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Regeneron STS Application Essay Questions

1 Research Project “Layperson’s Summary” (maximum 200 words)

Summarize your project in layperson’s terms, while maintaining scientific accuracy. Your explanation should be easily understandable and include background, procedures, conclusions and relevance. This summary will aid readers, including evaluators, journalists and the public.

El Niño, or ENSO, is a hugely influential climate cycle that occurs in the equatorial Pacific Ocean. It is a form of short-term climate change, so it causes certain years to be warmer or colder than others. My project shows that through greenhouse gas and aerosol emissions, human activities are causing ENSO to become stronger. I showed this by using data output by a climate model. This model uses a computer to simulate the earth’s climate. By repeating this simulation with and without greenhouse gas, aerosols, and other factors, researchers have created a picture of what climate will be like over the 21st century. I used this data to analyze changes to ENSO in the future by using established methods of measuring El Niño. After deducing that it was becoming stronger, I went into greater depth, analyzing what parts of ENSO are becoming stronger and why. It appears that global warming is allowing heat to spread between layers of the ocean more easily, which makes it easier for ENSO events to form. If these conclusions are correct, then we can expect more extreme weather in the future.

2 Project Benefits and Impact (maximum 200 words)

What benefits do you think your research will bring to the world, and/or to your field? What additional steps, and by whom, might be needed for this benefit to be realized?

3 Your Potential as a Scientist, Mathematician or Engineer (maximum 250 words)

Address through specific and concrete examples what characteristics you have that best demonstrate your affinity and aptitude for being a good scientist.

- What have you done that illustrates scientific aptitude, leadership, curiosity, inventiveness and/or initiative?
- After completing your research, how has your interest in science, engineering, and/or math been clarified? What are your other STEM-related interests besides your project?
- How does your experience suggest future success as a scientist, mathematician or engineer?
- What do you plan to study in post-secondary education and what occupation do you plan to pursue? What do you hope to be doing 10 years from now?

4 Major Scientific Question (maximum 250 words)

What is a major scientific question in your field whose answer you believe will have a significant impact on the world in the next 20 years, and why? Using examples from your own experience or research, explain how you might envision addressing the question over the next 20 years.

Climate predictions are usually grouped into three categories based on human greenhouse

gas emissions: worst case, average case, and best case. Under the worst case predictions, environmental regulation is minimal, and industry continues with the same practices it has today. In the best case scenario, renewable energy becomes widespread and fossil fuel burning all but stops. The average case is between the best and worst cases. The major question in my field is which pathway is the most accurate? If humans continue to emit greenhouse gasses like we are doing now, then climatologists' worst predictions will come true, but if we implement strict regulations and switch to renewable energy, much of this disaster may be averted. The answer to this question will determine which set of predictions is most applicable for helping humans to respond to climate change.

I would go about answering this question by comparing characteristics such as El Niño from climate models to those in the observed record of the climate. By correlating these characteristics with levels of greenhouse gas emissions in the observed and simulated climate.

5 “Tweet” about your project! Tell us about your project in 280 characters or less.

The Society might share this response if you are named a scholar or finalist.

Models show that CO₂ emissions are causing El Niño to become stronger due to global warming. An analysis of climate predictions shows that ENSO's variance is increasing, which could cause more extreme weather.

6 Greatest Accomplishment or Challenge (COMMON APP)

Please answer ONE of the prompts below from the Common App; we prefer that you think beyond your research project in this essay. (maximum 200 words) Discuss an accomplishment, event, or realization that sparked a period of personal growth and a new understanding

of yourself or others. OR The lessons we take from obstacles we encounter can be fundamental to later success. Recount a time when you faced a challenge, setback, or failure. How did it affect you, and what did you learn from the experience?

7 About You (COMMON APP) (optional)

Some students have a background, identity, interest, or talent that is so meaningful they believe their application would be incomplete without it. If this sounds like you, then please share your story. (maximum 200 words)

Six months ago, I sprayed myself in the face with pepper spray. Here's what happened: I was poking around in the back of a cabinet where my mom keeps flashlights and small gadgets, and I discovered an unusual-looking plastic device. It had a button on the back, with the word "PUSH" engraved on it. I felt a sudden urge to find out what that button did: Was it a flashlight? A laser pointer? A remote control? I pressed the button, and the next thing I knew, my face was on fire.

Why did I do this? The answer is simple: I was curious; mysterious buttons intrigue me. So I pressed the button to see what it did. That was one of my more painful experiments, but I have had plenty of other misadventures pressing buttons. This summer, while working at my city's performing arts' center, I was dying to play with a particular computer so I keyed in a command. After a few minutes of typing, I accidentally froze the screen, keeping the computer from doing what it needed to do to project images onto the stage curtain. That got me into some hot water. Nevertheless, at least nothing caught fire. I wish I could say that about the time I tried to fix a squeaky spotlight at my school's theater. It turns out when you put WD-40 inside of a stage light, it catches on fire.

In all these incidents and many others, I pushed a button I didn't fully understand – a physical button marked "PUSH", a dubious computer command, and a flammable liquid.

My lack of understanding of these buttons was what compelled me to push them; the allure of finding out what they do is irresistible. Experimenting with physical objects – buttons, computer keys, flammable liquids – is how I respond to my curiosity, and it drives me in many ways – intellectually, academically, and even ethically. If I can figure out how one thing leads to another, I can not only understand the world better, I can possibly even make it better.

Sometimes, experimenting with an object isn't enough to understand it. After learning what a button does, I want to learn how it works. I have spent hours of my life building circuits, writing computer programs, and taking apart broken appliances, all to see how they work. I am also curious about the natural world, not just the manmade world. Why are leaves green? Where do thunderstorms come from? While I can't disassemble a thunderstorm, I can still understand it in terms of its parts. This process of zooming in eventually reveals the layer of detail that underlies everything: mathematics.

Mathematics is the most fundamental language for describing nature. We need one plus one to equal two in order to understand the world as we know it. Mathematical principles are central to our perception because math underlies all science. For example, to answer the question, "How do plants grow?", one would invoke cellular division. But cells are composed of proteins, which themselves are made of smaller components, atoms, protons, neutrons, and electrons. These fundamental particles' behavior is determined absolutely by mathematical laws. When viewed from the smallest scale, every single aspect of nature or technology is simply a large ball of math.

I don't plan to literally be pushing random buttons, dissecting household appliances, or unintentionally breaking pieces of theater equipment for the rest of my life. But I plan to spend my life figuring out how large, mysterious phenomena can be understood as the sum of smaller parts, and to use that understanding to solve big and important problems. My life's work will involve discovering how things work. I will always be exploring science in new

ways as I develop as a student, and later, as a professional. Science is my calling; no matter where I go in life, I will always be pushing buttons (at least metaphorically speaking!).

8 COVID-19 Pandemic (adapted from COMMON APP) (optional)

The COVID-19 pandemic has been experienced differently throughout the country and world. Share how it has impacted your life, especially its impact on your learning and as applicable on your submitted project and ability to work on that project. Examples include:

- Illness or loss within your family or support network
- Employment or housing disruptions within your family
- Food insecurity
- Toll on mental and emotional health
- New obligations such as part-time work or care for siblings or family members
- Availability of computer or internet access required to continue your studies
- Access to a safe and quiet study space
- A new direction for your major or career interests