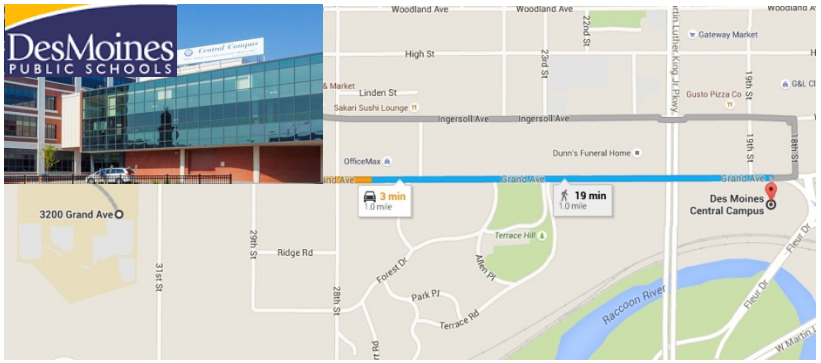
Identifying a Community Partner



Community Sketch: Central Campus

Des Moines is an urban community in a rural state. DMPS student population is 70% low income (based on eligibility for Free and Reduced Price Lunch program), 55% minority (including 7% Asian, 18% Black, 24% Latino, 6% multi-racial) and 18% English Language Learner.

Through Central campus high school students have the opportunity to take specialized college level classes and advanced learning opportunities. All students from the districts 5 comprehensive high schools are able to take a variety of classes at Central, while remaining enrolled at their home school. Non degree granting school.

Research has shown that when students from non-mainstream backgrounds receive equitable learning opportunities that are capable of attaining science outcomes comparable to mainstream peers (Lee, 2005).

NEEDS: Increase interest in STEM related fields, Decrease the Education Gap, improve student success rate

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Why STEM Education Matters?

- The USA is failing to produce enough skilled STEM workers
- USA is rapidly loosing its competitive edge
- US students aren't keeping up with students in other countries
- STEM shortcomings = loss in crucial research and development
- Reducing the basic scientific research that leads to growth
- STEM gap is costing Americans jobs and money
- STEM workers can expect high salaries
- Science, technology and engineering is where the jobs are at.

!

US Ranks 27th among developed nations in undergraduate science & engineering

1 in 3 Americans said they would rather clean a bathroom than solve a math problem

37% of American High School do not offer physics

60% of employers are having difficulty finding qualified employers

Only 16% of high school seniors are proficient in math and interested in STEM career

Only 1 in 2 US high Schools offer calculus

11% difference in wages between STEM vs non STEM degree counterparts

47% of bachelor degree holders in STEM fields earn more than PhD's in non STEM occupations

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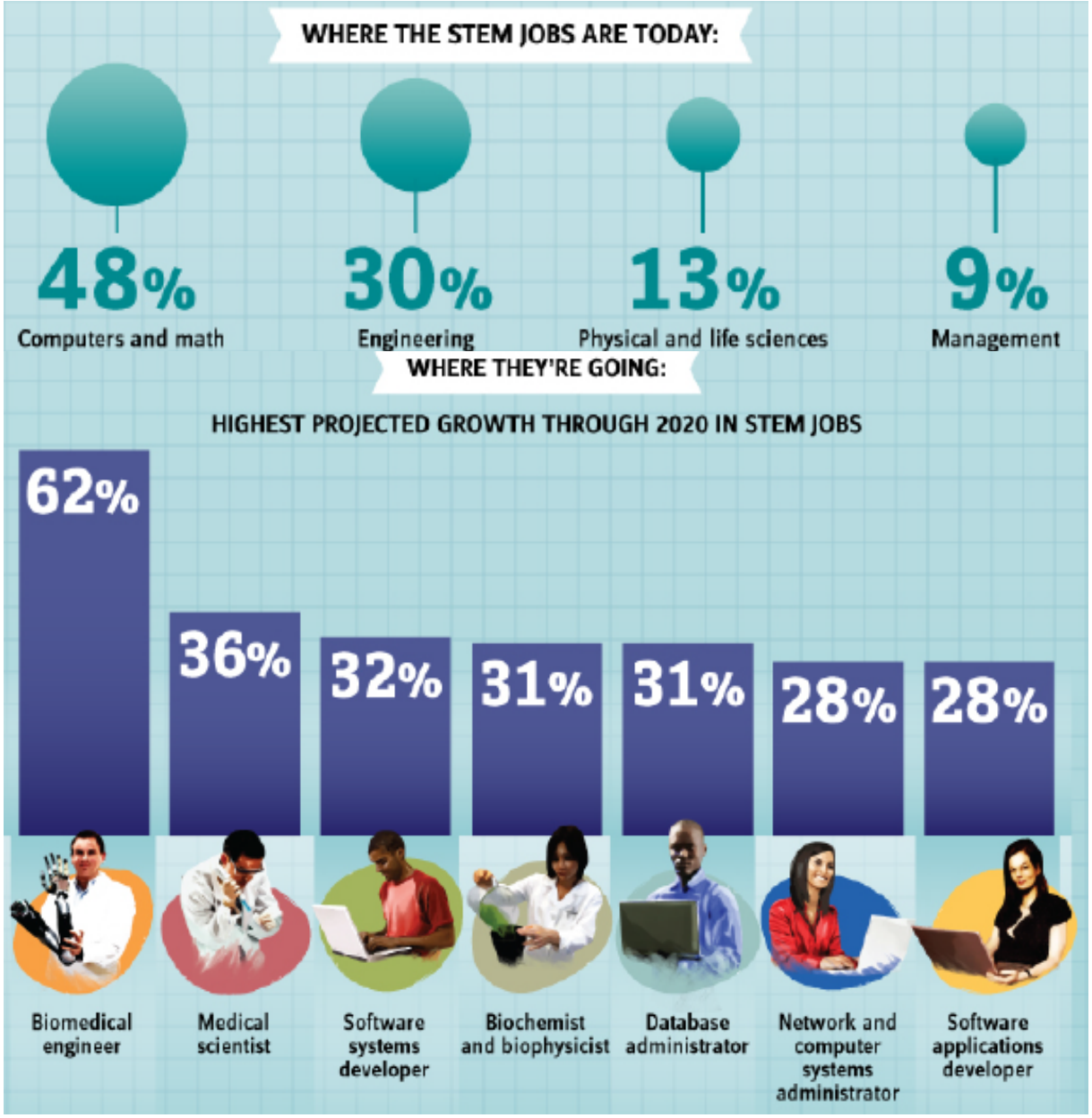

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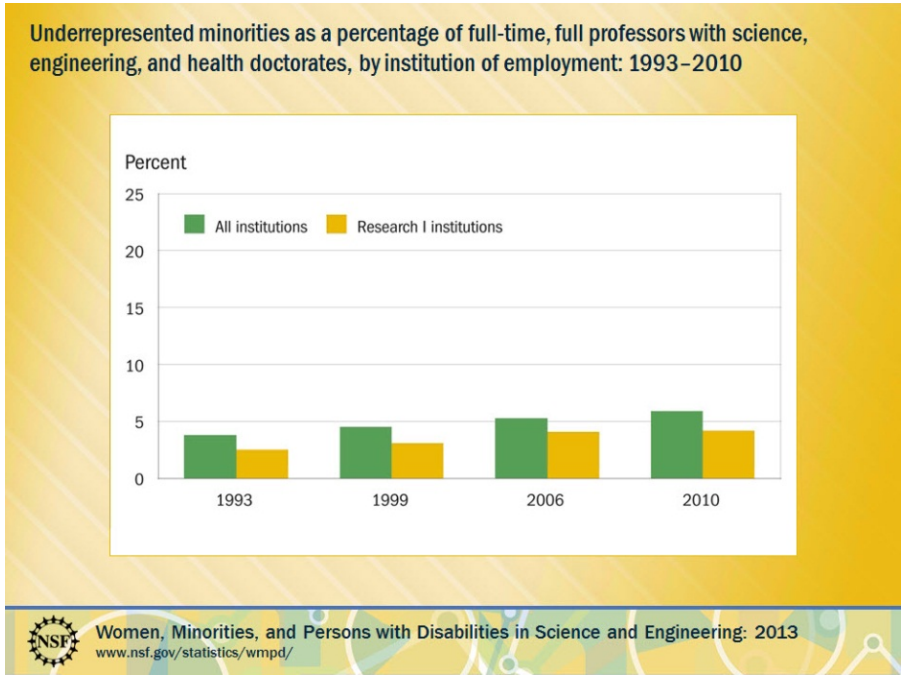
Where is the need for STEM?



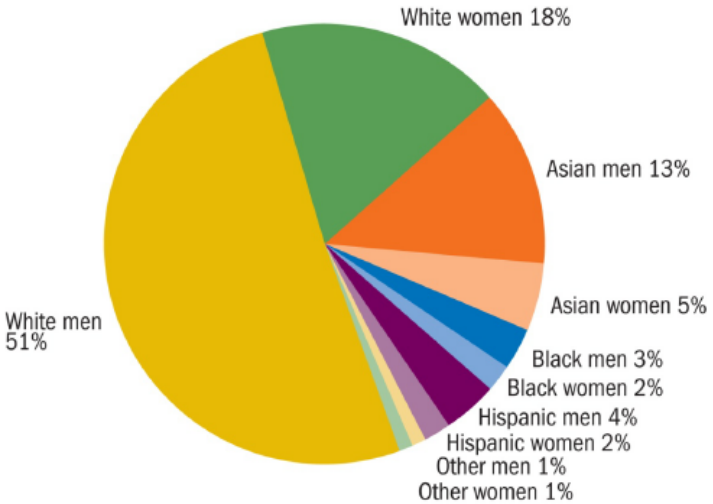
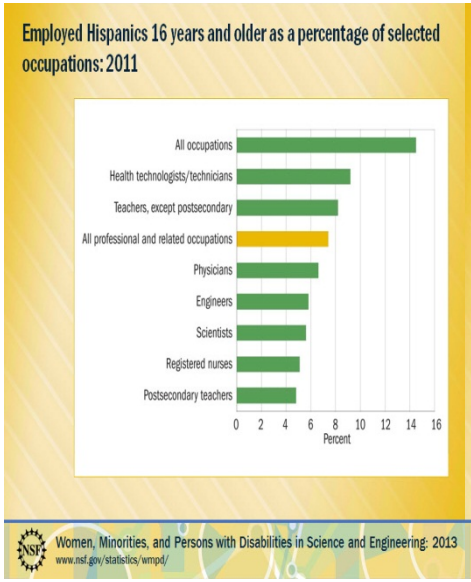
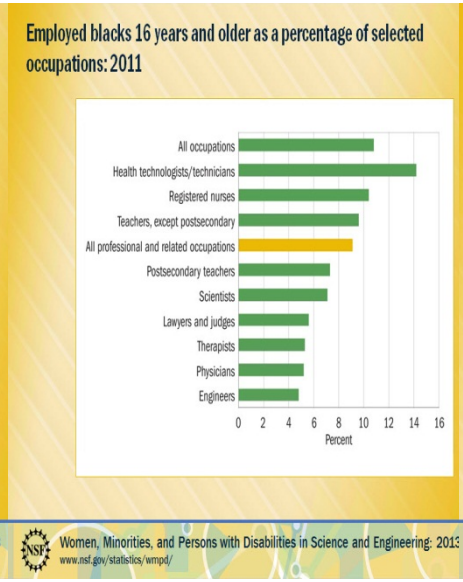
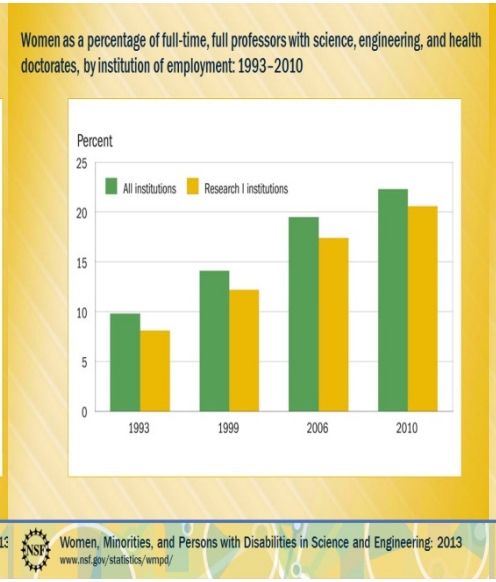
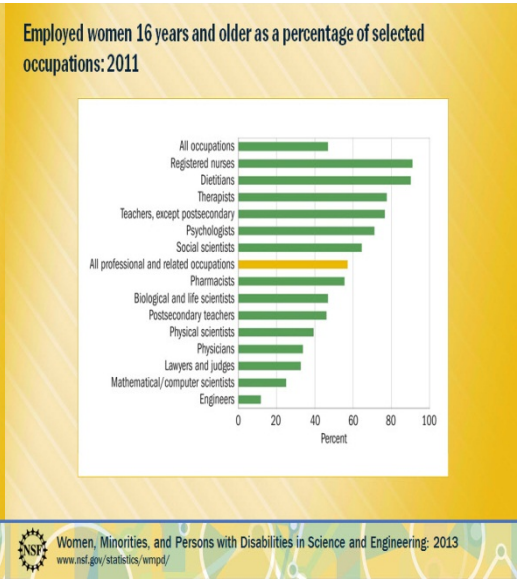


Figure 1: Scientists and engineers working in science and engineering occupations: 2010(NSF.gov/statistics)









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Addressing the Need!

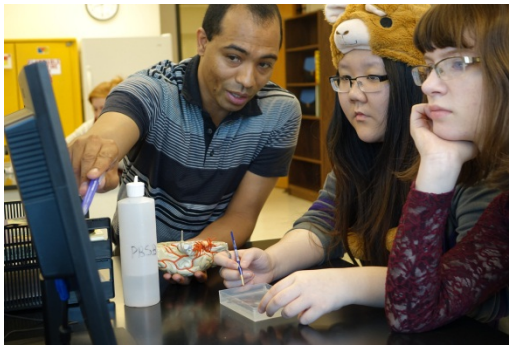
3 days a week (A-days)
Fall & Spring Semester
8am-9am, 2 years of data
N=22 students (~10 per class)

Course Name: Research Orientation Module in Comparative Neuroanatomy, Bio922 Field Studies (DMACC)
Instructors: Dr. Spocter, Mrs. Kacia Cain, Kathleen Bitterman & guest instructors

Course Purpose and Goals: This is an introductory course designed to familiarize students with comparative neuroanatomy and some of the research methods employed in mapping the human brain.

As a natural science course, it is designed to expose students to the scientific method and allow them to explore using basic observational skills and relevant theoretical knowledge, the underlying neuroanatomy controlling behavior in mammalian species. Students will have the opportunity to study science outside of the traditional classroom setting and to apply this knowledge by collaborating on a research project pertaining to mammalian brain evolution. Because this course assumes no prior knowledge of neuroscience, the first few class meetings will focus on fundamentals of neuroanatomy and neurophysiology. With this background we will survey functional systems in the brain, highlighting phylogenetic variation in projection pathways, neocortical diversification, and evidence of brain evolution from fossil endocasts.

Through this series of practical sessions, short lectures and seminars we hope to provide you with the suitable tools and exposure to neuroscience methods that will empower you to continue your inquiry beyond the classroom. Many of the skills you'll be exposed to during this research orientation are not exclusive to neuroscience and thus can be transposed to future careers in other disciplines requiring quantitative and critical thinking.



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Brain Mapping & Research Approach

In order to reconstruct the evolutionary history of neural substrates supporting a behaviour of interest there are a number of factors we would ideally like to know:

1) External morphology of the brain,

2) Size of brain regions, asymmetry

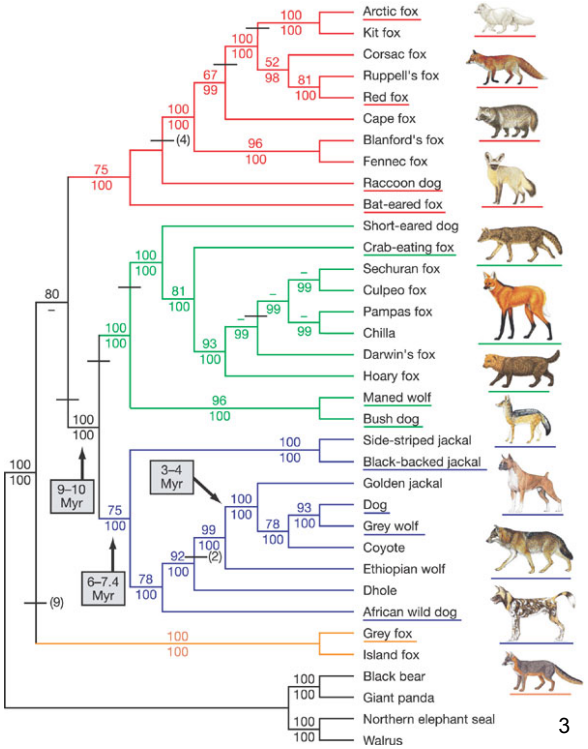
3) Number of subdivisions of these brain regions

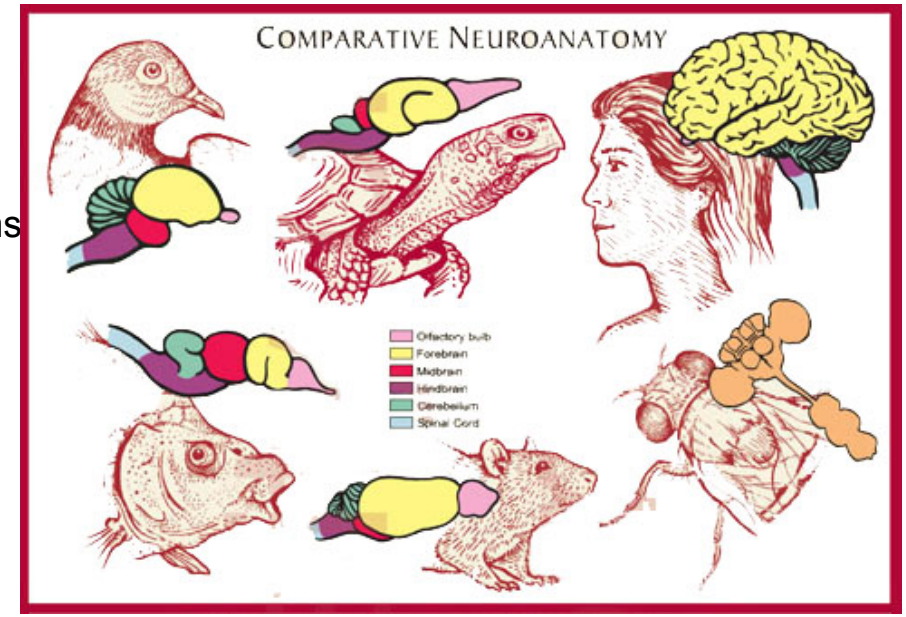
4) Neuronal morphology

5) Synapse density, axonal connectivity

6) Neurotransmitter and receptor levels

7) Genes underlying the development of regions and circuits/ changes in timing





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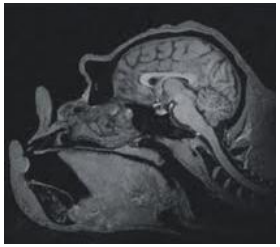
Creating a pipeline for mapping the brain

Tissue preparation and staining

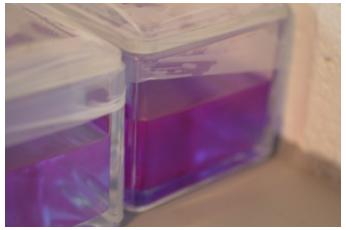
MRI Collection

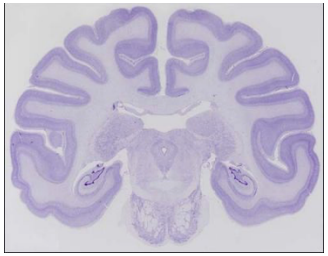


Fixation

Sectioned on Microtome

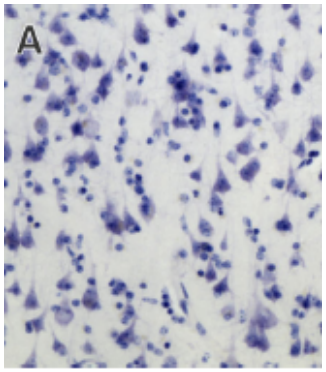
Slides are stained



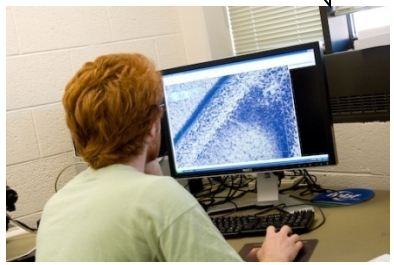


Nissl/myelin/
Imunohistochemistry

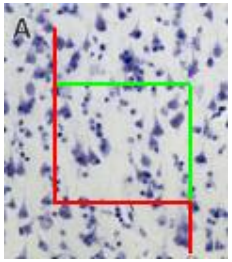
Workflow



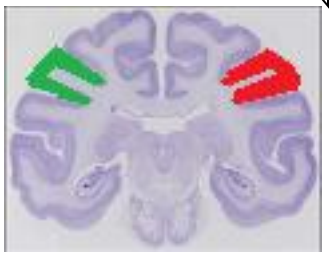
Nissl section 20X mag
Area identification



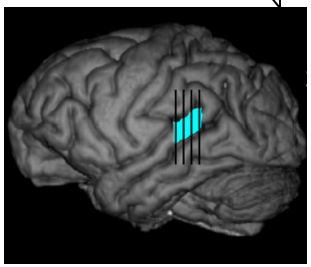
Cell counting (neuron #, density/area/vol.) estimates obtained using Stereological procedures



Point counting, random sampling design/ time and efficiency



Borders of areas are mapped onto flatbed scans of each slide



Areas delineated on slides are remapped back onto the MRI- (virtual cuts)

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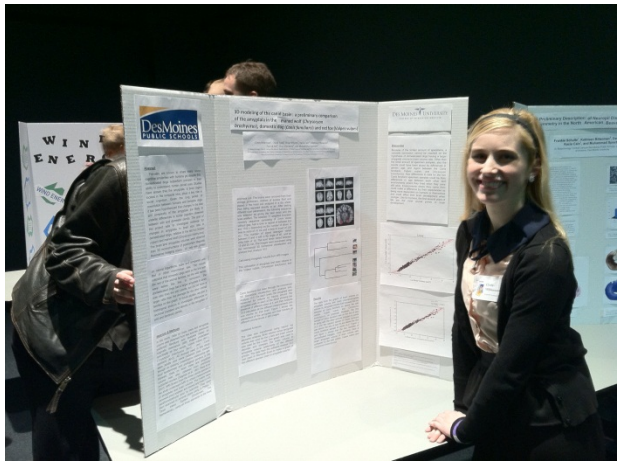
Course Goals

We will build our understanding progressively by working toward a series of **goals**. By the end of the course, you should be able to think like a natural scientist to:

- *Use your observational skills and basic quantitative procedures to contrast and compare features in the cerebro cortex of different mammalian species;*
- *Identify basic mammalian neuroanatomy and its functional correlates;*
- *Have a basic understanding of evolutionary theory as it pertains to the study of comparative neuroanatomy;*
- *Articulate the results of relevant scientific literature and the significance of any data collected during the research rotation;*
- *Evaluate the limitations in the data collected, how well or poorly this fits with existing models and the pitfalls and strengths of each of these models.*



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Prerequisites and Grading

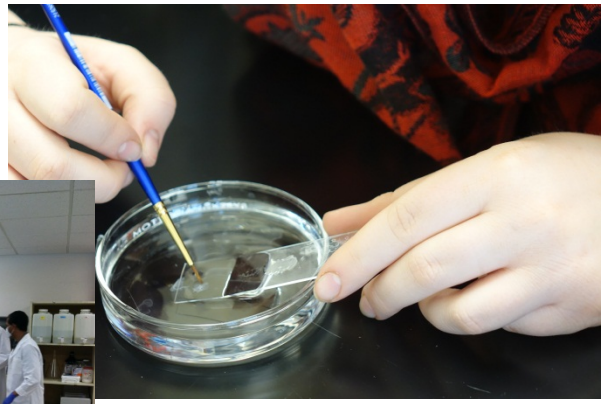
Class Prerequisites:
This course is open to all high school students meeting the requirements set out through our existing collaboration with the Des Moines Public School System (Contact: Ms. Kacia Cain).

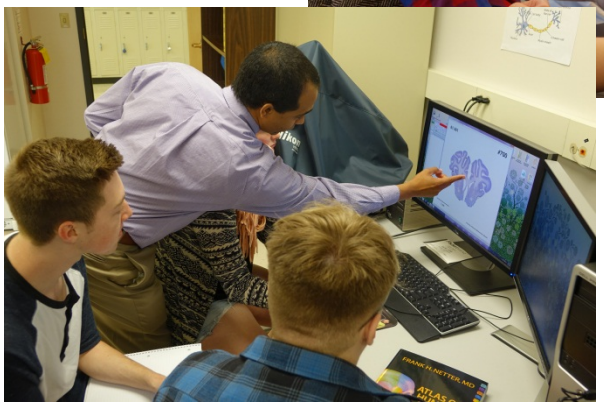
<u>Prerequisites include:</u>
Successful completion of college Anatomy and Physiology or college Biotechnology at Central Campus, and Concurrent enrollment in the second course, either college Anatomy and Physiology or college Biotechnology at Central Campus.

Grading Policy:
Attendance and Participation
To satisfy the class requirement of this course and to promote participation in the laboratory activities, half the total class grade will be based on an evaluation of your class attendance and participation in the laboratory. You are thus urged to attend the lecture series and to interact in group discussions in laboratory so as to ensure that you get the maximum worth from your learning experience. Please see the attached rubric for details of the assessment criteria.

As a component of your participation and learning experience, you will be asked to keep a research orientation portfolio. **Please bring a spiral bound notebook or composition notebook to class for this purpose.** This portfolio should consist of a weekly log of the research activities undertaken in the lab and the key issues learned during the orientation, lecture or discussion series. To sufficiently complete this task, each student is expected to spend a few minutes after each class reflecting on the orientation experience.

Project Assignments
The second half of your grade will be based on an evaluation of your literature review and team research projects. Complete project details and assessment criteria will be provided at the outset of each assignment.





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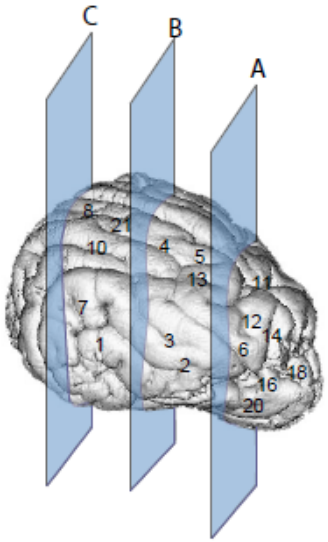
Canine Brain Project

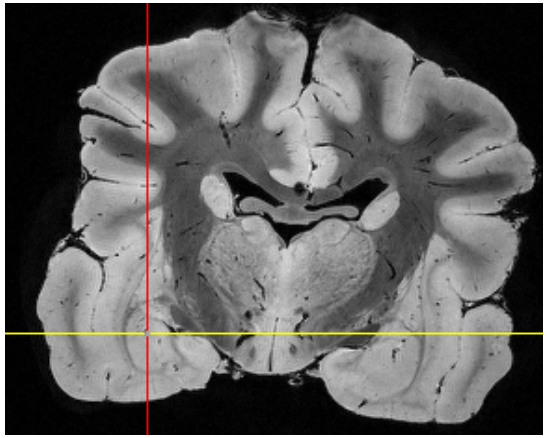
A research and educational initiative dedicated to the study of the canid brain and the use of canines in animal-assisted therapy

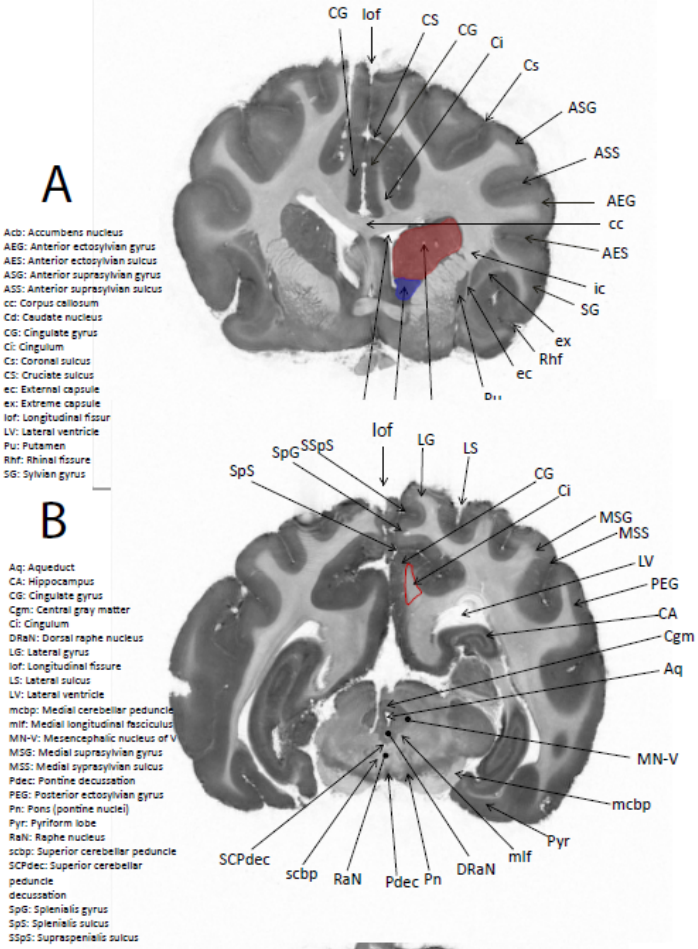
Specific Aim #1: Build a working digital MRI atlas of the canid brain which could be used by researchers and educators in veterinary medicine and neuroscience .

Specific Aim #2: Build a working digital histology atlas of the fox brain

Specific Aim #3: Contribute to the ongoing laboratory research focus on domestication and the use of canids as animal models.







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Assessment –Student – Broader Impact

Assessing Engagement Practices

- Project based-assessment – scored by peers and faculty.
- *Student development-identify intended competencies of each experience and evaluate the student and their participation in moving towards those competencies*
- *Student Departure/ Student Expectations-Interview students*
- *Student retention / Student continuation in STEM fields*
- *Professionalism*
- *Pre and post test survey*
- Google Analytics
- Youtube Hits

Assessment Rubric for the Research Orientation Module in Comparative Neuroanatomy Program

Name of student being evaluated: _____

Criteria	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
Intellectual curiosity	☐ Does not ask appropriate questions ☐ Does not engage in assigned readings	☐ Asks appropriate questions ☐ Engages in assigned readings	☐ Asks thought-provoking questions ☐ Engages in assigned and other readings
Motivation for self-learning	☐ Is not motivated; is overly dependent on other students and faculty	☐ Demonstrates a motivation for self-learning; use other students and faculty for further clarification as appropriate	☐ Exceptional self-learner; rarely requires clarification from others
Accepts responsibility for learning successes and failures	☐ Does not accept responsibility for successes and failures.	☐ Accepts responsibility for successes and failures.	☐ Readily accepts responsibility for successes and failures. Appropriately acknowledges successes of others.
Demonstrates cooperation and ability to both lead and serve as a team member	☐ Does not demonstrate cooperation ☐ Does not demonstrate an ability to lead and serve as a team member	☐ Demonstrates cooperation ☐ Demonstrates an ability to lead and serve as a team member	☐ Demonstrates exceptional cooperation ☐ Demonstrates an exceptional ability to lead and serve as a team member
Demonstrates respect for faculty, peers, and staff	☐ Does not demonstrate respect for faculty, peers, and staff.	☐ Does demonstrate respect for faculty, peers, and staff.	☐ Is always very respectful of faculty, peers, and staff.
Responds appropriately to constructive criticism	☐ Does not respond appropriately to criticism.	☐ Does respond appropriately to criticism.	☐ Actively seeks out constructive criticism and responds appropriately
Communicates with faculty in a timely manner and meets deadlines	☐ Does not communicate with faculty in a timely manner. ☐ Frequently does not meet deadlines.	☐ Usually communicates with faculty in a timely manner. ☐ Usually meets deadlines.	☐ Always communicates with faculty in a timely manner. ☐ Always meets deadlines.
Adheres to an appropriate level of ethical behavior	☐ Does not meet expectations. Is unable to recognize why their behavior is inappropriate.	☐ Adheres to an appropriate level of ethical behavior. Is able to recognize right from wrong.	☐ Adheres to a level of ethical behavior that is exceptional. Clearly recognizes right from wrong.
Recognizes personal strengths and weaknesses and can work to overcome or accept limitations	☐ Is not able to recognize personal strengths and weaknesses ☐ Cannot work to overcome or accept limitations	☐ Is able to recognize personal strengths and weaknesses ☐ Can work to overcome or accept limitations	☐ Clearly recognizes personal strengths and weaknesses ☐ Develops well defined strategies to overcome weaknesses and readily acknowledges limitations.

Adapted from Professionalism Assessment Rubric for the MSA Program, 2013

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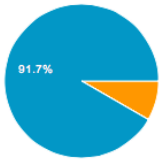
Post test Survey- June 2015 (N= 10)

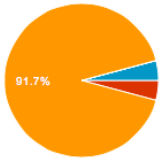
Summary

1. Primary nerve cell of the brain characterized by triangular shaped cell bodies



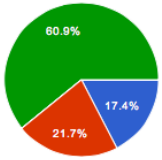
A. Amygdala	0	0%
B. Cortical columns	0	0%
C. Glial cells	2	8.3%
D. Laminar of the cerebral cortex	0	0%
E. Neuropil space	0	0%
AB. Pyramidal neurons	22	91.7%

2. Supportive cell in the central nervous system



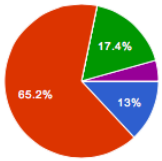
A. Hippocampus	0	0%
B. Cortical columns	1	4.2%
C. Glial cells	22	91.7%
D. Laminar of the cerebral cortex	0	0%
E. Neuropil space	0	0%
AB. Pyramidal neurons	1	4.2%

3. Organization of brain's outer most region into 6 layers



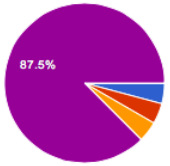
A. White matter	4	16.7%
B. Cortical columns	5	20.8%
C. Glial cells	0	0%
D. Laminar of the cerebral cortex	14	58.3%
E. Olfactory Bulb	0	0%
AB. Pyramidal neurons	0	0%

4. Connections "up" and "down" within the thickness of the cortex are much denser than connection



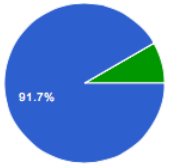
A. Occular dominance columns	3	13%
B. Cortical columns	15	65.2%
C. Glial cells	0	0%
D. Laminar of the cerebral cortex	4	17.4%
E. Neuropil space	1	4.3%
AB. Pyramidal neurons	0	0%

5. Any area in the nervous system containing a relatively low number of cell bodies.



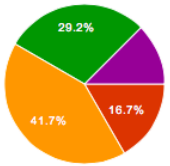
A. Amygdale	1	4.2%
B. Cortical columns	1	4.2%
C. Glial cells	1	4.2%
D. Laminar of the cerebral cortex	0	0%
E. Neuropil space	21	87.5%
AB. Pyramidal neurons	0	0%

6. Almond-shaped groups of nuclei located deep within the medial temporal lobes of the brain in complex vertebrat



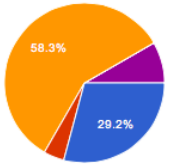
A. Amygdale	22	91.7%
B. Cortical columns	0	0%
C. Glial cells	0	0%
D. Laminar of the cerebral cortex	2	8.3%
E. Neuropil space	0	0%
AB. Pyramidal neurons	0	0%

7. How would you rate your confidence in your answers to questions 1-6, right now



Very High	0	0%
High	4	16.7%
Medium	10	41.7%
Low	7	29.2%
Very Low	3	12.5%

8. Acquisition of the same biological trait in unrelated lineages



A. Analogous traits	7	29.2%
B. Cladistics	1	4.2%
C. Convergent evolution	14	58.3%
D. Endocast	0	0%
E. Homologous traits	2	8.3%
AB. Phylogeny	0	0%

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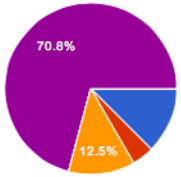
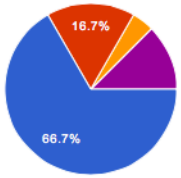
9. Similar characteristics with a common origin



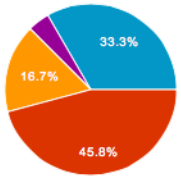
A. Analogous traits	3	12.5%
B. Cladistics	1	4.2%
C. Convergent evolution	3	12.5%
D. Endocast	0	0%
E. Homologous traits	17	70.8%
AB. Phylogeny	0	0%

10. Similar characteristics without a common origin



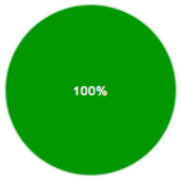
A. Analogous traits	16	66.7%
B. Cladistics	4	16.7%
C. Convergent evolution	1	4.2%
D. Endocast	0	0%
E. Homologous traits	3	12.5%
AB. Phylogeny	0	0%

11. The study of evolutionary relation among groups of organisms



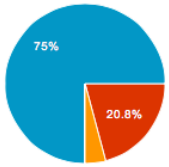
A. Analogous traits	0	0%
B. Cladistics	11	45.8%
C. Convergent evolution	4	16.7%
D. Endocast	0	0%
E. Homologous traits	1	4.2%
AB. Phylogeny	8	33.3%

12. A cast made of the inside of a cranial cavity to show the size and shape of the brain



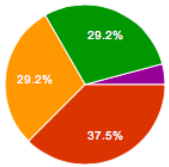
A. Analogous traits	0	0%
B. Cladistics	0	0%
C. Convergent evolution	0	0%
D. Endocast	24	100%
E. Homologous traits	0	0%
AB. Phylogeny	0	0%

13. A method of classifying species of organisms into groups, which consist of an ancestor organism and all its



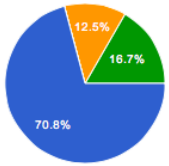
A. Analogous traits	0	0%
B. Cladistics	5	20.8%
C. Convergent evolution	1	4.2%
D. Endocast	0	0%
E. Homologous traits	0	0%
AB. Phylogeny	18	75%

14. How would you rate your confidence in your answers to questions 8-13, right now?



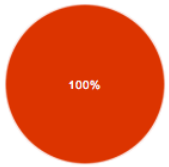
A. Very High	0	0%
B. High	9	37.5%
C. Medium	7	29.2%
D. Low	7	29.2%
E. Very Low	1	4.2%

15. Modeling the relationship between a dependent variable and explanatory variables



A. Linear regression analysis	17	70.8%
B. Mean	0	0%
C. Standard deviation	3	12.5%
D. Variance	4	16.7%

16. Average



A. Linear regression analysis	0	0%
B. Mean	24	100%
C. Standard deviation	0	0%
D. Variance	0	0%

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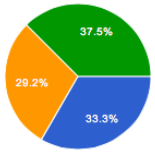
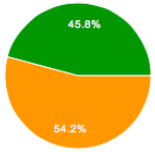
17. A measure of how far a set of numbers is spread out



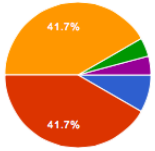
A. Linear regression analysis	8	33.3%
B. Mean	0	0%
C. Standard deviation	7	29.2%
D. Variance	9	37.5%

18. How much variation exists from the average or expected value



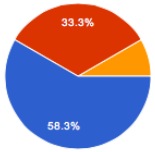
A. Linear regression analysis	0	0%
B. Mean	0	0%
C. Standard deviation	13	54.2%
D. Variance	11	45.8%

19. How would you rate your confidence in your answers to questions 15-18, right now?



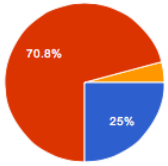
A. Very High	2	8.3%
B. High	10	41.7%
C. Medium	10	41.7%
D. Low	1	4.2%
E. Very Low	1	4.2%

You are likely to have had experiences with scientific equipment in the past. Below we present a l may use in the lab. Below each instrument name, rate your confidence level in using the piece of honest with your answers



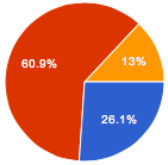
A. Very High– I ne
B. High– I n
C. Medium – I have used it but
D. Low– I have seen it or heard about it but h
E. Very Low– I'm not sure wh

25. How would you rate your interest in neuroscience right now?



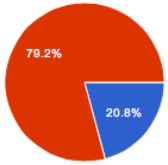
A. Very High	6	25%
B. High	17	70.8%
C. Medium	1	4.2%
D. Low	0	0%
E. Very Low	0	0%

26. How would you rate your interest in comparative neuroanatomy right now?



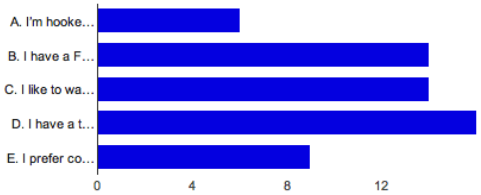
A. Very High	6	26.1%
B. High	14	60.9%
C. Medium	3	13%
D. Low	0	0%
E. Very Low	0	0%

27. How comfortable do you feel working with computer software?



A. Very comfortable, I could learn how to use this software on my own	5	20.
B. I need help starting out but I learn quickly	19	79.
C. I prefer to have someone guide me all the way through	0	
D. I don't like computers, I prefer pen and pencil	0	

28. How would you rate your experience with social media? Select all that apply.



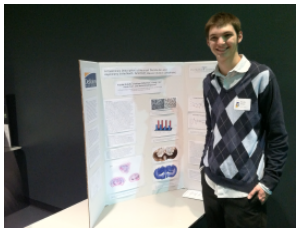
Is the model working?

DMU Students

Neurology Club

Faculty

Staff

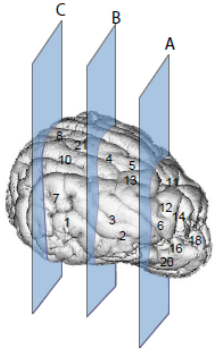


Framework STEM Education → Design Research Class → Participation → Outcomes

Faculty

Students

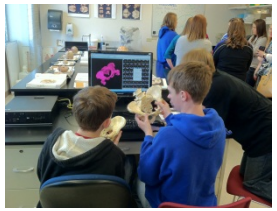
Real world opportunities



Research foot soldiers

Sustainable community link

PAWS & EFFECT



Collaboration

verizon foundation

DMU Student Engagement

Broader Impacts NSF

NSF

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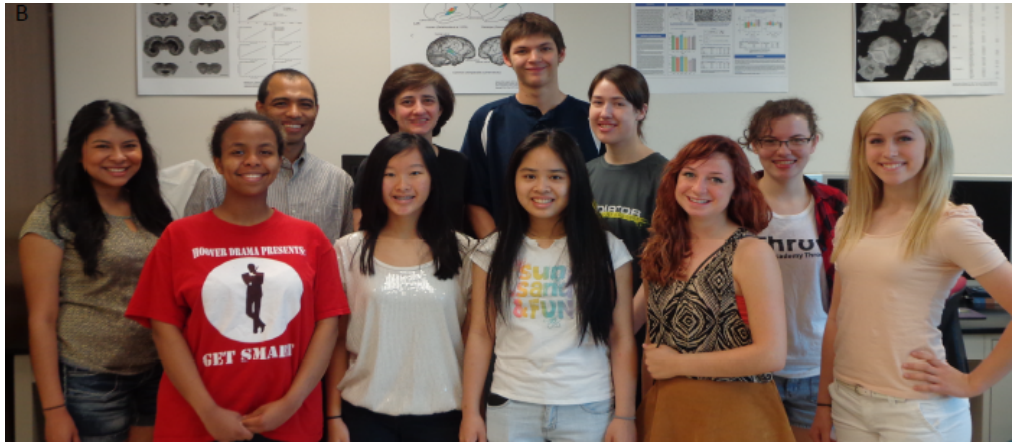
Conclusion

Significant benefits to our broader community in helping to engage learners early and building a pipeline towards graduate education in biomedical sciences

Start with knowing what is the need within your community and work together to build a framework for engagement

Know that there will be many challengers and that the benefits may not be seen in the short term- requires sustained interaction…Building a culture of engagement



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