

Engage and motivate

Brain Storm

Choose and Design

Create and Experiment

Refine and Improve

<p>NASA DESIGN PROCESS</p>	<ul style="list-style-type: none"> -Teachers ask questions to engage students' interests - Teachers clarify the problem to lead students to start imagining solutions - Students explore the conditions and limitations for the project 	<ul style="list-style-type: none"> - Inclusive environment is mandatory in order to take wide array of possible solutions from all students - Record all ideas - Participation of all students is required - Teamwork is mandatory 	<ul style="list-style-type: none"> - Visualize the design ideas by sketching them out - Evaluate if the design sketch is practical to build on - Pick the most promising idea with limited amount of time - Make plan for building as a team 	<ul style="list-style-type: none"> - Follow the initial plan and start building based on the chosen sketch - Record the measurement for each experiment on design - Present the difference in measurement to motive further improve - Team work is mandatory 	<ul style="list-style-type: none"> - Analyze the data collected from the experiment - Make possible change to further improve the design
<p>NGGS DESIGN PROCESS</p>	<ul style="list-style-type: none"> - Define and delimit engineering problem by stating the problem to be solved as clearly as possible in terms of criteria for success, constraints for limits. 	<ul style="list-style-type: none"> - Collect as many ideas as possible from the students 	<ul style="list-style-type: none"> - Design the solution for the problem - Student at grade k-2 do not require to provide original solution 	<ul style="list-style-type: none"> - Create, test the solution and compare - Students in the lower grade can use representations to convey solutions 	<ul style="list-style-type: none"> - Optimize the design solution by trading off less important feature for the one are more important
<p>DARMOOUTH DESIGN PROCESS</p>	<ul style="list-style-type: none"> - Define the problem in formats of open ended question, condition in need of change or design and construction given a kit of materials - Reinststate the problem to make statement more clear - Develop constrains and criteria and turn them into specs if possible - Conduct further research or market study for more clear criteria and specs 	<ul style="list-style-type: none"> - Explore possible ideas with an open mind. Encourage as many ideas as possible - Research alternatives to make qualitative comparison between solutions 	<ul style="list-style-type: none"> - Identify a potential solution from the highest score of the Trade-off Matrix - Research in detail the potential solution to ensure it meets all the specs - Design a potential solution (prototype) that can be testable against the specs - Present the potential solutions in both a written and an oral report for gaining feedbacks from teachers 	<ul style="list-style-type: none"> - Construct a prototype in groups - Evaluate and test the prototype by testing it against the specs 	<ul style="list-style-type: none"> - Reiterate the design process if it fails meeting specs - Simplify the design if it meets all specs

SIMILARITIES	<ul style="list-style-type: none"> - Clarity on the problem, constraints and criteria - Format of questions or problems have to be relatable and engaging for students 	<ul style="list-style-type: none"> - Maintain a neutral discussion environment to encourage and record as many ideas as possible from all students 	<ul style="list-style-type: none"> - Use drawing or sketching to visualize and present the ideas about design. 	<ul style="list-style-type: none"> - Create from the chosen design - Test on the solution and compare 	<ul style="list-style-type: none"> - All solutions can be improved - The design process can be repeated again for a better or simpler solution if time allows
DIFFERENCE	<ul style="list-style-type: none"> - In Darmouth Design Process, a further step to develop constraints and criteria into specs. Specs are used as a standard for later design and test process 	<ul style="list-style-type: none"> - NASA Design Process stress about team work - Darmouth Design Process put weights in research to help improving the accuracy of Specs 	<ul style="list-style-type: none"> - NGGS Design Process separates the standard and expectation for engineer design by different grades of students - Darmouth Design Process use Trade-off Matrix (Science of Data) to help in decision making for the potential solution. 	<ul style="list-style-type: none"> - NASA Design Process has students measure and compare the data generated from their own design, which leads them to the next process in design. - Darmouth Design Process test the design against specs 	<ul style="list-style-type: none"> - NASA Design Process encourage repetitive testing, experiment and data analyze to improve the design - Darmouth Design Process aims to simplify the design - NGGS Design Process foster students to evaluate different design features and make improve from there

Sum: All Engineer design process in NASA, NGGS and Darmouth are not a linear process. Students can avert to the previous process to re-evaluate if there is resistance or difficulty to proceed. Students who practice the process will be able to utilize the same process in their future problem solving or solution designing.