Dear Chemists,

Here is an outline and timeline for an independent research project to help us finish the year in chemistry. The idea is that you will either choose 1 large topic to investigate or 3 smaller topics to write about. Some suggested topics for both of these categories are listed at the bottom of this document. The first list are the smaller topics. The second list are the larger topics, which also include some element of ethical issues related to them. I want to stress that 1) these are only ideas, you are free to come up with something on your own and 2) You could conceivably turn one of the smaller topics into a larger, fully-fledged research paper if so desired (elements found in smartphones comes to mind), in which case I would expect you only do 1 longer more detailed paper, instead of 3 short ones.

**Week 1:May 4- May 8**

* Choose a research topic
* Craft a research question or identify the problem to investigate
* Find 1 resource (digital or print) you can use to find out more information about your topic
* Summarize what you know and what you want to learn more about regarding your topic
* Share your paper with your teacher so they can help you out/give comments

**Week 2: May 11 - May 15**

* Find 2 more resources into your topic
  + 1 must be based on implications for society/environment/economy/health
  + 1 must be based on DATA and not opinion/anecdotal
* Summarize 2 or more main viewpoints/arguments from different sides of the issue
* Share your paper with your teacher so they can help you out/give comments

**Week 3: May 18 - May 22**

* Finalize/Write up your paper with a….
  + research question,
  + how your topic works on the chemical level,
  + research performed so far and how it relates to society,
  + data to support the research,
  + future implications of the research,
  + additional questions to push the research (and plausible ways to answer them),
  + pretty pictures,
  + conclusion

*(Dates are rough guidelines. If you don’t have a certain section done by that date, don’t stress about it! Turn it in the next week!)*

**More Detailed Final Checklist:**

Problem/question you are investigating is clear and concise

Detailed description of research that has been done so far, including how your topic works on the chemical level

Implications of this research for society/the environment/the economy/the health of individuals

Fair assessment and synthesis of viewpoints/arguments from different sides of the issue, neatly organized (if applicable)

Data is presented in a table or graph, when appropriate

A summary of what the data means or indicates

Pertinent pictures! These could easily be pulled from the internet, or drawn by hand!

Information from multiple sources is present and cited when appropriate

Creative problem solving/possible solutions are well thought out

Further research that could be done to enhance our understanding of the problem is included

(Sure, you can probably google answers to these last 2, but the idea is that you come up with some potential creative solutions/further questions and how to conduct that research on your own!)

**Chem research home ideas (short and sweet)**

Coffee-caffeine- how it affects our brains

Sugar- effect it has on our brains

Soap- how does it clean

Onions- cutting-why do it make us cry

Pressure cookers- how do they work

Falling in love- chemicals in brain- how do they affect our decision making

Traumatic events/PTSD- same thing

Various hard drugs- how they work- how they affect chemistry of brain- long vs. short term

Vaping- current research on how it affects the lungs

Nicotine- why so addictive

Baking soda/baking powder- how it makes bread rise

Bleach- how does it work

Salt- how does it help preserve meat/why do we use it on our roads when it snows?

Elements/Minerals found in smart phones- where are they from/how are they mined, why are they essential, what properties do they have that make them essential, electrical conductivity

Why does adding salt to water change the melting/freezing point?

Algae blooms in Jordan Lake- implications, what causes them, how could it be avoided

Fridge/freezer- how it works (we kind of already talked about it, but I’m guessing most kids forgot/zoned out when I mentioned it)

Batteries- types, how they work (recap of what we learned), why is Tesla so obsessed about batteries, why are batteries so important to renewable energy

Drinking water- what chemicals are added, how much to make it safe to drink, other ways to sterilize water

What chemicals are added to tree pulp to make it paper?

Photography- chemicals involved, how to develop film

Paint- where does it come from, what chemicals are used, what chemical interactions are involved

**Ethical issues in chemistry (longer, more in depth)**

Use of fertilizer/pesticides in agriculture – affect on humans that are applying it, effect on plants/surrounding ecosystem/food web, effect on economy (can use historical example like DDT, or modern day examples. Numerous articles exist on excess nitrogen, likely from fertilizers, in Jordan lake and the toxic algae blooms they cause!)

Use of antibiotics- Direct effect on bacteria, connection to “Super bacteria”, alternatives

Solar geoengineering (increasing earth’s reflectivity to offset global warming)- How would it work, is it practical, who would fund it (keep in mind what is the chemistry behind it?)

CRISPR- what is it, how it works (definitely some review of biology may be required), potential implications

Invention of new inorganic compounds (eg. PCBs) how are they useful to humans, long term harmful effect on environment, potential overarching question: should humans always use what they invent?

War-time chemistry (invention of napalm/chlorine gas/dynamite)- role of chemists in their use and abuse, overarching question: should humans always use what they invent?

Thalidomide- what is it, how does it work, role of gov. / regulatory agencies in not realizing harmful chemical impacts on newborns, current use (against leprosy, cancer)

Bhopal disaster (worst chem. spill in world history)- what happened, how could it have been prevented, role of gov. and private industry in health and safety of workers versus profit, did anything change since then

Project MKUltra (US gov. giving LSD to civilians)- Why? What were the results? What effect do the chemicals of psychedelics have on brain development and function? Should they be legal?

Current EPA deregulations of air quality standards despite link of air pollution to increased risk of COVID19- Why is the EPA relaxing air pollution laws during a pandemic that affects the respiratory system? How does this affect industry? For that matter, why is the current head of the EPA a former lawyer who worked for coal companies and lobbied against the EPA?

Current EPA deregulations of mercury. How does mercury get into the environment? What are the effects of mercury in the environment? What are the effects of human consumption of mercury? Why is the EPA deregulating mercury? Who will this benefit? Who will this potentially hurt?

Falsifying/copying chem reports to gain stature as a researcher- Academic/researcher careers can be cutthroat, what draws scientists to make up/copy data? Can the scientific community reorganize itself so that scientists aren’t forced to compete and pump out papers? How is COVID 19 affecting scientists working together versus competing on research?

Possible Format/Layout of your paper:

Ask a Question (may not work for every single topic):

What is the effect of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on \_\_\_\_\_\_\_\_\_\_\_\_\_\_?

Research: Look online for articles that explain the concept and the chemistry behind the reactions taking place.

Look for different viewpoints if applicable. Try to determine if the site you are using is biased in any way. It’s ok if it is, you just should be aware. Typically .gov and .edu sites are have reliable info, but even the government can have a tendency to omit facts, esp. when it comes to something like climate change.

Provide data, could be in graph form, to back up your research.

Insert pictures that help illustrate the point you are trying to get across

Conclusion: Further questions you have, potential ideas on how to research these questions, a brief summary of the topic to wrap it up

Bibliography