STEM Summer Assignment 2021

Greetings, my name is Dr. Crowthers and I will accompany you on a wonderful STEM-filled journey next academic year (and hopefully beyond). This is a journey that I hope you will enjoy both in class and outside of class. With this in mind, I want to activate your mind, keep your skills sharp, and introduce you to parts of the curriculum. At first glance, this summer assignment appears to be a lot of work. IT IS NOT! I am getting you started on the brainstorming that many prior students have suggested that would be most advantageous.

The Purpose of the Summer Assignment is:

- To expose students to material/concepts/skills which are required in the curriculum.
- To provide an opportunity to get a leg up in your STEM planning (either in a research, engineering, or mathematics project)
- To provide an opportunity to show what you know, your creativity, and attention to detail.

Part I: Formal Letter:

We are going to spend a lot of time together next year, so I would like to learn a little bit about you. Your first digital assignment is to successfully send me (kcrowthers@wpi.edu) a formal email prior to the first day of school in August. *It might be worthwhile to complete this earlier in the summer so I am able to send you Zoom links to Summer Office Hours.*

Draft an email to me following these rules:

- make sure you use an email account that you will check frequently over the summer. I am planning on hosting Zoom sessions over the summer and will use this address for Zoom invitations.

- Use clearly written, full sentences. Do not abbreviate words like you are texting with a friend. Use spell check and check your grammar! This is a professional communication, similar to what you would be sending to a college professor or lab head.
- Address it to your teacher. My email address is kcrowthers@wpi.edu
- Make the Subject: 'STEM Introduction to (YOUR NAME)'
- Begin the email with a formal salutation, like "Dear Ms., Mr." I prefer Dr. Crowthers.
- Now introduce yourself:
    - What do you like to do? How would you characterize yourself?
    - Do you have a job or other significant time commitments outside of academics?
    - Was there anything that you liked about your earlier STEM/science classes?
    - What worked for you in terms of understanding the material in your previous science classes?

- **Mandatory**: What are you looking forward to the most in STEM1/2? Personal goals for STEM1?
- What are you most anxious or worried about next year? Science class? Group work?
- Is there anything significant that may affect your learning that I should know about beforehand that you aren't comfortable sharing with the class?

End the email with a formal closing and add your name.

Part II: STEM1 Preparation

"In life, you are judged by how good your questions are."
Robert Langer, MIT

For this part of the Summer Assignment, you will be doing some brainstorming for ideas/ direction in your STEM1 project. **It is essential to keep these ideas and your progress in a notebook to refer back to. Date your entries.** Doing some of the brainstorming early on may make the difference between obtaining a highly coveted place in a research lab (as an example) and searching for weeks for an available spot. Please contact me if you have an existing project that you would like me to consider.

This part requires keeping your progress in an ELECTRONIC NOTEBOOK (either Google Docs or Microsoft Word), reading 3 sources (based on brainstorming), and writing a summary:

Article Summary #1 (due- July 11th): https://forms.gle/VCCuGKiPEGRm1qop9

Article Summary #2 (due July 28th): https://forms.gle/SEXfCNTNoxwZ7cQk7

Article Summary #3 (due August 11th): https://forms.gle/d2tgSgDTeTLrrAyo8

Any questions, email me (kcrowthers@wpi.edu).

A: Brainstorming for Questions

*The goal of this exercise is to generate **a lot of ideas**. If you don't love every idea, DON'T WORRY! You can star the ideas you like. We will come back to them later.*

The first step in a project is to identify a problem or research questions. This requires narrowing the scope to facilitate question generation. It is much easier to ask a question or build a product around the chemistry of painting (as an example) than it is to ask a question or build a product around painting in general.

1: Select a challenge. There are two paths that can be used to narrow down a project; a direct observation or narrowing down a topic from a general interest. Using a notecard, take note of at least 5 patterns and at least 10 annoyances that you encounter. This can be over the course of a week, month, etc but should be something that you observe or have experienced. These observations can provide some specific directions for a project idea. Please take a picture of your notecard and place it in your notebook.

Additionally, you should also identify a project direction by making a list of general topics that you are interested in and using brainstorming techniques to narrow your ideas.

Hobbies	Academics	Careers	World Problems

Brainstorming is a way to generate a lot of ideas and then choose the ones that are feasible for a research/engineering/mathematics project (with some modifications). Some ideas will be great, some will be bad, and some will be **really, really** bad. But that is OK! Many of these bad ideas can be turned into a great idea (and unique) with some modifications. **This phase of a project is not the time to critically evaluate the efficacy of an idea!** Some of the rules of brainstorming are (Design Thinking for Educators, IDEO)

1: Defer judgement

2: Encourage wild ideas

3: Build on the ideas of others

4: Stay on topic

5: One conversation at a time (if done in a group)

6: Be visual

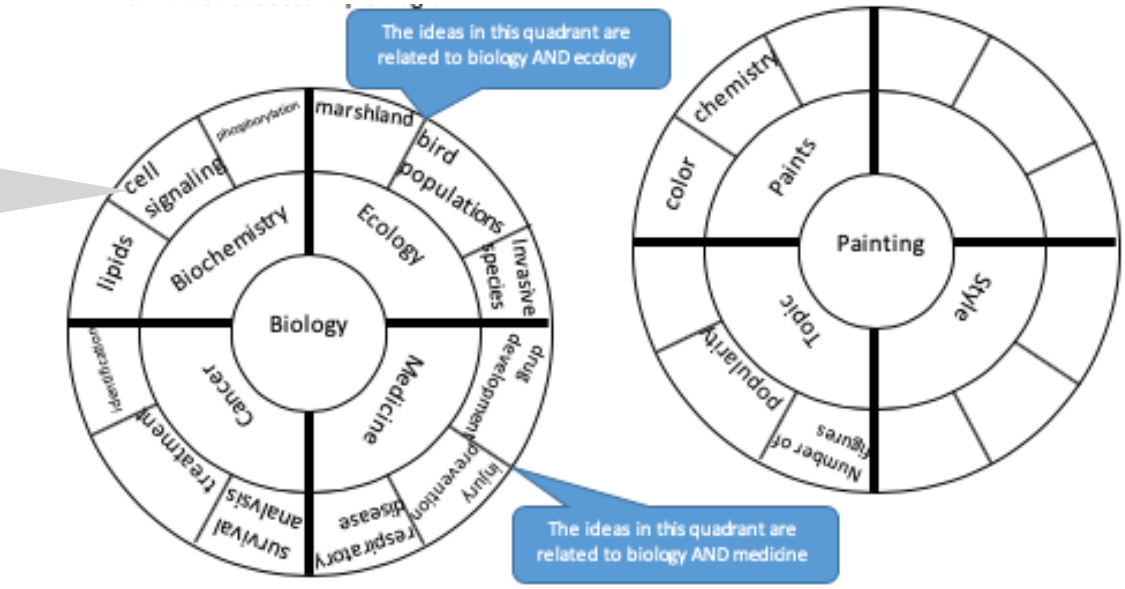
7: Go for quantity

Ask yourself if any of these ideas/areas in your table or notecard make your heart beat fast. If it does, these are probably good candidates to keep in mind and engage others in thinking about.

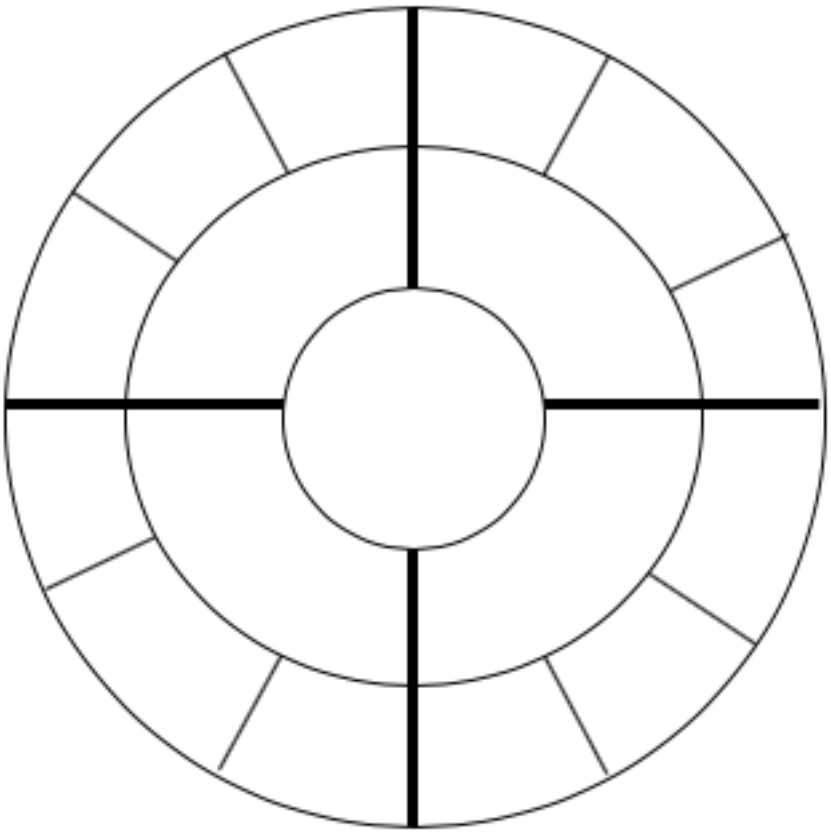
The first brainstorming method we will try is called a **pie diagram**. In a pie diagram, the broad interest is placed in the center. The second smallest circle will contain topics that are associated with the central idea. As you work your way outwards, you should think about offshoots from that idea. There are two examples below. One has been completed. One has been partially completed.

When you fill in your pie diagrams, challenge yourself to look for overlaps between your interests. For example, if you like painting AND math AND computer science, could you develop a program to statistically analyze something about the brush strokes of your favorite Renaissance artist? If you are interested in painting AND assistive technology, could you find a way to make painting accessible to individuals without hands? Look for connections and think outside of the box.

Q: What types of natural spices can prevent the adherence of coronavirus on cells?



Fill in t**hree pie diagrams** (like the diagram below and attached at the end of this description). You may want to use separate paper for each diagram. Put a topic you are interested in at the center. That topic can be from question 1 (a direct observation from your notecard), or something completely different like a hobby that you want to investigate further (from the table above). Add connected ideas as you move to the outer circles.



2: The next step is **NOT** to look for answers but to ask questions. Brainstorming for **QUESTIONS** makes it easier to venture into uncharted territory (Gregersen, 2020). In 5 minutes, write as many questions down (around the outer ring- as shown in the example above).

3: Invite a few other people to help you consider the challenge or topic from fresh angles. Give a brief introduction (2 minutes- MAX) of the task and provide the brainstorming rules (above). In 5 minutes, ask them to add as many **QUESTIONS** onto your pie charts as possible. Write these questions down VERBATIM on the pie chart. As you are recording, add additional questions on your own. Bringing in others (that have no direct experience with the problem) can provide a unique perspective that can broaden your ideas and knowledge base. This is a crucial component to the brainstorming process. Asking others to participate helps to bring in empathy and foster idea generation (Gregersen, 2018). You will also be brainstorming with others in your class.

Some guidelines might help in generating questions:

A: making random associations or taking on an alternative persona can help unlock new perspectives.

B: OPEN Questions (ones that are more cognitively complex) are better than closed questions (or ones that have a definitive answer or recall). How might you change a closed question to an open one?

C: Short and simple questions are best to get people thinking.

D: Don't pose questions aggressively. Remember the 1st tenet of brainstorming- Defer judgement.

E: Don't propose a solution disguised as a question.

4: Check-in:

https://forms.gle/jLsyZZYM6mdx4e13A

5: Do a post-mortem on the questions:

Identify some of the new pathways uncovered during the question session. Select a few that intrigue you and expand on these into your own set of follow-up questions. Remember to keep these questions open, short, and not posed to produce an answer. A great way to continue the questioning would be to utilize Sakichi Toyoda's "5 Whys" (https://kanbanize.com/lean-management/improvement/5-whys-analysis-tool). This is a method to get at the root of a particular problem or stumbling block. For instance, if a customer states that they have an untuned bagpipe, the "why" question would be "Why do you think your bagpipes are out of tune?" or "Why is this important?" Then, continue asking the "why" questions, typically for 4 more times.

You should be considering at least three ideas and moving them forward for your STEM1 project.

Part III: STEM Reading:

Start thinking about your area of interest. Diving deeper into your idea/problem (at least deep enough to develop questions or needs) requires you to do some reading from various sources. One good place to start are the science news sites that contain abbreviated science/engineering stories. As an example,

Quanta Magazine (www.quantamagazine.org)

Live Science (www.livescience.com)

phys.org (phys.org)

As you begin to narrow your topic, you will need to do some research in scientific journals and professional publications. Sites like:

Science Journal (www.sciencemag.org)

Nature (www.nature.com)

IEEE (www.ieee.org)

Proceedings of the AMS (https://www.ams.org/publications/journals/journals)

All have peer-reviewed articles that will help guide you on what is currently thought of in the field. Part of this assignment is to do some reading in

2 Science news sites

1 scientific/professional publication

Write one paragraph for each source summarizing the article and how it pertains to your prospective idea(s). I understand that in the previous section I have asked you to pursue at least 3 ideas for your STEM1 project. For this reading assignment, choose the idea that makes your heart beat faster to complete your reading. This is practice. You will be completing additional research in the other areas when we return to school.

Please submit your responses to the following

Article Summary #1 (due- July 11th): https://forms.gle/VCCuGKiPEGRm1qop9

Article Summary #2 (due- July 28th): https://forms.gle/SEXfCNTNoxwZ7cQk7

Article Summary #3 (due- August 11th): https://forms.gle/d2tgSgDTeTLrrAyo8

E: Brainstorming Session with your colleagues:

I will be scheduling Zoom office hours over the summer so please keep an eye on your email for an invitation. This is a great opportunity to share your ideas and get your colleagues' feedback.

Open Office Hours:

June 27th, 4pm	July 23rd, 4pm
July 9th, 4pm	August 13th, 4pm

Citations:

Gregersen, H. (2020, February 7). Better Brainstorming. Retrieved from https://hbr.org/2018/03/better-brainstorming