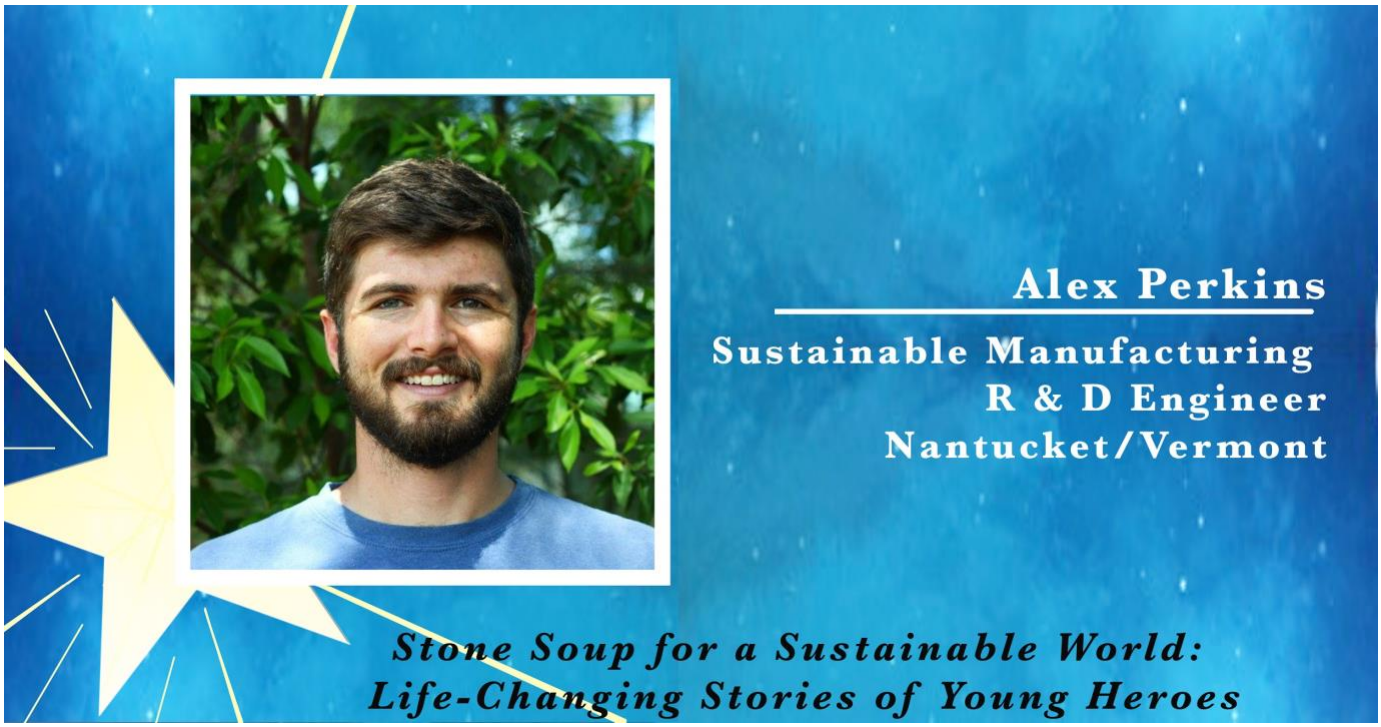

Engineering Solutions to Climate Change Problems
Alex Perkins
Nantucket/Vermont USA

Alex Perkins grew up in Nantucket, helping his parents take tourists out on their whale-watching boat. In high school he spent a semester in the Bahamas, where he learned about sustainability issues, and observed the horrible effects of burning plastic waste. He became fascinated with sustainability issues, and especially with finding technical solutions to these problems. First he joined with others to build a wind turbine at his school. Later he became a mechanical engineer, and even developed a machine that can turn plastic waste into fuel. For Alex, passion, technical skills, and collaborating with others are key to fighting the climate crisis. "We need to find innovative solutions to the problems we're facing," he says. "It's all about collaboration: talking about problems with friends, talking about ideas that you can build together."

Values : Caring Cooperation Imagination Determination Commitment

Lessons Learned

- When you see something, do something! Use the resources you have to solve a problem you feel passionately about?
- To solve environmental problems, reach out to others, and get them to work collaboratively toward the same goal.
- We need to all work together to find alternatives to plastics that are healthier for people, and for our planet.

Language Arts

- Imagine you are part of a group of students tasked with convincing your school to start using energy generated by wind power. In order to do this, you will need the support of other students, teachers, and administrators. Create a promotional piece to educate people in your school about the benefits of wind power. Be creative. You can use video, audio, graphic design, music, anything you like to create your campaign. Then write a reflection paper on the choices you made, and explain why you think this would be

the most effective way to create awareness of the issue of your choice.

- Create a social media post designed to convince people to join your cause. Address just one specific group of people in your school community (students, teachers, or administrators). You can use still images and/or video. Then write a reflection paper explaining why you made the choices you made: why you chose to address that particular group of people (and how you think they can help your cause); why you addressed them the way you did (the language you used, the tone of the post, etc.); and why you chose the medium you used (video, music, graphics, written word).
- Create a PowerPoint presentation about the importance of teaching sustainability in schools. Focus on how including sustainability in the curriculum would add to the quality of kids' educations, and explain why using wind power at your school would contribute to the students' education. Then write a reflection paper explaining why you made the choices you made: why you chose to address that particular group of people (how you think they can help); why you addressed them the way you did (the language you used, the tone of the post, etc.), and why you chose the medium you used (video, music, graphics, written word).
- Write a speech to be delivered to the school board on the issue of using wind-generated power for your school district. The speech must address not only the environmental benefits of wind power, but also the practical and financial benefits of this type of electricity. The speech must be no longer than three pages, and it must include facts gathered from research.

STEM Activities

- Research areas in and around your community that could be sites for ecotourism. Alex's home in Nantucket is surrounded by the beautiful ocean. But a forested mountain range, a sprawling desert, or a prairie grassland could be equally interesting places to visit. Any places untouched by people are perfect spots to appreciate the beauty of our planet. Remember that it is important to remain respectful of the earth; leave everywhere you go just as it was when you arrived. List three potential ecotourism sites in or near your community, and three global ecotourism sites you may want to visit.
- Are there any wind turbines or other sources of renewable energy in your community? If not, do you see any potential sources of renewable energy? For example, if there are large open fields with consistent sunshine upon them, solar panels could be installed to take advantage of the surface area. If you live in a particularly windy area (like Nantucket) a wind turbine could be the perfect answer to providing power to your community! List two renewable energy resources that you think would be a good fit for your community.
- Learning is one of the most important steps on any journey; Alex helped his peers by creating a free online library. Check out your local library's selection of online books. Most libraries have books on sustainability and renewable energy; so sign up for a library card online and check out a book on sustainability. The keywords to search for are "sustainability," "renewable energy," "solar power," "geothermal," and "wind power."
- Alex used "pyrolysis" to turn plastic waste into fuel. What other waste materials do you think could be recycled into something useful? For example, did you know that scientists have found ways to use corn husks as the base for a biological car fuel? List three items that you do not see being recycled (or that are not recycled efficiently) and think about how they could be turned into something useful.
- What is a problem that you struggle with that you think could be aided, or fixed entirely, by technology? Alex says that change can happen even when it's not commercially viable, so don't limit yourselves only to profitable solutions. For example, it costs more money to build elevators in buildings than to simply use the stairs, but we can all agree that 90-story buildings do need elevators!

Sustainability Innovations

- SeaAhead: sea-ahead.com: SeaAhead is a blue tech startup platform, based in Boston, that helps build companies and facilitates investments. They are helping to catalyze a blue tech cluster in the Northeast.
- AirCarbon: https://www.newlight.com/aircarbon AirCarbon uses natural ocean microorganisms to make PHB from air and greenhouse gases as an alternative to plastic.
- ENGIE Impact: https://www.engieimpact.com/: ENGIE Impact is a sustainability and energy management company.

Sustainability Career Pathways

- **Mechanical Engineer.** As Alex's story shows, with engineering skills we can redesign our manufacturing processes to make things—from wind turbines to toasters—more efficient and more sustainable! Want to explore the field of engineering? Start here.
- **Renewable Energy Site Design Consultant.** A lot goes into identifying an appropriate site for a new renewable energy project, from figuring out whether it will generate enough electricity, to determining what impact it will have on the surrounding environment. As we transition to renewables, there is a great demand for people who are skilled in helping to set up new projects. For example, Geo SubSea, a consultancy firm, assesses and maps the design of offshore wind farm sites in the Northeastern United States.
- **Sustainable Finance**. With billions of dollars being invested, where the money goes will shape the future of business. Should we be investing in oil companies, or in renewable energy companies? In downtown real estate or suburban malls? Working with a socially responsible investment firm, or with a university or foundation as an asset manager can be a great way to help develop the sustainable business sector. Here is a brief introduction to the many jobs in the field.
- **Inventor.** It's not easy to invent something, and it's even harder to get the world to notice. But a good idea can change the world! Explore these 5 Steps to Inventing Something, and these 7 steps to becoming a full-time inventor.

Call to Action: Identify a problem you feel passionate about, and figure out what skills you need to learn so you can do something about it. Then find others who can work with you to create a solution. Learn more about Alex's work in technological solutions to climate change problems. https://www.roadpitch.co/pitcher/synticos-llc/

State Standards

California

- **ELA**
- W.11-12.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from and supports the argument presented. f. Use specific

rhetorical devices to support assertions (e.g., appeal to logic through reasoning; appeal to emotion or ethical belief; relate a personal anecdote, case study, or analogy). CA

- W.11-12.3: Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences. a. Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events. b. Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters. c. Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution). d. Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters. e. Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.
- W.11-12.6: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information
- W.11-12.9: Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics"). b. Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential
- WHST.11–12.2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
- WHST.11–12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- RH.11–12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.
- SL.11-12.1: Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. b. Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed. c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or

challenge ideas and conclusions; and promote divergent and creative perspectives. d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

- SL.11-12.4: Present information, findings, and supporting evidence (e.g., reflective, historical investigation, response to literature presentations), conveying a clear and distinct perspective and a logical argument, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. Use appropriate eye contact, adequate volume, and clear pronunciation. CA a. Plan and deliver a reflective narrative that: explores the significance of a personal experience, event, or concern; uses sensory language to convey a vivid picture; includes appropriate narrative techniques (e.g., dialogue, pacing, description); and draws comparisons between the specific incident and broader themes. (11th or 12th grade) CA b. Plan and present an argument that: supports a precise claim; provides a logical sequence for claims, counterclaims, and evidence; uses rhetorical devices to support assertions (e.g., analogy, appeal to logic through reasoning, appeal to emotion or ethical belief); uses varied syntax to link major sections of the presentation to create cohesion and clarity; and provides a concluding statement that supports the argument presented. (11th or 12th grade) CA
- SL.11-12.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

- **STEM**
- HS-ESS3-2: Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social, and environmental cost-benefit ratios. Clarification Statement: Examples include developing best practices for agricultural soil use, mining (for metals, coal, tar sands, and oil shales), and pumping (for petroleum and natural gas).
- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Massachusetts

- **ELA**
- W.11-12.1: Write arguments (e.g., essays, letters to the editor, advocacy speeches) to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
- W.11-12.1.a: Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
- W.11-12.1.b: Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
- W.11-12.1.d: Establish and maintain a style appropriate to the audience and purpose (e.g., formal for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
- W.11-12.2: Write informative/explanatory texts (e.g., essays, oral reports, biographical feature articles) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

- W.11-12.2.e: Establish and maintain a style appropriate to audience and purpose (e.g., formal for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
- W.11-12.3: Write narratives to develop experiences or events using effective literary techniques, well-chosen details, and well-structured sequences.
- W.11-12.3.a: Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create an appropriate progression of experiences or events.
- W.11-12.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in Writing Standards 1-3.)
- W.11-12.6: Use technology, including current web-based communication platforms, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- SL.11-12.1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 11–12 topics, texts, and issues*, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2: Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
- SL.11-12.4: Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, vocabulary, substance, and style are appropriate to purpose, audience and a range of formal and informal tasks. (See grades 11-12 Language Standards 4-6 for specific expectations regarding vocabulary.)
- SL.11-12.5: Make strategic use of digital media (e.g., audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

- **STEM**
- 9-12.DTC.c.2: Perform advanced searches to locate information and/or design a data-collection approach to gather original data (e.g., qualitative interviews, surveys, prototypes, simulations).
- 9-12.DTC.c.4: Gather, organize, analyze, and synthesize information using a variety of digital tools.
- HS.ESS.3.2: Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social, and environmental cost-benefit ratios. Clarification Statement: Examples include developing best practices for agricultural soil use, mining (for metals, coal, tar sands, and oil shales), and pumping (for petroleum and natural gas).
- HS.ETS.1.1: Analyze a major global challenge to specify a design problem that can be improved. Determine necessary qualitative and quantitative criteria and constraints for solutions, including any requirements set by society. Clarification Statement: Examples of societal requirements can include risk mitigation, aesthetics, ethical considerations, and long-term maintenance costs.
- HS.LS.2.7: Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.* Clarification Statement: Examples of solutions can include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, and ecotourism.