

$$\epsilon_{ex} = \frac{dQ_{ex}}{de} \cdot \frac{e}{Q_{ex}}; \epsilon_{im} = \frac{dQ_{im}}{de} \cdot \frac{e}{Q_{im}}$$

$$NE(e) = Q_{ex}(e) - eQ_{im}(e),$$

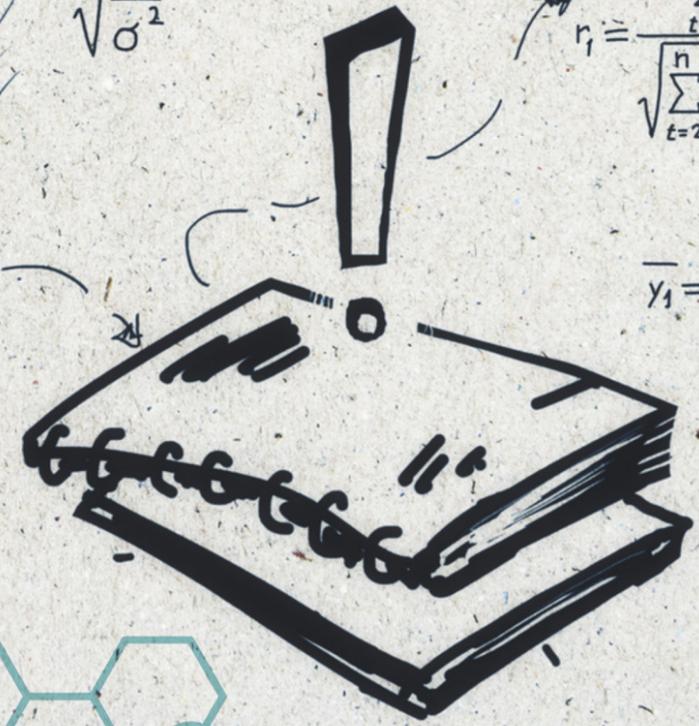
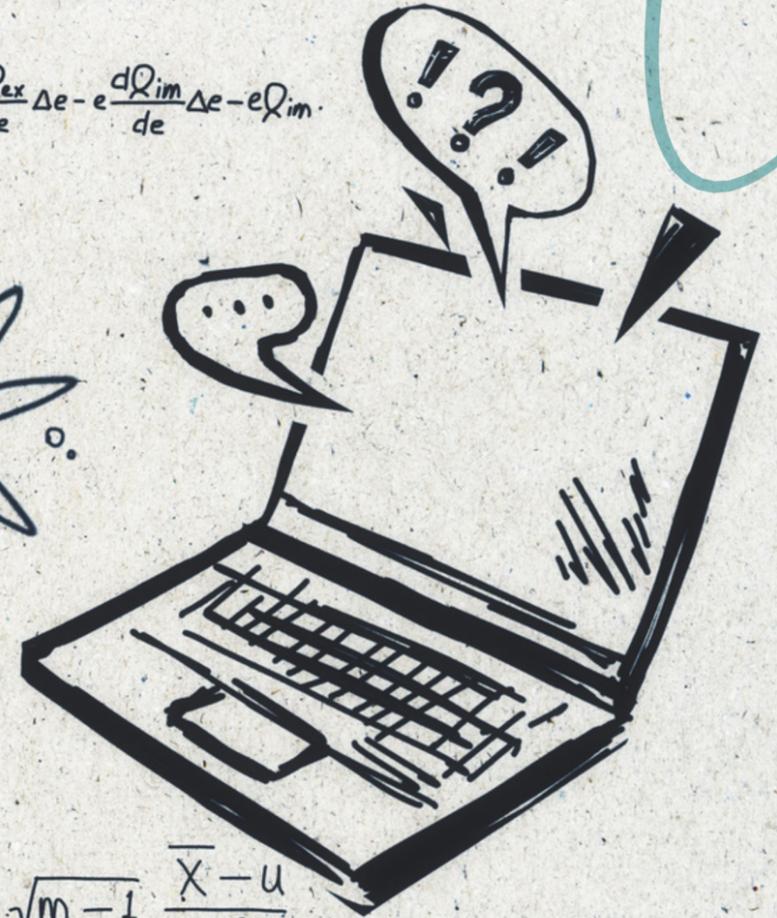
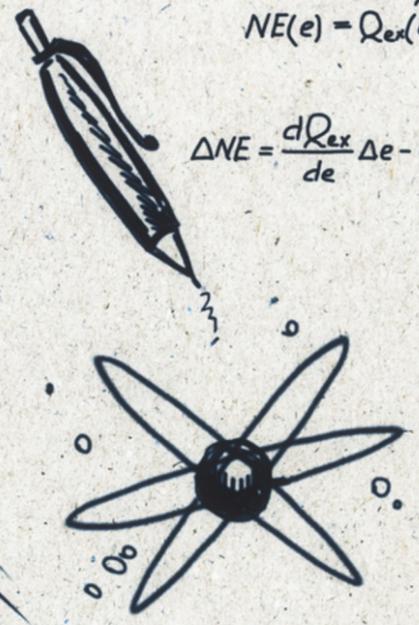
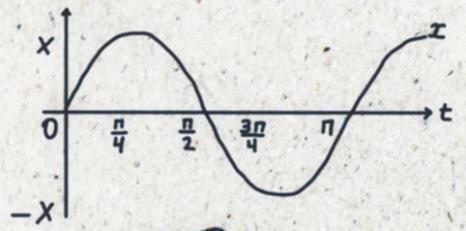
$$\Delta NE = \frac{dQ_{ex}}{de} \Delta e - e \frac{dQ_{im}}{de} \Delta e - eQ_{im}$$

$$\frac{\bar{X} - u}{\sigma} = \sqrt{n-1} \frac{\bar{X} - u}{s}$$

$$r_i = \frac{\sum_{t=2}^n (y_t - \bar{y}_1) \cdot (y_{t-1} - \bar{y}_2)}{\sqrt{\sum_{t=2}^n (y_t - \bar{y}_1)^2 \cdot \sum_{t=2}^n (y_{t-1} - \bar{y}_2)^2}}$$

$$\bar{y}_1 = \frac{\sum_{t=2}^n y_t}{n-1}; \bar{y}_2 = \frac{\sum_{t=2}^n y_{t-1}}{n-1}$$

$$\tilde{G}^2(\epsilon) = \tilde{S}^2(\epsilon) = \frac{\sum_{i=1}^n e_i^2}{n-2}, (1)$$



IT'S JUST ROCKET SCIENCE

By Sona Uradnik

$\iint \sqrt{x+\sqrt{1+x^2}}$
 Integrate $\int \frac{1}{(x^2+2x+2)}, \{x, 0, \text{Infinity}\}$
 $\frac{8}{105} (x+\sqrt{1+x^2})^{1/5} (-2x+5\sqrt{1+x^2})^{1/5}$
 $\frac{1}{56} (7+\sqrt{1+x^2})^{1/5} (5+\sqrt{1+x^2})^{1/5}$





For most people, the road to NASA starts with an interest in the skies and a sense of adventure. For the students at Airway Science for Kids (ASK), the journey down that road starts with a video game called Kerbal Space Program (KSP). At its core, KSP teaches kids and adults alike about rocket science. Even in a video game, getting into space isn't an easy feat, but KSP makes it approachable. In KSP, players can build rockets, space stations, and even explore different planets. The game covers many advanced concepts in physics and rocket science, but in a way that is more accessible to the average student than traditional learning in a classroom.

When the students at ASK want to play Kerbal, they begin in ASK's brand new Kerbal Lab at the Aerospace Training Center (ATC).

Over the past year, ASK has been in the process of designing a computer lab specifically for playing Kerbal Space Program. Airway Science's resident Kerbal expert, Jay, has been playing Kerbal for nine years and helped design the Kerbal Lab. He wanted each computer station in the lab to resemble the science museums that he loved as a kid. "I wanted to create an immersive, hands-on space that could be used to teach people about spaceflight in fun and engaging ways - a space where people could go to forget the troubles of the outside world, broaden their horizons, learn new things - and most importantly have fun!"

The Kerbal Lab incorporates cutouts of characters from the game, murals of the planets and stars, and whiteboard tables where students and instructors can further explore some of the more complex aspects of the game.



Jay's favorite thing that he designed for the lab was the computer keyboards. The stickers on the keyboards help players identify and remember the complex controls of the game, and the hand controls mimic real life spacecraft controls. Jay understands how "learning about spaceflight in more traditional environments like a classroom can be an overwhelming, or even boring experience."



Even before the recent renovation of the Kerbal Lab, ASK has had a relationship with the developers of KSP, Intercept Games, but that relationship reached new heights after their development team visited the ATC. After seeing the work that ASK has been doing with KSP, they shared how supportive they are of our mission.

The greatest benefit to having a space solely dedicated to playing Kerbal, is that students can come to an after-school program and learn how to play the game for free. One of these students, Ben, comes into the ATC at least once a week. He is a friendly twelve year old and he always has a large grin across his face.

As time went by, ASK employees didn't even have to ask what he wanted to do that day, and they instead directed him straight to the Kerbal Lab. Ben has been playing Kerbal for a month now, and in that time he has learned an impressive amount.

"I've learned a lot about launching the rockets and what you have to do when you're inside the atmosphere. And when the atmosphere starts and how high you have to be to stay in orbit."

Ben's favorite part of Kerbal is building rockets. "Launching them is fun but I really like building them and figuring out what you need to do to land places.

I like figuring out how much you'll need." After playing for a few weeks, Ben figured out how to build a rocket that would make it to the Moon. But all of Ben's Kerbal success came with a surplus of trial and error.

"One time I tried to launch this rocket to the Moon and I missed it and I got stuck in deep space. I kind of forgot about it, but I came back a couple days later and a ton of my astronauts were stuck on there and all my pilots and one scientist. And I had to get it back and it took like 20 years to get an encounter with Earth. Luckily you can fast forward, but it still took half an hour even with the time warp. But it ended up landing and everything was fine!"

Cody is nineteen years old and first started playing Kerbal in 2014. He joined Airway Science for Kids in January of 2021 making video content that used Kerbal Space Program to teach concepts like thrust, lift, drag, and more, and has recently worked on making educational content in KSP. Cody was first exposed to spaceflight from KSP. "By playing Kerbal I was able to learn the basics of spaceflight, and from there my curiosity grew. By teaching using Kerbal Space Program I am able to plant that seed of curiosity much like how people on the internet did for me." In his nine years of playing Kerbal, Cody has really let his creativity take over.

"I think my favorite thing about Kerbal Space Program is the sheer amount of creative freedom it gives you. While KSP is first and foremost a game about launching rockets, the limits of the game are truly your imagination. The selection of aerospace-related parts is surprisingly versatile. If you want to put a race track on the moon, you can do that! You want to make a highly detailed re-creation of an aircraft? You can do that!"

"You can do that" may be the most basic tenet of KSP. For a field like aerospace that can feel out of reach for so many adults, let alone children, having a game that encapsulates some of the most difficult concepts in modern science and applies them to real world scenarios makes outer space feel a little more within reach. And after all, it's just rocket science.

