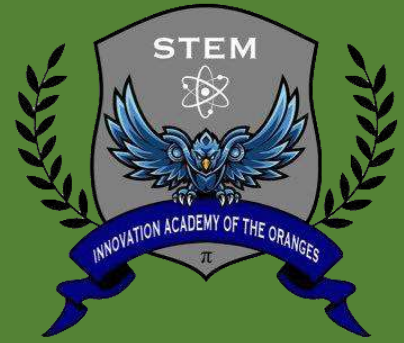


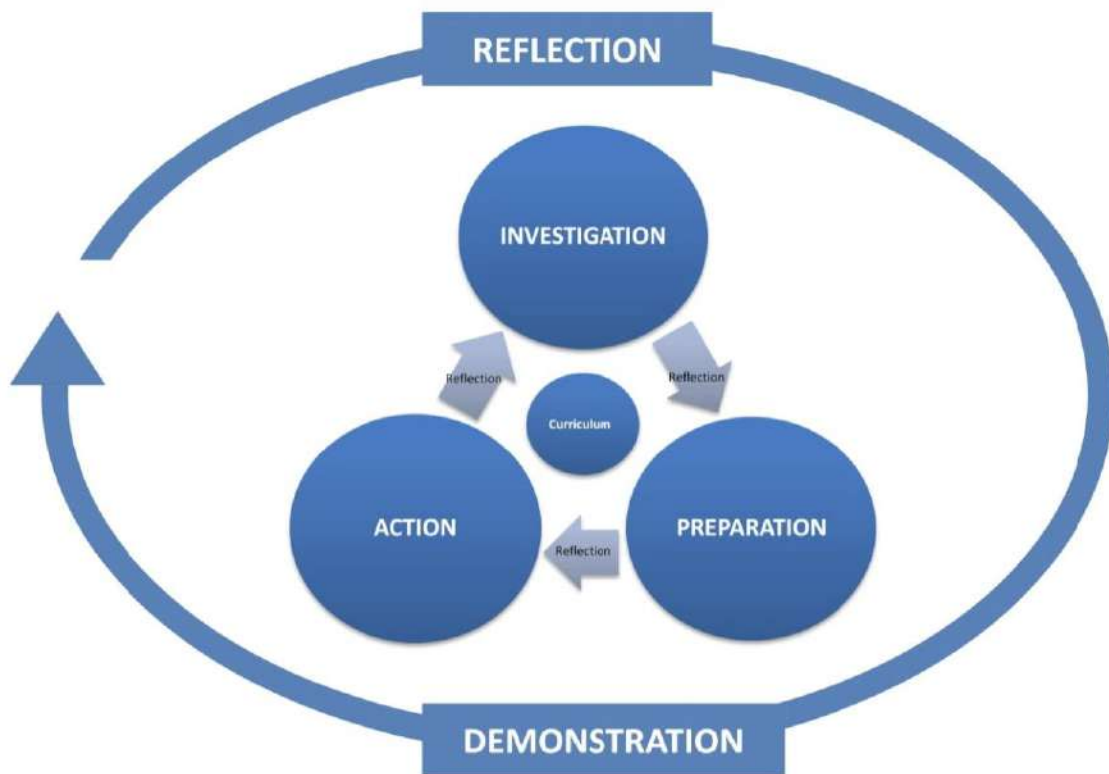
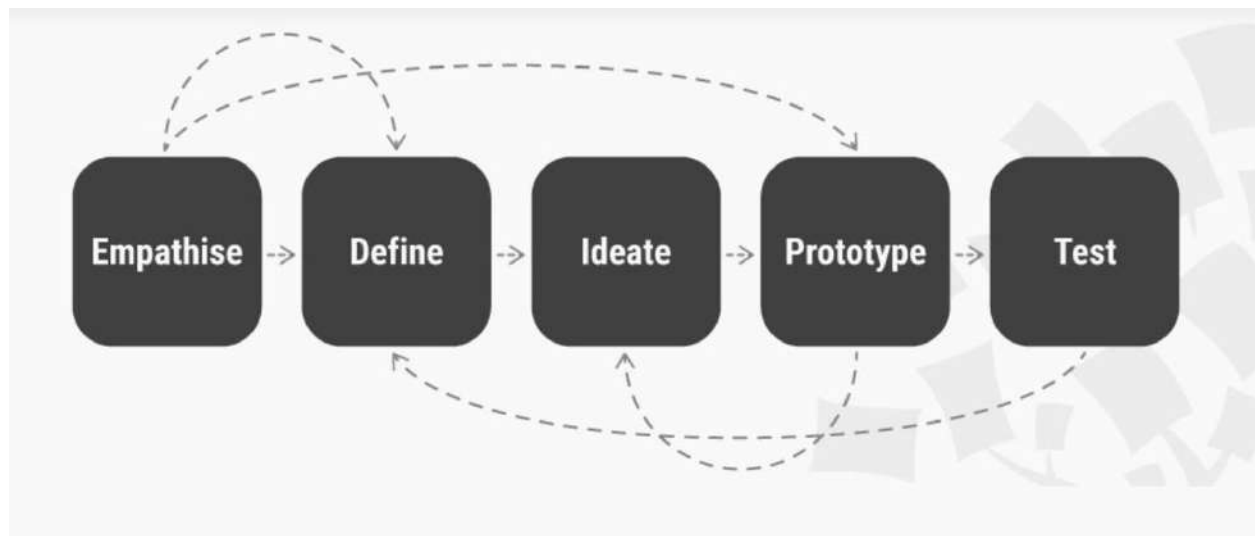
The Orange Public Schools

# The STEM Innovation Academy of the Oranges



## Senior Capstone Project Booklet

2020-2021



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## End of Year Capstone Projects: Descriptions



### Grades 12

#### SENIOR CAPSTONE

The Senior Capstone Project is designed to reflect a culmination of the students' experiences in their respective Track courses. The Senior Capstone integrates 3 elements: Community Service, Project Design, and a Research Paper such to explore and overall, student-selected Research Question. A full outline of expectations is described on page 3.



# Senior Capstone Project

A successful Capstone Design requires careful planning and organization



## Components of the Senior Capstone Project

Community Service



Research Report



Demonstrable Solution  
w/Engineering  
Notebook/journal



Presentation Board



Brainstorm

Determine  
Problem

Compose  
Hypothesis

Conduct  
Experiment

Collect Data

Analyze Data

Draw  
Conclusions

Complete by June 7, 2021

*Bolded headers reflect Pages in*

<input type="checkbox"/>	1.1.1 10 points	<b>Select A Partner</b> When selecting your partner please keep in mind that you will work with this person for the entire length of the school year. You may not have more than 3 people in your group. You and your partner will use the Experimental Design Process (Appendix B) as you complete each step of your project.
<input type="checkbox"/>	1.1.2 10 points	<b>Identifying a Project Topic</b> When selecting your topic try to explore something that you are passionate about, or maybe know little about. Start by going out into your community and asking questions. Take a walk around your school or through your town and ASK questions. Make a list of three topics that peak you and your partner's interest.
<input type="checkbox"/>	1.1.3 10 points	<b>Research Question</b> Clearly state your research question or problem. Your solution will be demonstrable; <b>applying what you've learned in your track classes to create a final project that helps answer your research question.</b>
<input type="checkbox"/>	1.1.4 15 points	<b>Securing your Qualified Mentor in your Field of Study</b> Whether you are completing a research project, you must secure a mentor.
<input type="checkbox"/>	1.1.5 30 points	<b>Literature Review/Rationale</b> Properly document all sources using APA format. Your Literature Review should answer the following questions: • What is the purpose of the project? • What is the conceptual framework informing your questions? • What theoretical perspectives or assumptions do you draw from? • What is the relevant existing work in the field, and how is your proposed project situated in relation to it? • <b>How is this a genuine need? What are the assets from your community/expert that have informed your rationale? What contribution might your project make to the field? • What can we learn from your work? • How might surveys be utilized to support your research question?</b> <i>If you reached out to local community members, then please include the mode of communication and professional correspondence. *If your project requires specific supplies to be order you must notify your track instructor three weeks before the supplies are needed. When planning your methods keep the following in mind: • Try not to</i>

		<i>schedule data collection over breaks • Weather could potentially impact outdoor projects; Materials are not always available • You may need to obtain transportation to meet with your mentor or to conduct your research.</i>
<input type="checkbox"/>	1.1.6 30 points	<b>Methodology Research</b> <u>Use the PLTW experimental design process for reference.</u> State your hypothesis and develop your methods in such a way that they can be repeated by another researcher if necessary. Include your materials in your methods, as they should not be listed separately. These materials will greatly reflect what you've learned in your track courses. Methods should be written in past tense and all variables should be clearly identified. Data sheets should be created before methods are started. Tell your story. What did you do and how did you do it?
<input type="checkbox"/>	1.1.7 20 points	<b>Results</b> Analysis of the data provides the information to determine if your hypothesis was supported or not. Data may involve observations of change (qualitative), or require numerical data to be collected (quantitative). Your data should be organized in such a way (graphs/tables/charts) that creates a simplified visual effect. Your results should include statistical analysis where appropriate, and both Figure Legends (below figure) and Table Legends (above table) should be apparent. If you included community outreach: What was the outcome? How many people did you reach? If you have data to support your project, please organize in the form of a graph, table, or chart.
<input type="checkbox"/>	1.1.8 20 points	<b>Discussion of Findings</b> Explain your most significant results, and specify the meaning of your results. You will draw conclusions based on your results and answer the following questions: <ul style="list-style-type: none"> <li>✓ Was your hypothesis supported by the data? Why or why not?</li> <li>✓ What are potential sources of error that occurred?</li> <li>✓ What could be done differently in the future to improve the experiment?</li> <li>✓ How is this experiment a significance to society?</li> </ul>
<input type="checkbox"/>	1.1.9 20 points	<b>Creating Your Rough Draft</b> See Rubric
<input type="checkbox"/>	1.2.0 80 points	<b>Creating Your Final Documentation</b> After your instructor reviews, please make appropriate changes.
<input type="checkbox"/>	1.2.1 100 points	<b>Oral/Visual Presentation</b> See Rubric
<input type="checkbox"/>	1.2.2 50 points	<b>Peer Review &amp; Citing References</b> See Form

## End of Year Capstone Projects: Teacher Roles

Grade 12: Senior Capstone	<b>Level I:</b> Lead: Track Teacher Role: <i>Responsible for the overarching project design within the track</i>
<b>Mechanical Engineering</b> <i>Martin</i>	<b>Level II:</b> Social Studies Teacher: <i>Johnson</i> Role: Community Outreach
<b>Biomedical Science</b> <i>Gold</i>	English Teacher: <i>Mathews</i> Role: Research/Topic Support: English/Research Report
<b>Computer Science</b> <i>Antigua</i>	Mathematics Teacher: <i>Salama/Gregory</i> Role: Statistics/Data/Calculations/Graphical Representation
	<b>Level III:</b> Digital Design Teacher: <i>Anewalt</i> Role: Visual Representations (Displays/Brochures/Presentation/Posters)

Panel Rubric – Grade 12

**Defense Proposal Rubric**

<b>NONVERBAL</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>EYE CONTACT</b>	Holds attention of entire audience with the use of direct eye contact, seldom looking at notes	Consistent use of direct eye contact with audience, but still returns to notes.	Displayed minimal eye contact with audience, while reading mostly from the notes.	No eye contact with audience, as entire report is read from notes.
<b>BODY LANGUAGE</b>	Movements seem fluid and help the audience visualize.	Made movements or gestures that enhances articulation.	Very little movement or descriptive gestures.	No movement or descriptive gestures.
<b>POISE</b>	Student displays relaxed, self-confident nature about self, with no mistakes.	Makes minor mistakes, but quickly recovers from them; displays little or no tension.	Displays mild tension; has trouble recovering from mistakes.	Tension and nervousness is obvious; has trouble recovering from mistakes.

<b>VERBAL SKILLS</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>ENTHUSIASM</b>	Demonstrates a strong, positive feeling about topic during entire presentation.	Occasionally shows positive feelings about topic.	Shows some negativity toward topic presented.	Shows absolutely no interest in topic presented.
<b>ELOCUTION</b>	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student mumbles, incorrectly pronounces terms, and speaks too quietly for a majority of students to hear.

<b>CONTENT</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>SUBJECT KNOWLEDGE</b>	Student demonstrates full knowledge by answering all class questions with explanations and elaboration	Student is at ease with expected answers to all questions, without elaboration.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student does not have grasp of information; student cannot answer questions about subject.
<b>ORGANIZATION</b>	Student presents information in logical, interesting sequence which audience can follow	Student presents information in logical sequence which audience can follow.	Audience has difficulty following presentation because student jumps around.	Audience cannot understand presentation because there is no sequence of information.
<b>MECHANICS</b>	Presentation has no misspellings or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Audience cannot understand presentation because there is no sequence of information.

<b>Capstone Requirements 1.1.1-1.1.5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>1.1.1 Selecting a Partner</b>	Students have selected and confirmed 1-2 partners	N/A	N/A	Students have not selected partners
<b>1.1.2 Identifying a Project Topic</b>	Students have selected a project topic	N/A	N/A	Students have not selected a project topic
<b>1.1.3 Research Question</b>	Students have a clearly defined research question and they can explain how the chosen question will allow them to apply their knowledge from prior track classes	Students have a clearly defined research question	Students have a research question, but it is unclear or lacks focus	Students have not identified a research question
<b>1.1.4 Securing a Mentor</b>	Students have identified and secured a qualified mentor, and are able to speak to meetings/ experiences they have had with their group mentor	Students have identified and secured a qualified mentor, but have not yet held meetings with their mentor	Students have secured a mentor, but the mentor's experience/ job description does not align with the student's capstone topic	Students have not secured a mentor
<b>1.1.5 Literature Review</b>	Students obtained a score of 90% or greater on their literature review (based on attached rubric)	Students obtained a score of 80% -89% on their literature review (based on attached rubric)	Students obtained a score of 70%-79% on their literature review (based on attached rubric)	Students obtained a score of 69% or less on their literature review (based on attached rubric)



## Literature Review Rubric

### Rubric:

	Rating				Score
	4	3	2	1	
<b>ASSIGNMENT BASICS</b>					
Articles	Information is gathered from at least 7-10 research-based sources.	Information is gathered from 4-6 sources.	Information is gathered from 2-3 sources.	Information is gathered from a single source.	
<b>SUMMARY</b>					
Research Question	Research question(s) are formed through the literature review and clearly stated.	Research question(s) are formed through the literature review.	Research question(s) were not formed but could be formed through the literature review.	Research question(s) were not formed and are not apparent from the literature review.	
Theoretical Framework	The group provides a particular perspective, or lens, through which to examine their topic that is clear and is derived from existing theory.	The group provides a particular perspective, but it is too broad to focus their lens.	The group provides a particular perspective but it is not clear or derived from existing theory.	There is no theoretical framework used to focus the groups' perspectives.	
Theme	Well organized, demonstrates logical sequencing and structure that communicates the purpose of the project.	Well organized, but demonstrates illogical sequencing or structure.	Weakly organized with no logical sequencing or structure.	No organization, sequencing, or structure.	
Synthesis of Literature	Identifies where author's conflict on their opinions or research in at least three instances.	Identifies where author's conflict on their opinions or research in at least two instances.	Identifies where author's conflict on their opinions or research in at least one instance.	Does not identify	
Background/Foundation	Detailed conclusions are reached from the evidence offered.	Conclusions are reached from the evidence offered.	There is some indication of conclusions from the evidence offered.	No conclusions are made from the evidence offered.	
Reference Sheet	Information is cited properly and in APA format.	Information is cited properly.	Information is cited, but has errors.	Information is not cited or is cited incorrectly.	
<b>PRESENTATION</b>					
Length	Adheres to 3-6 page criteria.	Exceed or does not meet 3-6 page criteria by ½ page or less.	Exceed or does not meet 3-6 page criteria by ½ to 1 page.	Exceed or does not meet 3-6 page criteria by more than 1 page.	
Format	Font, spacing, and APA format are correct.	Font and spacing, font and APA, or spacing and APA are correct.	Font, spacing, or APA format is correct.	Font, spacing, and APAP format are incorrect.	
Grammar	There is 1 or less grammatical error.	There are 2 grammatical errors.	There are 3 grammatical errors.	There are 4 or more grammatical errors.	
<b>TOTAL POINTS</b>					

## **GUIDELINES FOR WRITING A LITERATURE REVIEW**

A literature review provides a scholarly context for the argument you propose and support in your paper. It helps readers perceive how your argument fits into past and present scholarly discussion of your subject. Unlike an annotated bibliography, which provides information on one source at a time, a literature review offers a generalized picture of what scholars have thought and written about your topic. To arrive at this overview, you need to:

- Survey important representative samples of the scholarly literature on the topic
- Summarize the contents of those works
- Group those works in a purposeful manner (perhaps according to the extent of coverage of the topic, date of publication or age, purpose, or point of view)

*What are the parts of a literature review?*

Most literature reviews use a basic introduction-body-conclusion structure; the introduction and conclusion pieces may be just a few sentences while you focus most of your attention on the body.

### **Introduction:**

- An introductory paragraph that explains what your working topic and thesis is
- A forecast of key topics or texts that will appear in the review
- Potentially, a description of how you found sources and how you analyzed them for inclusion and discussion in the review

### **Body:**

- Summarize and synthesize: Give an overview of the main points of each source and combine them into a coherent whole
- Analyze and interpret: Don't just paraphrase other researchers – add your own interpretations where possible, discussing the significance of findings in relation to the literature as a whole
- Critically Evaluate: Mention the strengths and weaknesses of your sources
- Write in well-structured paragraphs: Use transition words and topic sentence to draw connections, comparisons, and contrasts.

### **Conclusion:**

- Summarize the key findings you have taken from the literature and emphasize their significance
- Connect it back to your primary research question

# SENIOR CAPSTONE RESEARCH QUESTIONS



# BIOMEDICAL INNOVATIONS

## **Group 1**

Topic: Cochlear Implants

Research Question(s): How can biomedical innovations be used to support new patients, particularly young children, in the process of acclimating to a new cochlear implant device?

## **Group 2**

Topic: Racial Disparities in Maternal Care and Infant Delivery

Research Question(s): How can biomedical innovations be used to improve patient outcomes, particularly women and children of color, in the fields of gynecology and obstetrics?

## **Group 3**

Topic: Language Barriers in Healthcare

Research Question(s): What disparities exist in the treatment of non-English speaking patients compared to English speaking patients? How can biomedical innovations be used with regards to programs, devices, or interventions to ensure that all patients receive quality care and clear communication with their providers?

## **Group 4**

Topic: Wernicke's Syndrome

Research Question(s): Wernicke's syndrome develops as a result of nutrient and vitamin deficiencies related to alcoholism. What prevents alcoholics from receiving adequate nutrition? How can biomedical innovations be used to prevent the progression of this syndrome?

## **Group 5**

Topic: Back Pain

Research Question(s): How can biomedical innovations be used to mitigate back pain for individuals who work desk jobs or spend long periods of time sitting? How effective are these devices and how can they be improved?

## **Group 6**

Topic: Organ transplant

Research Question(s): How are organs allocated to patients when need is greater than supply? How do allocation procedures differ at various institutions? How can biomedical innovations be used to address the issues of supply and demand and/or allocation?

**Group 7**

Topic: Music Therapy in Mental Health Fields

Research Question(s): How effective is music therapy in reducing the symptoms of anxiety and depression? How can biomedical innovations be used to improve music therapy techniques and extend these therapies to the general public?

# COMPUTER SCIENCE

## Group 1

**Research Premise:** One problem I know of is the safety of people who travel and within their own communities. Many times they aren't aware of the dangers that exist around them which can lead them into life threatening situations that could harm them.

### Research Questions:

Research Question(s): How does violence effect community? How can technology be leveraged to improve the safety of individuals in their own communities?

## Group 2

**Research Topic:** We are going to create a game log app that tracks the games you play and your progress within them along with information about the games it's also able to interact with others to see what games they are playing as well. The connection between gamers and their games is unbreakable and it only get better when you have a friend to play with. Neighborhood - our current app idea includes making an app called Neighborhood that has different sections of what people are currently doing in their homes while being quarantined due to Covid-19. People can see what other individuals in their neighborhood are doing and interact with them. The different sections can be what video games people are currently playing YouTube videos they are watching movies television shows and anime they could be viewing etc. This app would turn out to be the sole connection between absolute strangers and will work to help encourage bonds between them and change lives everywhere.

Research Question(s): During the COVID era, how can gaming technology be leveraged to build community while continuing to promote social distancing?

## Group 3

**Research Topic:** Community Work & Service - CWS

The app will post services and work that are needed and allows users to accept those offers as a chance to help the community.

Research Question(s): What supports do students need to find community service hours? How can technology be leveraged to enable students to successfully complete community service hours virtually?

#### **Group 4**

**Research Topic:** Stem app that allows students quick access to their school-related items such as their schedule, genesis transcript, and locker number etc. It will also show students where places are and we can make a built in map that shows your location and your friends/teachers. It can show how to get to the school if you are somewhere else and you want to know how to get to school It can show top news like what's happening at the school or around the school so the staff, students, and parents know what's happening.

Research Question(s): What logistical challenges do freshman face when starting high school? How can technology be leveraged to improve the freshman experience when acclimating to a new school?

#### **Group 5**

**Research Topic 1:** We are going to create an app that provides information about COVID. The app with users continue communication with peers or stay updated on COVID-19.

Research Question 1: What social problems has COVID-19 created? How can technology be leveraged to address the social issues associated with COVID-19 and help users critique sources of information?

**Research Topic 2:** Don't you just despise when you can't add a family member to the iMessage group chat because the bubbles will turn green, singling them out because of the phone they use? Don't you dislike when you can't send an android-user an iMessage game, taking away a chance for you both to interact? Don't you just hate when you try to add someone to a social media group chat but you don't want them to see your profile on that social media. Well now you could add someone to a group chat with no strings attached.

**Research Question 2:** How can the tools of technology be used to develop a school environment through an app that is intended for select people and their respective professional group that would serve as a hub for students to associate and potentially inquire about anything related to their specific school or interests?

# MECHANICAL ENGINEERING

## Group 1

**Problem Statement:** Many people use Chapstick or lip balms to moisturize their lips. A common problem experienced is the melting of Chapstick or lip balms when exposed to heat. The greasy and sticky feeling in your pockets or handbags can become troublesome and can cause stains and damage.

Research Question(s): How can engineering provide a solution for the challenges associated with waxy lip balms?

## Group 2

### Problem Statement

When cooking in a pan, food remains in contact with the oils and fat it was cooked with causing the food to become unhealthier than it has to be. (Draft)

Research Question(s): What are the dangers associated with fats and oils when cooking? How can engineering provide a solution for reducing the amount of unhealthy fats and oils absorbed by foods when cooking?



### **Panel Questions for Students**

1. How did you select your team members for this project? Explain the process of selecting your team members and why is it important to establish team norms.
2. What is the purpose of defining a problem and writing an effective problem statement?
3. How did your team justify your problem academically and ethically and why is it important?
4. What research supports your claim that the problem is worth solving? Briefly explain your research.

# University Level Supports



## STEM Innovation Academy of the Oranges Senior Capstone Project Consultation w/TCNJ

In collaboration with The College of New Jersey's Service Learning Department, the Orange Public Schools is seeking to establish a consultation model that promotes support for the Senior Capstone Project at the STEM Innovation Academy of the Oranges:

TCNJ Primary Point of Contact:

Dr. Maureen Connolly  
Associate Professor  
Secondary Education Undergraduate Coordinator  
Department of Educational Administration and Secondary Education  
The College of New Jersey

### Proposed Engagements with the Senior Capstone Project

1. Providing Professional Development with the teachers in support of the Action Research that will inform the Lit Rev and Rationale; framing this process within the Service Learning Framework where we have solid **Investigation**, **Reflection** (through the design process), **Preparation** and **Action** (start in the development of their prototypes); **Demonstration** is within their final presentation.
2. Development of project articulation materials (templates, rubrics, etc.)
3. Grounding the work of the Humanities Teachers in the Need for **Service Learning**
4. Refining the Capstone Expectations at Level II in the context of short term and long term demonstrable solutions.

### Other Opportunities

1. Critical review of the students' topics.
2. Serving on the panels or identifying a panel inclusive of Pre-service teachers



### **Rutgers University-Newark(RU-N)/Collaborative Teaching Initiative (CTI) Intern Program**

In collaboration with Rutgers University-Newark(RU-N)/Collaborative Teaching Initiative (CTI), establish a partnership model that promotes support for CTI teachers around

- INVITING GUEST SPEAKERS
- LESSON PLANNING AND PREPARATION
- COTEACHING
- SUPPORTING STUDENTS via OFFICE HOURS
- **SUPPORTING CAPSTONE PROJECT DEVELOPMENT/SHOWCASE**

Rutgers Primary Point of Contact:

Lucille Booker, Ph.D.  
Office of the Chancellor / Data Science  
Rutgers University, Newark

### **Logistics**

- 3 Interns assigned to each site (OPA/STEM/OHS)

Ms. Lisette Antigua	Mr. Sheick Touré
Ms. Allyson Smith	Ms. Lissette Figueroa
Ms. Ashley Brooks	Ms. Jada White

- Beginning in January 2021
- Fully Virtual Model
- 20 hours per week of partner support