Allen R. White, Ph.D.

RPGs for Science and Engineering Education Workshop

STEAM Hack

RPGs for Science and Engineering Education

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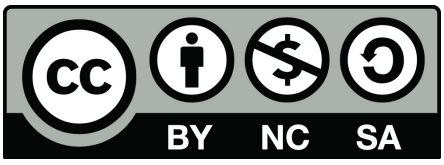

First Assumption:

The learning and practice of science and engineering can be fun.
And not merely fun, but delightful.
(If you doubt this, even a little, read "Surely You're Joking, Mr. Feynman" by Richard Feynman)

Second Assumption:

We cannot make students learn.
We can only create the environment in which learning can happen.

Introduction

This workshop is about creating a classroom environment that better supports learning. I can list all of the things involved in that (e.g. engagement, challenge, support, etc.) but the point here is to create an immersive environment that is challenging, rewarding, and delightful to both student and educator via tools that attendees of this convention know to be effective. This workshop will explore game and role-playing techniques that have been proven to be effective in teaching[1] [2] and to find a way around constraints on creativity (and, thus, around self-monitoring), even in participants who self-identify as uncreative[3]. Hopefully your presence here indicates that you are on board to using RPGs in the classroom, or at least not hostile to it, so we won't spend a lot of time justifying the efficacy of the approach. If you are even a bit skeptical, think about how all games that have a following - board game or RPG - are successfully getting people to spend hours of their time learning and playing. They are definitely onto something.

The challenge, and the opportunity, of using RPGs in a science or engineering course is that they are a substrate/framework/scaffold - choose your favorite - to which we will attach our course content. They are not the content itself. As such, we should be careful in choosing which game mechanics we use to achieve our learning objective, lest we blame a classroom failure on the RPG approach being unsuccessful rather than attribute it to not selecting the appropriate game mechanic. Aside: The words "learning objective" may cause mental chaffing - if they do, please mentally substitute "what am I trying to convey to my students" whenever you encounter them.

Before we go too much further, I would be remiss if I did not mention the pioneering, broad, and terrific work that has been and is being done to use RPGs in history education by the **Reacting to the Past (RTTP)** consortium - find them at reacting.barnard.edu and come join them at one of their conferences!

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[1] *International Education Studies*, Vol. 8, No. 6, pp. 211-216, 2015

[2] Minds on Fire, How Role Immersion Games Transform College, Carnes, Mark C., Harvard University Press, 2014

[3] PLOS One, February 1-, 2016, DOI:10.1371/journal.pone.0142567

Overview
While we will be discussing using both boardgames and RPGs in the classroom, we will spend most of our time on RPGs because 1) the application isn't as easy to see and 2) they have been proven to be effective in improvement for a broad range of skills (https://reacting.barnard.edu/news/publications).

In this workshop, we will primarily discuss RPG game mechanics and their connection to course learning objectives, or what we want students to explore in the game. First we will define game mechanics and explore their utility with respect to different courses and learning objectives. Next we will go through some simplified RPGs together to explore their mechanics and their applicability to course content. We will conclude the RPG discussion with a few brief examples of simplified RPGs for a few different types of courses before concluding with an overview of board games that might be useful in the classroom and how they might be utilized.

Glossary:

RPG - RolePlaying Game

GM - "Game Master" - the person who runs the games and makes rulings (the course instructor, in our case)

PC - "Player Character" - a game character whose actions are decided by a player

NPC - "Non-Player Character" - a game character whose actions are decided by the GM

Game Mechanics
Game mechanics are rules that govern outcomes, dice rolls, and game master rulings. They are the mechanisms that make the game what it is and are central to its operation and, more importantly, its "feel." RPGs with a lot of rules are often referred to as "crunchy" (e.g. Hackmaster, Advanced Dungeons & Dragons) while those that have fewer rules are "rules light" or "open" (e.g. Fate, Apocalypse World). RPGs can broadly be put on a continuum of game mechanics complexity from story games, which use mechanics in a very limited way to create a storytelling structure (e.g. Kagematsu, Wasted Youth, Microscope, Downfall) on one end of the spectrum and simulations (e.g. Hackmaster, AD&D, etc.) at the other:

Story Games Simulations

If I have tread on the sacred territory of your favorite game and mischaracterized it, I am sorry. My goal here is not to create a taxonomy but to create a framework that we can use to evaluate

what game mechanics might best achieve our learning objectives. On the same note, if you have a correction, adjustment, or addition to my ideas (or characterization, sorting or accounting), please email them to steamhackd20@gmail.com, I would love to hear them.

Story Games

Story games have mechanics that are designed to support building a narrative structure (thus "Story Games") with few additional mechanics to avoid getting in the way of story creation or to take the narrative away from the players. If you haven't encountered this, it is called "player agency" and most games, even those that are more of a simulation, use them to ensure that players feel they have a sense of control. While this provides freedom, too much freedom can leave students unsure of what they should be doing. Better games are elegantly designed to help players develop a narrative framework and then step aside to let them build and explore it. It could also be used to develop a list of solution methods or technologies that, when combined in different ways, can produce a unique solution. Write answers down on index cards and combine them in different ways by re-arranging them.

The strength of this method is that all opinions are equal but this can be a problem too - what if all opinions are not equal? Or what if there is a dispute? Simulation game mechanics can address those problems - they will arrive in a bit.

Story Game: Microscope

Microscope is a story game that has participants collaboratively create a story by creating a beginning and an end and then adding Periods, Events, and Scenes. The players agree on a beginning and an end and then take turns filling in the details of what happens in-between, playing off of the previous additions to make a fuller and more interesting story.

The collaborative elaboration of *Microscope* can be used to help students discover the necessary elements for a process to achieve its goal or for a problem to be resolved. This approach can be used to great effect in:

- problem solving
- research
- design

An example of how this might be used to help a group of students (e.g. design, management, etc.) understand the design and manufacturing process from concept to product by using cookies as an example. To start, the instructor would write "Concept: New Cookie Recipe" on a notecard and place it on the left of the table and "Produce Cookies" at the other end of the table on the right and asking students to write a part of the process on a card and place it where it would be in the process. A student might write "Hire a Chef" and place it toward the concept and another writes "Distribution Network" and places it to the right. You can see how this quickly clarifies and organizes the process! It is useful in teasing out the complexity of a seemingly simple process (thus my application to cookie production) and it can be used to show all of the steps involved in problem solutions, computer simulations, etc.

The advantage of this approach is it has students discover how to proceed collaboratively with the process coming from an emergent understanding rather than a prescriptive requirement. In my experience, this has proven to be very effective.

It is especially helpful to use this in a team based course by starting with an example, like cookie production above, that the whole class participates in and then asking each team to do the same for their project. The team or group begins with the start and end supplied by the course requirements or the instructor and then takes turns filling in the intermediate portions of the process or problem. Having multiple teams compare their results helps to uncover multiple approaches to the same problem. The depth of thought is often surprising.

If this approach is too open, the instructor can provide intermediate steps one at a time or start from the beginning and do it sequentially. However, the addition of intermediate elements forces the team, and the individuals in it, to think recursively about the problem or processes.

Story and Simulation Pairing

The story game approach may have left some cold, so lets add a new element from simulations (we haven't explored pure simulations yet - we will). Before introducing the STEAM Hack mechanics - let's discuss typical RPG attributes and how they could be used to determine success or failure at a wide variety of tasks.

Most RPGs use general attributes to describe the abilities of a player's character - their PC - and use those to determine how well they perform in actions related to their ability with the corresponding dice roll.

The most common basic attributes for a PC and their description are:

Attribute	Description
Strength (STR)	How strong is your character? How likely are they to be able to lift things, overcome an opponent, etc?
Dexterity (DEX)	How agile, stealthy, and coordinated?
Constitution (CON)	How is their health and ability to remain healthy?
Intelligence (INT)	This is not "street smart" and not memory. How likely are they to solve a complex puzzle or learn a new skill?
Wisdom (WIS)	Do they just "get it"? Does your PC remember things well and solve problems via intuition?
Charisma (CHA)	How attractive are they? Are others drawn to them? Do they seem to be a "born leader"?

The classic method to determine your PCs ability in each attribute, roll 3d6 (roll a six sided dice three times) and add the results. This gives a number from 3-18, with 3 being exceptionally poor and 18 being exceptionally good. When you see the numbers together, you can image the person that they describe, e.g. a STR of 14 DEX of 12 and an INT of 8 describes someone who is very strong, relatively coordinated, but not the brightest bulb in the pack.

If you want higher attribute values than those generated by the 3d6 rolls, roll 4d6 and throwout the lowest die value. To allow some customization in character generation, roll 3d6 six times record all of the values and then choose which values go to which attribute to shape what sort of PC you have.

Example of classic attributes in use:
To see if your PC is able to catch the vase before it drops, roll a d20 (20 sided die) - if the number is under their Dexterity attribute value, you are successful. For example, if your PC has an INT of 16 and you want to see if they can figure out a solution to the problem, roll a d20 - if the value is 16 or under, you succeed. This method can also be used to solve for conflicts as well: an argument between two PCs could be resolved by using either their INT or CHA (depending on if they are trying to reason or charm) with the winner being the one who rolls the most under their ability. Let say Harry has an INT of 17 and he is trying to reason with Bob. Bob has an INT of 11 but a CHA of 16, so he tries to charm Harry. They each roll a d20; Harry rolls a 12 (5 below his INT of 17) but Bob rolls a 6 (10 below his CHA of 16), so Bob wins the argument by charming Harry!

As you can quickly see, the combination of attributes can be used to describe specific characters and estimate how they would do at a number of tasks in a rough approximation of our world. Lennie from Of Mice and Men would have clearly had a very high strength but not as high intelligence while George would have a lower strength, higher intelligence but, arguably, a higher wisdom.

While there are many ways of using attributes with dice rolls to determine the success or failure of the use of that ability as a function of the PC's ability score, we will use a simplified version that is conceptually easier for those who are new to RPGs. If you are an experienced gamer or you value the verisimilitude of different mechanics, of course you should feel free to modify this simulation as desired.

STEAM Hack

The following mechanics are an RPG game mechanics "hack", called the STEAM Hack ("STEAM" is an acronym for Science Technology Engineering Art Mathematics), based on the basic mechanics for the first roleplaying game, which the Open Game License (OGL) allows (but it does not allow me to use the name of that game - see Appendix 6). The STEAM Hack mechanics are inspired by the Holmes Basic rules *Blue Hack* by Dreamscape design - I highly recommend their *BLUEHOLME* RPG.

For our purposes, let's use the simplified mechanics described above and modify the attributes to describe an engineer (**taken from the National Academy of Engineering's *The Engineer of 2020***): **research, analysis, experimentation, ingenuity, creativity, and leadership**.

Engineering Attribute	Engineering Attribute Description
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem
Creativity	Ability to see novel and or unique solutions
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example

As with the traditional abilities mechanics discussed above, when asked to determine if their PC can successfully use the ability, called an **ability check**, you roll a d20 and a roll of the ability score or lower is successful. For example, on a Leadership check, a player with a Leadership of 12 is successful on a roll of 12 or under and unsuccessful on a higher roll. Thus the higher the score, the higher the probability of success. If thinking of these as probabilities makes more sense to you, see the "Basic Role-Playing (BRP)" topic in Appendix 1.

You can assign values or have students roll their abilities. One of the benefits of roleplaying is playing a PC that is very different than you; if you are deeply analytical, you can play a PC that is ingenious and creative. This may take some students some time to get used to but the approach has significant potential to bring out the importance of different skills and how to use multiple skills to solve a problem.

So let's use this approach on a problem and involve a twist to help motivate the students…

Simulation: Mission to Mars

This simulation will begin with a **Background** to motivate the **Preparation Phase** that will get you ready for the **Crisis Phase**. The **preparation phase** is where your team jumps back in time, motivated by what they have seen, to do the work the real engineers do to prepare for a crisis and the next is the **crisis analysis phase** where they will use the information that they find during preparation to find the source of the mission problems. Starting with the crisis and going back to preparation motivates the research and allows for the quality of the preparation to impact the findings of the simulation by modifying the dice rolls that determine the success or failure of the team's efforts.

Background:

You are part of the NASA launch team and in the mission control room on launch day. You are among the elite few, the best of the best, who have been chosen to be in the control room. It is launch day, a surprisingly gorgeous day after the hard frost last night, of the first human mission to Mars and you are thrilled to be here! Everything has gone smoothly - maybe too smoothly - and the countdown went down to launch without a hitch. You are watching that lovely rocket that you have worked so long on power upward and, as it is just about to clear the tower, you see a.. flash? - was it? what was that? - and immediately after you hear your FIDO, the flight dynamics officer, yell out to your flight director "FLIGHT, I've got bad telemetry." Immediately the propulsion engineer, PROP, says "Me too FLIGHT. These numbers don't make any sense" and your stomach hits the floor but not before the guidance, electrical, and instrumentation all chime in with the same bad news that you are seeing on your monitor. Numbers and letters that don't belong where they are showing up - like "A37M" as the value for "Nozzle Temperature". And then, just when you thought you couldn't get any sicker to your stomach, CAPCOM says she has lost all telemetry from the crew and can't get radio contact with them. You have got a very large rocket with very large engines (that are still very loudly and very brightly - maybe a bit too brightly? - burning propellant) hurtling your rocket towards Mars, you hope, but maybe not.

You and everyone else have to think very quickly to try to save this mission and, if not the mission, the crew. Fortunately, you have prepared extensively for this…ok, not this, but for myriad possible bad things. Your emotions step out of the way as all of your training, analysis, and simulation experience start to tear into what is going on with your rocket…

You will be using many/most of your PC's attributes during the simulation but, in general, the attributes most useful to each phase will be based on the time scale of the phase:

Phase	Attributes Utilized	Time Scale
Preparation	Research, Analysis, Experimentation	Days/Weeks/Months
Crisis	Ingenuity, Creativity, Leadership	Fractions of a Second/Seconds

As you can see, while you could use ingenuity, creativity, and leadership in the preparation phase, it would be significantly less likely that you would have time to use them in the crisis phase

Preparation Phase

We will divide, as you would divide your class, into teams based around the propulsion (PROP), structure and flight dynamics operations (FIDO), guidance operations (GUIDO), data processing, launch pad operations, and Flight operations (FLIGHT).
The preparation phase begins with a question:

"What would your PC have done to prevent or diagnose the possible failures in your area that could lead to a failure?"

There are classroom approaches below but, here, since we all have different backgrounds, we will use our abilities to determine the value of what is created in the preparation phase. After you review your character sheets (supplied in game and also in Appendix 4), look at your abilities and use them to decide what you would have investigated and how. Your character sheet has a few examples to get you started. In general, you are trying to use research, analysis, and experiments to prepare your team for the crisis. On a successful attribute check, you will get a card that grants you a "+" bonus to your attribute check roll during the crisis phase. As this data is available to everyone on the team, any team member can use any card. The value of the card is the difference between your attribute and your roll, i.e. a PC with a research value of 16 who rolls a 10 on their ability check gets a "+6" on that card.

Example:
You decide your PC would order an engine stability test to determine the likelihood of combustion instabilities during launch. You could use your PC's "Experimentation" attribute to determine if s/he successfully interprets the results of the experiments. Let's say your PC's "Experimentation" is a 16 and you roll a 17 - a failure. You fail to correctly interpret what this data would mean during the crisis. *But, you aren't sunk yet!* You can then ask another player for their PC's assistance in understanding the experimental data. Let's say they have an 18 in experimental data and they roll a 7; the result is a "+11" card for "Engine Stability", meaning that during the crisis phase, the team would have a +11 to determine if engine stability were a part of the crisis problem.

In your classroom:

First go through a few examples of the STEAM Hack mechanics in action but don't spend a lot of time on going through the rules, just jump right in - Appendix 5 has a great summary of how to teach game mechanics.

If this were a course, you would give the class information on their rocket and connect it to the course content. I would recommend using the Saturn V - the flight manual is available at https://history.nasa.gov/afj/ap12fj/pdf/a12_sa507-flightmanual.pdf and it is ridiculously full of information. You could have the entire team focus on the engines, telemetry, guidance, etc. as best suits your course. Here we will provide each team with information that could have been found during the preparation phase but, in classes, you could make this phase extend over a few weeks of course time, allowing for detailed research, simulation, and analysis.

You could focus on just one area, such as propulsion, that serve your course and learning objectives and sub-divide it into different areas based on the course content. They should then start coming up with a list of possible failure modes and how to diagnose and prevent them, maybe even a full Failure Modes Effects Analysis (FMEA). You can motivate analysis, research, etc. by assigning a value to it that can be used to modify dice rolls in the crisis has. For example, for very good research on combustion instability, you can assign a "+2", meaning that if they used their "Research" skill, they could add two to their attribute on a roll. For example, if their PC's research attribute is 14, the +2 takes it to 16, meaning any dice roll of 16 or under is successful. If you are willing to, you can also record a probability of a failure and adjust it based on the quality of their efforts - a starting point is https://www.nasa.gov/pdf/140639main_ESAS_08.pdf . Add all of the probabilities together to 100% and use a percentile dice (d100 - or any random probability generator) to determine which failure happens (away from class so they are guessing during the crisis phase). Don't worry about being super accurate - a failure has to happen somewhere.

An option during the preparation phase is to separate the player's ability to understand the analysis/research/simulation they are working on from their PC's ability. For example, if a student finds some really useful info, have them roll on the corresponding ability to see if their PC understands it - if they fail, they can show it to another players PC for assistance and the two of them can both roll; this simulates the real benefit of working through a problem with someone else but if you and your class find it irritating, don't use it.

Crisis Analysis Phase

Once the research, analysis, and simulations are complete, we jump forward in time to analyze our rocket that is in crisis. The goal is to use the information and analysis from the preparation phase to diagnose the problem correctly by rolling the dice. As in the Preparation phase, another PC can assist and roll an attribute check as well.

Example: Gary is using his PC's Analysis attribute to determine if there is a combustion instability. His score is 11 but his preparation research was terrific, so it gives him a +2 to his ability score, meaning he must roll a 13 (11+2) or under to determine if there is an instability Note this doesn't mean that there is one - there may not be - but Gary must pass the ability

check to know either way. Gary needs a 13 or under and rolls a…17. A failure - Gary's PC can't make sense of his diagnostic check. Karen decides her PC would help and rolls to analyze the data as well. Her PC's Analysis ability is a 16 but, since she is on Gary'd team, her PC has read his research, giving her a +2 for a total of 18. She rolls a…12! Success! She and Gary successfully determine that there is minimal combustion instability.

It would be useful to have a number of results for each team to find but it isn't necessary. Maybe even two problems - one in the area of the most effort during the preparation phase and another in the area of least effortYou can keep them guessing with fuzzy responses. A few red herrings are fun too.

Role-Playing Game, Pure Simulation: Fate

RPGs are about collaborative storytelling, working together to make a story better than we could have individually, and immersing yourself in being another person. The rules are typically very flexible, allowing for myriad possible approaches with the outcomes decided by dice. Here we will be using the Fate Core system which is, typically, not considered a rules-heavy or simulation game but, given the limit of setting and scope, it loses most of its open nature (which shows the flexibility of this system).

As educators, we frequently discuss the intrinsic value of collaboration and stress the importance of the ability to collaborate in the workplace but, frankly, many/most of our students find it intimidating to engage with others at the level necessary to collaborate. Similarly, we often speak about the need for diversity and seeing other points of view without putting that into practice. Games in general, and role-playing games in particular, offer a wonderful substrate for us to attach the interaction skills necessary for collaboration and the opportunity to see the world from another perspective. We can focus on the game on not worry about the interaction. This is where role-playing games, especially cooperative ones, are of particular value as they get us to creatively work together toward a common goal, which forces, or at least results in, interaction and, ultimately, in developing the skills necessary for successful collaboration. We are fooled into thinking it is about the game. Our interaction is softened by working though our characters because we are not expressing our thoughts or feelings, we are expressing those of our character. Additionally, each character has unique strengths that make them better suited to different game situations, just like the engineering workplace. And just as in the engineering workplace, greater success is achieved with collaborative efforts that utilize the strengths of each participant.

Fate Core System as an Education Tool

Project meetings are a critical part of engineering design; they often determine how well, or poorly, a product will turn out but they are rarely discussed in engineering design courses due to the complexity of the meeting dynamics. Role-playing games (RPGs) in general, and Fate Core RPG in particular, offer the opportunity to explore the complex technical and ethical issues involved in project meetings without requiring students to actually have the depth of knowledge required to play their role in a way that will give rise to the complex dynamics of an actual project meeting (e.g. the conflicting goals of product features and price, the need to meets the demands or engineering, manufacturing, sales, and purchasing, etc.).

Fate Applied: Corvair Case Study

Fate Core RPG is a flexible and easy to learn and use system and was utilized as the basis of a meeting simulation surrounding an engineering meeting to make a manufacturing decision that turned out to have ethical implications. The simulation explores an actual manufacturing decision made by General Motors about the addition of a suspension stabilization device (an sway bar) to the 1960 Corvair. The consequences of the actual

decision were significant; GM's decision to not install the sway bar is cited as the cause of unsafe vehicle behavior (most notably in Ralph Nader's *Unsafe at Any Speed*) and resulted in significant controversy for both GM and the automotive industry. This topic was chosen based on its limited scope (but significant complexity) and the significance of the outcome. If you are concerned about running this game, the *Fate Core* book has advice on running a game and I have included an excellent summary of how to teach a game in Appendix 5.

The participants are introduced as project team members in a meeting at a fictional company, RH Motors, that has been called to discuss the proposed engineering changes to the company's new product, code-named "YS" for "young sporty." It is important to not mention the actual product to prevent a knowledgable participant from advocating the "correct" solution or disclosing the background and nullifying the simulation. The vehicle is aimed at younger buyers who want a sporty vehicle and is a response to vehicles produced by competitors. The project team is under pressure by RH Motors' sales group to get the vehicle to market as quickly as possible to get younger buyers into dealerships but the project is being slowed by challenges arising from design decisions that were intended to capture young buyers but that have proved to be difficult for manufacturing, engineering, and vehicle dynamics. Each participant is given an information sheet that describes attributes of the character they are to play, their title within the "company", and what their player character (PC) knows about the YS. Each PC has different pieces of the puzzle and no one PC has the entire picture of the problem or the possible solutions. Each PC also has different skills and different amounts of "reputation". Before the simulation begins, each player choses an "Aspect" (or two) for their PC - that describes the personality and goals of their PC, for example the VP of Purchasing may have an aspect of "Reducing the cost of the product is vital to this company's survival." It can be anything that helps the player (and other players) understand the PC.

The instructor typically acts as a moderator of the simulation. One way of playing this role without breaking the simulation is to act as a "Project Manager" or "Product Manager" - someone who is responsible for the final product and who represents the voice of the customer in the process.

The simulation begins by a brief history of the problem, an introduction by each player of their PC and a description of their Aspect, followed by a discussion of each of the PC's title in the meeting. The moderator explains that the meeting has been called to discuss the proposed addition of a sway bar to the vehicle followed by an opportunity for each PC to relate their position on the sway bar. All persuasion, argument, intimidation, or resistance is decided by dice rolls modified by their PC's skills and is run largely by the Fate RPG rules with modification to make the game run more quickly and more intensely.

Each PC skill (e.g. "Intimidate", "Resist", "Persuasion") ranges from +3 to +1 and can be used against another PC (with the exception of "Resist") or to defend and each skill can only be used once. The dice are six sided "Fudge Dice" that have a "+", "-", or no

marking (denoted henceforth by "_") on two sides each. Four dice are rolled at a time and the results are summed, giving possible results of four sides with a + (called a +4), to four with a - (called a -4). Each skill has a modifier based on their PC's strengths that adds to the dice roll. For example, lets say the VP of Sales is attempting to persuade the Plant Manager. The VP of Sales uses their "+3 persuasion" skill and lets say the dice read "+ _ _ - "(one +, two blank die, and one -), the + cancels the - and the blanks do not add, so the result is a "+3" (just the +3 from the skill). The Plant Manager can respond by Persuasion but that skill is only a +2 for them so they instead chose "Resist", as it is a +3. They roll the Fudge dice and get a "+++-" which is a +3 that adds to their skill, resulting in a +6. Comparing to the +3 from the VP, the Plant Manager has given them a total difference of -3 (3-6=-3), meaning that the persuasion attempt went terribly.

That leads to an additional element: Mental Stress. Each PC can tolerate two points, or occurrences, of mental stress before they leave the meeting. Mental stress happens to the initiator of any failed persuasion but can also be caused to the target of a successful "Intimidate" attempt. It is designed to add a realistic element and can be used to drive out an opposing PC.

Two elements, Reputation and Aspects, have been added to more accurately simulate the complexities of real interactions during meetings. Some PCs start with "Reputation", represented by a chip that can be given to the moderator to add +2 to their outcome or to re-roll the dice. This simulates the effect of an experienced and respected person "throwing their weight around" to push the outcome to their desired direction. This also simulates the real-world imbalance that exists between the different levels of power associated with the PC's title and position within the company outside of the narrow confines of this simulation. The Aspects that each player made for their PC can be invoked by the player to add +2 to the outcome or a re-roll when the roll is related to that aspect. For example, if the PC's Aspect is "Always fights for the highest technology in the product" and they can reasonably argue that their Aspect is connected to the argument or persuasion, they can receive the +2 or re-roll. This would be similar to invoking your history within the organization and what your PC is "known for" or how they will be expected to behave after the meeting. This is at the moderator's discretion; it can allow for a more balanced and realistic simulation when utilized.

The tension in the simulation is between the engineers who wish to install a sway bar and those who oppose that decision based on cost, manufacturing complexity, etc, just as it was at GM. The problem is that a rear engined car, such as the Corvair, tends toward oversteer (the care overreacts to steering inputs and the rear of the vehicle swings out during cornering), which is typically considered as unsafe for all but very experienced drivers. The option to change the tire pressure between the front and the back is attractive as it does not add cost and makes the ride quieter - in reality it does both - but maintaining the correct tire pressure is, in practice, quite difficult as few owners consult the manufacturers tire pressure requirements. This was the solution ultimately chosen and it was blamed for a number of accidents. GM ultimately decided to add the sway bar but only after the Corvair's reputation had suffered.

The simulation concludes once all parties have agreed on a course of action. A concluding debriefing that explains the actual scenario, the choices actually made, and the outcome is beneficial. It is useful to note that no one in the meeting was acting to harm the customer; rather they were acting with incomplete information and, possibly, without considering the consequences of their decisions on actual customers in actual real-world situation. It is also useful to discuss the potential long-term consequences of the PC's actions during the meeting; have they damaged a relationship, built stronger bonds, or caused potential future retribution?

There is one more thing that should be said here but that applies to all RPG approaches here: the unquantifiable effect on the fun and the tension of rolling dice and the type of dice you roll. Rolling a 20 sided dice may seem cool, or geeky, to students; rolling four Fudge dice may not. Choose your system accordingly.

Appendix 1
Additional Game Content

Story Games for Collective Visualization

While we have discussed a simplified story game, *Microscope*, there are a number of broad, inventive story games. If you haven't played one of these games, it is a wholly unique experience to see a whole narrative world emerge from different people collaborating on its creation. Either way, let's discuss how this can be used in a classroom and for what learning objectives.

We will use a modified version of the mechanism that *Kagematsu* (Cream Alien Games) uses to generate the game world. We will do this separately and then together. Use the worksheet below.

We will be exploring the life in a village. To create our setting, have each person in class fill in the details that will be used to help us understand what our village is, where it is, and who we are in it.

	Your Vision:	**Group Vision:**
Season (Fall, Winter, etc.)		
Location (near a mountain, etc)		
Another location descriptor (by a stream, etc.)		
What is the village known for?		
How do we survive?		
What is the problem in the village that could become a crisis?		

After you've given everyone a chance to fill this out, ask them to spend a moment and visualize it. Then ask for suggestions for each area from the class. Note how different these two are and how different your story would be for each but they both arose from the same game mechanic, asking separate questions that build to a story setting. Each answer is influenced by those before it when asked in this way; an alternate approach is to request them without reference to their use or have different students get different questions and have the class choose before selecting.

This approach is useful to help **develop visualization**, especially in science and engineering, and for **creative writing**. You could use this as a warm up to visualizing physical phenomena, e.g. "what does the photon see as it travels from the laser?", or you could replace all of the prompts with technical ones, e.g. "name an energy source", "name a material", "name an insulator." This would create a course related problem that the class can solve by visualizing the problem and doing the appropriate calculations. **The approach gets around the "we have to be serious" rule that students often feel constrained by and changes their expectations for the course, demonstrating a willingness to use "non-traditional" tools.**

This technique could also be used, without pre-amble, to help you see how different clients/customers/users might see a design or a technology. For example, they could select a state, a setting (urban, suburban, rural), an occupation, a house, etc. to ask "What would a meatpacker from rural Arkansas who lives in a tudor style house think about our new WizBang 6000?" This type of setup changes the assumptions and the context of the solution dramatically.

Story Game - Simulation Combination

List a number of possible ways to <u>collect rainwater</u>:

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

(don't feel obligated to fill all slots)

Now, from those, choose the ones that would work in typical suburb (adding new ones is ok!):

_____ _____ _____ _____

_____ _____ _____ _____

My favorite rain collection method is: _____. Why?

We will now share these with each other - feel free to fill in the good ones that others have come up with.

Now, take the role of someone at a city council meeting (as provided by your friendly game master) and list your mission or concern (or both, as appropriate to your character). For example, the home owners association representative will probably have a concern, the mayor may have a mission, the city utility manager may have both. Go with whatever you think is best.

I am a/the _____. My concern/mission is: _____.

My favorite rain collection method is:_____. Why?

You can now have a meeting of the city council about the possible solution to the perennial droughts that face Dragon, Arizona. Give roles to each student for mayor, city council members (several), city water manager, city sewer manager, homeowners association members, concerned citizens, etc. Have a meeting and then vote to choose a course of action.

After the meeting, what is your favorite method? _____. Why?

Note how assuming the role (probably) changed your favorite and how the meeting (probably) changed it again. This is the reality that scientists and engineers face. We start with our pet ideas but they rarely go unchanged through the needs of many individuals and the court of public opinion.

You can modify this by giving a poker chip to each player who makes a strong argument, representing public opinion, and had a vote at the end with the results modified by the their vote plus the number of poker chips they have. We could have also rolled dice to settle disputes between different council members, giving a modifier based on their knowledge, etc. We will explore that approach more in a bit, as the mechanics are simulation mechanics.

I have used the combined story and roleplaying approach to show the power of roleplaying but also to see how our assumptions change our preferred solution. This approach could be useful in any class in which assumptions can change the solutions (which is all of science and engineering).

Simulation: Basic Role-Playing (BRP)

A similar rule system to the STEAM Hack is “Basic Role-Playing” from Chaosium (also called “BRP” - the PDF is available for free from Drive-Thru RPG at drivethrurpg.com). The difference is that you take the basic abilities of 3-18 and multiply them times five, giving you a value between 15 and 90. You use percentile dice (called d100 - two ten sided dice, one is just determined to be the “tens” dice - i.e. its results are 10, 20, 30… rather than 1,2,3… or you can buy percentile dice, that have one die with 00-90 rather than 0-9) to determine if you are under that value. The advantage of this system is that it allows significant modification and is also more intuitive - “you have a 75% chance of success” (having to roll under a 20 on a d100) makes more intuitive sense to many than “roll under a 15 on d20.”

An additional benefit of this system is that you can list a wide range of skills and their associated percentage skill. “Library Research”, “daredevil driving”, “lock picking” are all skills that you can list, as appropriate to the exercise you plan, that also help students to think of what they might do to resolve problems or overcome difficulties. A sample of the skills portion of the character sheet is on the next page. Notice that, for some skills, there is a value to the left and a blank to the right. For example, in the top left, Under “Communication” the skill “Bargain” is listed as 05% with ____% to its right; this allows the game master - you - to add to this value for each time they successfully apply it, allowing the PC to improve as the game progresses.

Skills

COMMUNICATION *bonus* (____)

- ❑ Bargain (05%) _____%
- ❑ Command (05%) _____%
- ❑ Disguise (01%) _____%
- ❑ Etiquette (05%) _____%
- ❑ Fast Talk (05%) _____%

Language, Own (INT/EDUx5%)

- ❑ _____ _____%

Language, Other (00%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Perform (05%) _____%
- ❑ Persuade (15%) _____%
- ❑ Status (15% or var.) _____%
- ❑ _____ _____%
- ❑ Teach (10%) _____%

MANIPULATION *bonus* (____)

Art (05%)

- ❑ _____ _____%
- ❑ _____ _____%

Craft (05%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Demolition (01%) _____%
- ❑ Fine Manipulation (05%) _____%

Heavy Machine (01%)

- ❑ _____ _____%
- ❑ _____ _____%

Repair (15%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Sleight of Hand (05%) _____%

MENTAL *bonus* (____)

- ❑ Appraise (15%) _____%
- ❑ First Aid (30%) _____%
- ❑ Gaming (INT+POW) _____%

Knowledge (____%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%

Literacy (____%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Medicine (____%) _____%
- ❑ Psychotherapy (____%) _____%

Science (01%):

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Strategy (01%) _____%

Technical Skill (____%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%

PERCEPTION *bonus* (____)

- ❑ Insight (05%) _____%
- ❑ Listen (25%) _____%
- ❑ Navigate (10%) _____%
- ❑ Research (25%) _____%
- ❑ Sense (10%) _____%
- ❑ Spot (25%) _____%
- ❑ Track (10%) _____%

PHYSICAL *bonus* (____)

- ❑ Climb (40%) _____%
- ❑ Dodge (DEX x02%) _____%

Drive (____%) _____%

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Fly (____%) _____%
- ❑ Hide (10%) _____%
- ❑ Jump (25%) _____%

Pilot (01%) _____%

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Projection (DEX x02%) _____%

Ride (05%)

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ Stealth (10%) _____%
- ❑ Swim (25%) _____%
- ❑ Throw (25%) _____%

COMBAT *bonus* (____)

Martial Arts (01%)

- ❑ _____ _____%
- ❑ _____ _____%

see **WEAPONS** *below for more combat skills*

- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%
- ❑ _____ _____%

Appendix 2
Board Games Organized by Historical Topics
Compiled by:

Scout Blum
Andrew Peterson
Paul Wright

Presented at the
Reacting to the Past
Game Design Conference 2017
Newman University, Wichita KS

Historical Topic	Possible Board Games	Possible RTTP games (Level 2 basic prototype and up)
Classical World (Greeks and Romans)	Command & Colors Ancients; Pericles; Polis; Republic of Rome; Falling Sky; Time of Crisis	The Threshold of Democracy; Coniuratio! The Crisis of Catiline: Rome, 63 BC; Beware the Ides of March
Chinese History		Confucianism & the Succession Crisis
Japanese Feudalism & Shogunate	A Most Dangerous Time; Sekigahara	Legacy of the 47 Rônin
Late Antiquity & European Middle Ages	Pendragon: The Fall of Roman Britian (available Fall 2017)	Constantine & the Council of Nicaea; The Second Crusade; A Queen's Ransom: The Crisis of the Fourth Crusade
European Renaissance & Reformation	Florenza; Pax Renaissance; Here I Stand; Virgin Queen; Venetia	Il Duomo; Machiavelli & The Florentine Republic; Diet of Worms, 1521; Henry VIII & the Reformation Parliament; Trial of Galileo; Stages of Power, Marlowe & Shakespeare
English Civil War & Aftermath	Unhappy King Charles	King or Commonwealth? The English Civil War, 1647–1652; Constitutionalism vs. Royal Absolutism: The English Glorious Revolution, 1685-1689
Colonial America	Wilderness War; Legends of the American Frontier	Forest Diplomacy; Trial of Anne Hutchinson; Jumonville Incident, 1754; Bacon's Rebellion;
Exploration/Colonization	Colonial; Empires at Sea; Anno 1503; Civilization	
American Revolution	Liberty: The American Revolution, 1775-83; Liberty or Death: The American Insurrection; Washington's War; Empires in America	Patriots, Loyalists and Revolution in NYC; Launching the Ship of State: Ratification Debates in New York State, 1788
Constitution	Founding Fathers	America's Founding; Amending the Constitution
Early America	Lewis and Clark	
Enlightenment & French Revolution	Imperial Struggle (available Winter 2017); Legacy: The Testament of Duke de Crecy; Liberté	The Crisis of Diderot’s Encyclopédie, 1759; Rousseau, Burke, and Revolution in France
Napoleonic Era	Command & Colors Napoleonics; Empires in Arms; The Napoleonic Wars	
Jacksonian America		Red Clay 1835; Victory or Death (TX Revolution)
Slavery	Freedom: The Underground Railroad	Frederick Douglass
American Civil War/Reconstruction	A House Divided	Kentucky, 1861; Reconstructing the South;
Imperialism & Native American History	Navajo Wars; Comanchería	Red Clay 1835

Gilded Age/Progressive Era		Greenwich Village, 1913; Paterson 1913: The Silk Strike; Hetch Hetchy; Vice in New York; Harlem 1919
Industrialization	Age of Steam	Rage Against the Machine
History of Science	The New Science; Dominant Species; Tesla vs. Edison	Trial of Galileo; Charles Darwin, the Copley Medal, & Rise of Naturalism
Urbanization	New York, 1901; Power Grid; Quadropolis	
The West	Settlers of Catan: Trails to Rails; Ticket to Ride; Great Western Trail	
History of Art	Florenza	Modernism vs. Traditionalism, Art in Paris; Conflict at the Bauhaus, 1922
World War I	Paths of Glory; The Grizzled	July Crisis, 1914; Sinking of the Lusitania, 1915; Petrograd, 1917; Treaty of Versailles, 1919
Great Depression/New Deal	Monopoly	Ways and Means, 1935; American Artists' Congress; Oklahoma Revolution ; (1923); Making a Motion Picture Production Code, 1930; FDR's 100 Days; US Investment in Liberia, 1925-1935; Teapot Dome: Pres Scandal and Tensions in Government
Rise of Fascism	Rise of Totalitarianism; Democracy Under Siege; Triumph & Tragedy	Democracy in Crisis; Weimar Germany, 1929-32; Japan, the West, and the Road to War
World War II	Memoir '44; Axis and Allies; Black Orchestra; Churchill; Conflict of Heroes; Escape from Colditz; The Manhattan Project	Japan, the West, and the Road to World War; Yalta, 1945; Democracy in Crisis, Weimar Germany, 1929-32; Decision to Use the Bomb
Revolutions & Insurgencies	The Spanish Civil War; Pax Porfiriana; Cuba Libre; Days of Ire (Budapest 1956); Colonial Twilight: The Franco-Algerian War; Gandhi (available Winter 2017)	Saint-Domingue to Haiti: The Haitian Revolution, 1791-1804; The February Revolution and Dual Power in Petrograd, 1917; Mexico in Revolution; Second Spanish Republic; Chicago 1968; The Collapse of Apartheid, South Africa; Argentina 1985
India and Pakistan	Gandhi: The Decolonization of British India (available Winter 2017)	Defining a Nation: India on the Eve of Independence; A "virtuous woman"? The Abolition of Sati, India 1829
Cold War	Twilight Struggle; 13 Days; 1960: The Making of the President; Cold War: CIA vs KGB; Cuba Libre	Cuban Missile Crisis
Vietnam	Fire in the Lake; Hearts and Minds	Memory and Monument Building: The Vietnam Veterans Memorial
Kennedy/Johnson	1960: The Making of the President	Chicago, 1968

Civil Rights Movement		Montgomery, 1956: The Montgomery Bus Boycott; Civil Rights Tactics: From Mainstream to Extreme
Disease	Pandemic	London 1854: Cesspits, Cholera, and Conflict; Congressional AIDS hearings
Science/Environment	Evolution; CO2; Progress: Evolution of Technology; Manhattan Project: Energy Empire	Charles Darwin and the Copley Medal; Kansas, 1999: Evolution or Creationism; The Pluto Debate; Diet and Killer Diseases: McGovern Committee, 1976; Climate Change in Copenhagen; Challenging the USDA Food Pyramid; Acid Rain; Alan Turing, the Quest for the Artificial Mind, and the Rise of Cognitive Science: Manchester, 1949
Late 20th Century US		Title IX and the American University; Guerilla Girls in or Midst; Love Canal; Augustine, Afghanistan and Iraq; Space Shuttle Challlenger
South America	Andean Abyss	Argentina 1985
Postcolonialism & Human Rights	Colonial Twilight: The Franco-Algerian War; Gandhi (available	The Needs of Others (Rwanda)
War on Terror	Labyrinth; A Distant Plain	Augustine, Afghanistan and Iraq: Just War Theory and Realism in American Foreign Policy, 2001-2006

Appendix 3
STEAM Hack *Mission to Mars* Character Sheets

Role: Propulsion (PROP)

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	16
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	15
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	18
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	10
Creativity	Ability to see novel and or unique solutions	12
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	8

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Role: Structure and Flight Dynamics (FIDO)

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	12
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	18
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	16
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	15
Creativity	Ability to see novel and or unique solutions	8
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	10

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Role: Guidance Operations (GUIDO)

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	12
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	15
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	8
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	18
Creativity	Ability to see novel and or unique solutions	10
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	16

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Role: Data Processing

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	18
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	16
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	10
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	12
Creativity	Ability to see novel and or unique solutions	8
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	15

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Role: Launch Pad Operations

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	10
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	12
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	16
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	15
Creativity	Ability to see novel and or unique solutions	18
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	8

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Role: Flight Operations (Flight)

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	12
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	10
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	8
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	16
Creativity	Ability to see novel and or unique solutions	15
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	18

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

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Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

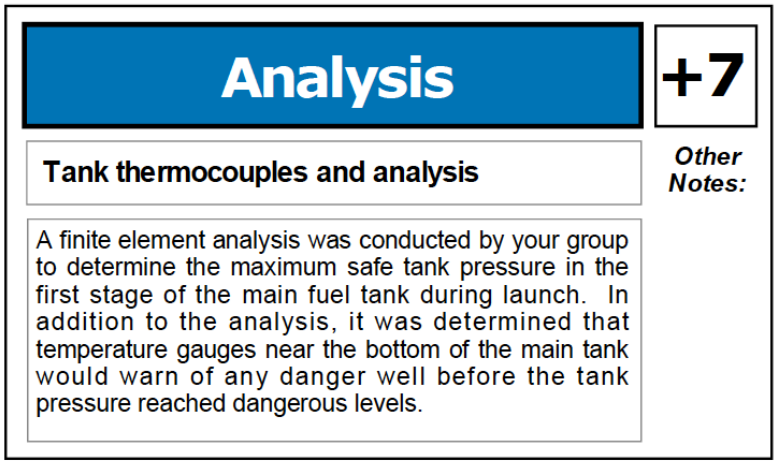
Example of Resource Generation (in Preparation Phase) and Utilization (in Crisis Phase):

Preparation Phase - Resource Generation Example

You are concerned that the first stage fuel tanks might be a problem during launch. You order an **Analysis**, specifically a finite element analysis, to determine the maximum safe tank pressure of the first stage main fuel tank during launch. The GM tells you that the team decides temperature gauges at the bottom of the tank, near the heat of the engines, would warn of danger well before the tank pressure became dangerous.

Your PC has an Analysis ability of 16, you roll a 9. You are awarded a "+7" (16-9) resource card for "tank thermocouples"

As a result, you receive this resource card:



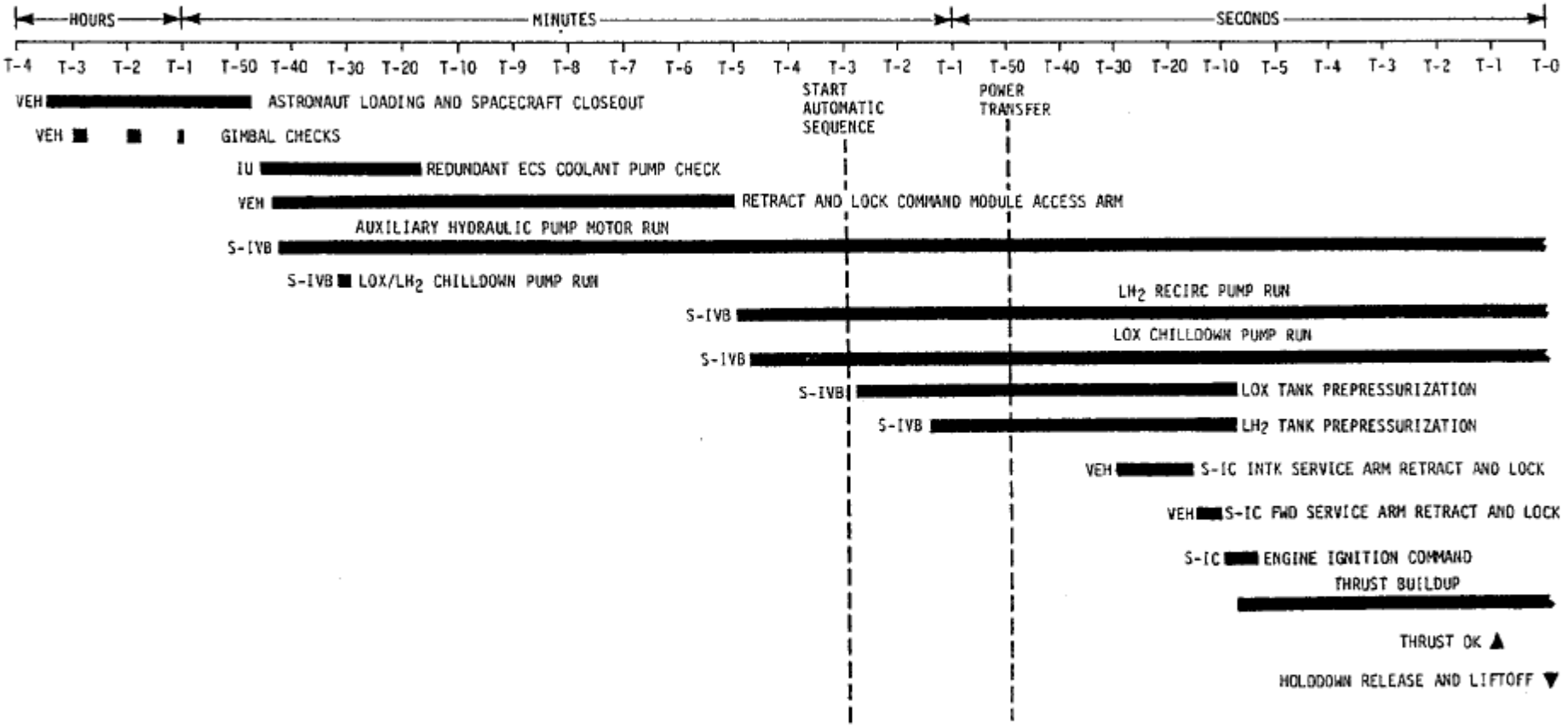
Crisis Phase - Resource Utilization Example

A fire in the first stage of the launch vehicle would cause a number of problems. To eliminate that as a concern, you use your **Ingenuity** ability to use the thermocouples in the first stage fuel tank to determine if the temperatures are abnormally high inside the first stage.

You use the "+7" resource card for "tank thermocouples" from above. You have an Ingenuity ability of 15 - the card adds +7, so you have a 22, meaning an automatic success (since a 22 is impossible on a d20).

The GM tells you that the temperature is well within the nominal range. You are confident there is no fire inside the first stage. Onto the next variable.

TYPICAL PERCEPTIBLE PRELAUNCH EVENTS



TYPICAL CRITICAL EVENT SEQUENCE, FIRST OPPORTUNITY TLI
(EVENT TIMES ARE BASED ON AS-507 SIMULATIONS FOR MISSION H-1
NOVEMBER 14, 1969 WINDOW, 72.029° FLIGHT AZIMUTH)

TIME FROM FIRST MOTION (HR:MIN:SEC)	TIME FROM REFERENCE (HR:MIN:SEC)	EVENT
-0:00:17.3	T_1-0:00:17.7	Guidance Reference Release
0:00:00.0	T_1-0:00:00.4	First Motion
0:00:00.4	T_1+0:00:00.0	Liftoff
0:00:01.4	T_1+0:00:01.0	Begin Tower Clearance Yaw Maneuver
0:00:09.4	T_1+0:00:09.0	End Yaw Maneuver
0:00:12.3	T_1+0:00:11.9	Pitch and Roll Initiation
0:01:06.9	T_1+0:01:06.5	Mach 1
0:01:23.5	T_1+0:01:23.1	Maximum Dynamic Pressure
0:02:15.0	T_2+0:00:00.0	S-IC Center Engine Cutoff
0:02:38.3	T_2+0:00:23.3	Begin Tilt Arrest
0:02:42.2	T_3+0:00:00.0	S-IC Outboard Engine Cutoff
0:02:42.7	T_3+0:00:00.5	S-II Ullage Rocket Ignition
0:02:42.9	T_3+0:00:00.7	Signal to Separation Devices and S-IC Retrorockets
0:02:43.0	T_3+0:00:00.8	S-IC/S-II First Plane Separation Complete
0:02:43.6	T_3+0:00:01.4	S-II Engine Start Sequence Initiated
0:02:44.6	T_3+0:00:02.4	S-II Ignition (Start Tank Discharge Valve Opens)
0:02:46.6	T_3+0:00:04.4	S-II Engines at 90% Thrust
0:02:47.2	T_3+0:00:05.0	S-II Ullage Thrust Cutoff
0:03:12.9	T_3+0:00:30.7	S-II Aft Interstage Drop (Second Plane Separation)
0:03:18.4	T_3+0:00:36.2	LET Jettison (Crew Action)
0:03:23.0	T_3+0:00:40.8	Initiate IGM
0:04:22.2	T_2+0:01:40.0	S-II Lox Tank Pressurization Flowrate Step
0:07:41.2	T_3+0:04:58.0	S-II Center Engine Cutoff
0:07:42.2	T_3+0:05:00.0	S-II Fuel Tank Pressurization Flowrate Step
0:09:10.7	T_4+0:00:00.0	S-II Outboard Engine Cutoff
0:09:11.5	T_4+0:00:00.8	S-IVB Ullage Ignition
0:09:11.6	T_4+0:00:00.9	Signal to Separation Devices and S-II Retrorockets
0:00:11.7	T_4+0:00:01.0	S-II/S-IVB Separation
0:09:11.7	T_4+0:00:01.0	S-IVB Engine Start Sequence, First Burn
0:09:14.7	T_4+0:00:04.0	S-IVB Ignition (Start Tank Discharge Valve Opens)
0:09:17.2	T_4+0:00:06.5	S-IVB Engine at 90% Thrust
0:09:19.3	T_4+0:00:08.6	S-IVB Ullage Thrust End
0:09:23.5	T_4+0:00:12.8	S-IVB Ullage Case Jettison
0:11:23.1	T_4+0:02:12.4	Begin Chi Freeze
0:11:29.6	T_5-0:00:00.2	S-IVB Cutoff, First Burn
0:11:29.8	T_5+0:00:00.0	Set Time Base 5
0:11:30.1	T_5+0:00:00.3	S-IVB APS Ullage Ignition
0:11:39.6	T_5+0:00:09.8	Parking Orbit Insertion
0:11:49.8	T_5+0:00:20.0	Initiate Maneuver to and Maintain Local Horizontal Alignment (CSM Forward, Heads Down)
0:11:50.3	T_5+0:00:20.5	Begin Orbital Guidance
0:12:28.8	T_5+0:00:59.0	LH_2 Continuous Vent Open
0:12:56.9	T_5+0:01:27.1	S-IVB APS Ullage Cutoff
0:13:18.3	T_5+0:01:48.5	Begin Orbital Navigation Calculations
2:37:41.8	T_6+0:00:00.0	Begin S-IVB Restart Preparations
2:38:23.8	T_6+0:00:42.0	O_2H_2 Burner (Helium Heater) On
2:38:24.0	T_6+0:00:42.2	LH_2 Continuous Vent Closed
2:45:58.1	T_6+0:08:16.3	S-IVB APS Ullage Ignition
2:45:58.6	T_6+0:08:16.8	Helium Heater Off
2:47:11.8	T_6+0:09:30.0	S-IVB Engine Restart Sequence
2:47:14.9	T_6+0:09:33.1	S-IVB APS Ullage Cutoff
2:47:19.8	T_6+0:09:38.0	S-IVB Reignition (Start Tank Discharge Valve Opens)
2:47:22.3	T_6+0:09:40.5	S-IVB Engine at 90% Thrust
2:49:02.3	T_6+0:11:20.5	MR Shift (First Opportunity Only)
2:53:04.8	T_7-0:00:00.2	S-IVB Engine Cutoff, Second Burn
2:53:05.0	T_7+0:00:00.0	Set Time Base 7
2:53:05.5	T_7+0:00:00.5	LH_2 Continuous Vent Open
2:53:05.7	T_7+0:00:00.7	Lox Nonpropulsive Vent Open
2:53:05.8	T_7+0:00:00.8	LH_2 Nonpropulsive Vent Open
2:53:08.6	T_7+0:00:03.6	Flight Control Coast Mode On
2:53:10.0	T_7+0:00:05.0	Enable SC Control of LV
2:53:14.8	T_7+0:00:09.8	Translunar Injection
2:53:25.0	T_7+0:00:20.0	Initiate Maneuver to and Maintain Local Horizontal Alignment (CSM Forward, Heads Down)
2:55:35.7	T_7+0:02:30.7	Lox Nonpropulsive Vent Closed
3:08:04.8	T_7+0:14:59.0	LH_2 Nonpropulsive Vent Closed
3:08:04.8	T_7+0:14:59.8	LH_2 Continuous Vent Closed
3:08:05.0	T_7+0:15:00.0	Initiate Maneuver to and Maintain TD&E Attitude
3:18:05.0	T_7+0:25:00.0	CSM Separation (Variable)
3:28:05.0	T_7+0:35:00.0	CSM/LM Docking (Variable)
3:53:05.4	T_7+1:00:00.4	LH_2 Nonpropulsive Vent Open
4:08:04.0	T_7+1:14:59.0	LH_2 Nonpropulsive Vent Closed
4:18:05.0	T_7+1:25:00.0	SC/LV Final Separation (Variable)
4:21:05.0	T_7+1:28:00.0	Initiate Maneuver to and Maintain S-IVB Evasive Attitude (Variable)
4:29:05.0	T_8+0:00:00.0	Set Time Base 8
4:29:06.2	T_8+0:00:01.2	S-IVB APS Ullage Ignition
4:30:26.2	T_8+0:01:21.2	S-IVB APS Ullage Cutoff
4:38:45.0	T_8+0:09:40.0	Initiate Maneuver to and Maintain Slingshot Attitude
4:38:45.2	T_8+0:09:40.2	LH_2 Continuous Vent Open
4:50:25.0	T_8+0:21:20.0	Start Lox Dump
4:51:23.0	T_8+0:22:18.0	End Lox Dump
4:52:25.2	T_8+0:23:20.2	Lox Nonpropulsive Vent Open
4:52:30.0	T_8+0:23:25.0	LH_2 Nonpropulsive Vent Open
5:25:45.0	T_8+0:56:40.0	S-IVB APS Ullage Ignition
5:30:45.0	T_8+1:01:40.0	S-IVB APS Ullage Cutoff
5:39:05.0	T_8+1:10:00.0	Initiate Maneuver to and Maintain Communications Attitude

Figure 2-1

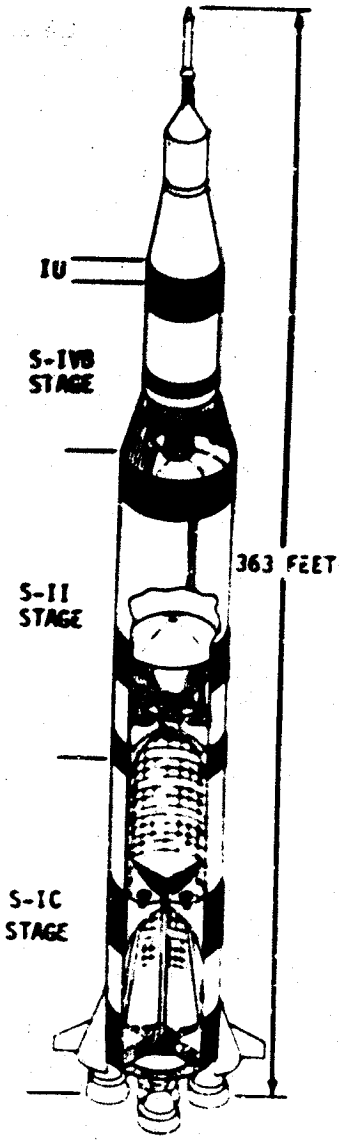
SATURN V LAUNCH VEHICLE

SOLID ULLAGE ROCKET AND RETRO ROCKET SUMMARY				
STAGE	TYPE	QUANTITY	NOMINAL THRUST AND DURATION	PROPELLANT GRAIN WEIGHT
S-IC	RETRO ROCKET	8	75,800 POUNDS* 0.541 SECONDS	278.0 POUNDS
S-II	ULLAGE	4	23,000 POUNDS† 3.75 SECONDS	336.0 POUNDS
	RETRO ROCKET	4	34,810 POUNDS† 1.52 SECONDS	268.2 POUNDS
S-IVB	ULLAGE	2	3,390 POUNDS** 3.87 SECONDS	58.8 POUNDS

ENGINE DATA					
STAGE	QTY	ENGINE MODEL	NOMINAL THRUST EACH	NOMINAL THRUST TOTAL	BURN TIME (MINUTES)
S-IC	5	F-1	1,530,000	7,650,000††	2.8
S-II	5	J-2	230,000	1,150,000	6.1
S-IVB	1	J-2	207,000	207,000	1ST 2.4 2ND 5.6

STAGE DIMENSIONS			STAGE WEIGHTS	
	DIAMETER	LENGTH	DRY	AT LAUNCH
S-IC Base (including fins)	63.0 FEET	138 FEET	288,650 POUNDS	5,022,262 POUNDS
S-IC Mid-stage	33.0 FEET			
S-II Stage	33.0 FEET	81.5 FEET	80,220 POUNDS	1,060,415 POUNDS
S-IVB Stage	21.7 FEET	59.3 FEET	25,050 POUNDS	261,576 POUNDS
Instrument Unit	21.7 FEET	3.0 FEET	4,306 POUNDS	4,306 POUNDS

SATURN V STAGE MANUFACTURERS	
STAGE	MANUFACTURER
S-IC	THE BOEING COMPANY
S-II	NORTH AMERICAN-ROCKWELL
S-IVB	McDONNELL - DOUGLAS CORP.
S-IU	INTERNATIONAL BUSINESS MACHINE CORP.



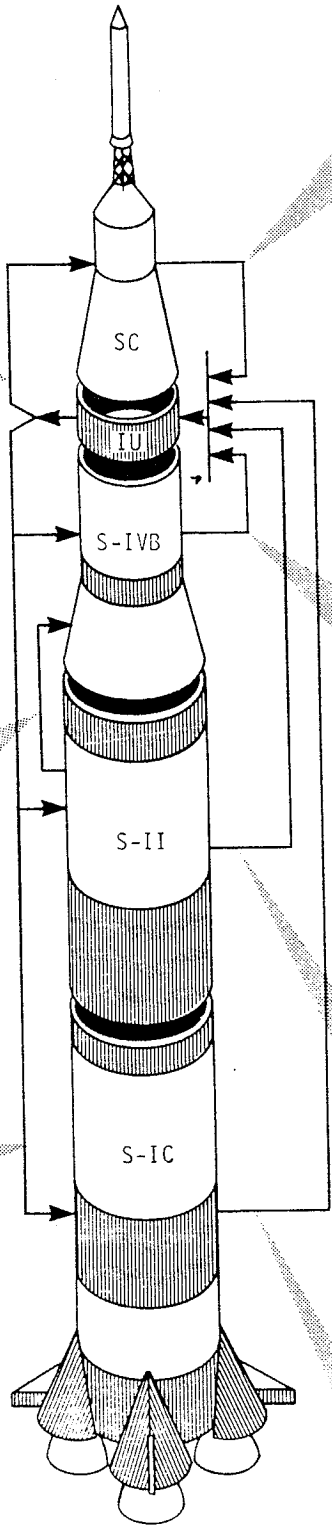
PRE-LAUNCH LAUNCH VEHICLE GROSS WEIGHT ≈ 6,348,659 POUNDS

* MINIMUM VACUUM THRUST AT 120°F
† AT 170,000 FT. AND 70°F
‡ NOMINAL VACUUM THRUST AT 60°F
** AT 175,000 FT AND 70°F
†† AT SEA LEVEL

NOTE: THRUST VALUES, WEIGHTS, AND BURN TIMES ARE ALL APPROXIMATIONS.

Figure 1-3

STAGE ELECTRICAL INTERFACE FLOW



IU TO SPACECRAFT

EDS LIFTOFF
EDS AUTO ABORT
+28 VDC FOR EDS
+28 VDC FOR Q BALL
S-IVB ULLAGE THRUST OK
GUIDANCE REFERENCE RELEASE
AGC LIFTOFF
Q BALL TEMPERATURE SENSING
S-II AND S-IVB FUEL TANK PRESSURE (V)
LV ATTITUDE REFERENCE FAILURE (V)
LV RATE EXCESSIVE (V)
EDS ABORT REQUEST (V)
S-II START/SEPARATION (V)
STAGE ENGINES OUT (V)

(V) = VISUALLY DISPLAYED

S-II TO S-IVB

+28 VDC FOR RETRO-ROCKET PRESSURE TRANSDUCER
S-IVB ENGINE START ENABLE

IU TO STAGES

STAGE ENGINE ACTUATOR COMMANDS
STAGE ENGINE ACTUATOR MEASURING VOLTAGES
+28 VDC FOR SWITCHING AND TIMING
STAGE SWITCH SELECTOR SIGNALS (VERIFY, COMMAND, ADDRESS, READ, RESET, ENABLE)
STAGE EDS COMMAND ENGINES OFF
S-IVB ATTITUDE CONTROL SYSTEM COMMANDS
TELEMETRY CLOCK AND SYNC.

SPACECRAFT TO IU

+28 VDC TO EDS
LV ENGINES CUTOFF TO EDS
ATTITUDE ERROR SIGNAL
Q-BALL PITCH AND YAW
S-IVB ENGINE CUTOFF
AGC COMMAND POWER
S-IVB IGNITION SEQUENCE START
AUTO ABORT DEACTIVATE (M)
INITIATE S-II/S-IVB SEPARATION (M)
SPACECRAFT CONTROL DISCRETE (M)
TRANSLUNAR INJECTION INHIBIT (M)

(M) = MANUALLY INITIATED

S-IVB TO IU

+28 VDC FOR TIMING
SWITCH SELECTOR ADDRESS VERIFICATION
ENGINE ACTUATOR POSITIONS
ATTITUDE CONTROL RATE GYROS SIGNALS
ATTITUDE CONTROL ACCELEROMETER SIGNALS
LOX TANK PRESSURE
FUEL TANK PRESSURE
RSCR & PD EBW FIRING UNIT ARM AND ENGINE CUTOFF ON
ENGINE THRUST OK
TELEMETRY SIGNALS

S-II TO IU

ENGINE ACTUATOR POSITIONS
+28VDC FOR TIMING
S-IC STAGE SEPARATED
AFT INTERSTAGE SEPARATED
S-II STAGE SEPARATED
S-II ENGINE OUT
S-II PROPELLANT DEPLETION
SWITCH SELECTOR VERIFY
FUEL TANK PRESSURE
ENGINE THRUST OK
LOX TANK PRESSURE

S-IC TO IU

ATTITUDE CONTROL ACCELEROMETER SIGNALS
ATTITUDE CONTROL RATE GYRO SIGNALS
+28 VDC FOR TIMING
ENGINES OUT
OUTBOARD ENGINE CUTOFF
S-II ENGINES START ENABLE
SWITCH SELECTOR ADDRESS VERIFY
S-IC THRUST OK

Figure 1-4

Role:

Engineering Attribute	Engineering Attribute	Attribute Score
Research	Ability to use information resources to find useful information that leads to valuable results and/or solutions	
Analysis	Ability to analyze problems, analytically and computationally, to determine the best approach and find the source of problems when they arise.	
Experimentation	Ability to perform experiments that provide insight and detect potential problems before they arise	
Ingenuity	Ability to deal with the information, tools, and equipment that you have to solve the problem	
Creativity	Ability to see novel and or unique solutions	
Leadership	Ability to lead but also the ability to rally a team that feels lost or to inspire others by their example	

Ability Check Success:

d20 Roll <= Ability Score

Examples:

Ability: 15, Roll: 12
Success!

Ability: 12, Roll: 13
Fail

Assist: Use your ability roll to re-try another team member's failed roll

Preparation Phase: Here we will spend minutes discussing work that would take weeks/ months/years. The abilities that are most useful are Research, Analysis, and Experimentation.

Goal: Gather resources to diagnose and resolve the source of the crisis.

Abilities	Examples
Research	Search archived test data, find journal articles
Analysis	Finite element analysis, computational fluid dynamic analytical model analysis
Experimentation	Order tests on systems and components and placement of measurement devices based on the results

Crisis Phase: You have used your abilities to gather resources to prepare for the launch crisis. Here we will spend minutes discussing decisions that would be completed in second or fractions of a second. Place all of your resource cards so that other team members can see and use them as well - you are all in this together.

Abilities	Examples
Ingenuity	Using a resource in a unique way, connecting two pieces of data for a new result,
Creativity	Finding a novel way to do something, finding a new path to a solution
Leadership	Coordinating efforts, teams, or resource utilization, setting a direction, helping another team to resolve their problems

Appendix 4
Fate Simulation Character Sheets

Are you on offense?

Your Result - **Opponents Result** =
(Roll+Aspect+Skill+Reputation)

Are you on defense?

Opponents Result - **Your Result** =
(Roll+Aspect+Skill+Reputation)

Result	
+6	Defender is an advocate
+5	Defender is a supporter
+4	Defender very convinced
+3	Defender convinced
+2	Defender considering(-2 next)
+1	Defender positive(-1 next roll)
0	No Change
-1	+1 Attacker Mental Stress
-2	+2 Attacker Mental Stress

Intimidate?

If Intimidate skill is used and fails, add 2 mental stress - leave meeting

Examples

Offense

Your Roll	Aspect	Skill		Result		Opponent
+2	+1	+2	➡	+5	-	2

The result is a +3 for you. The table shows a +3 means "Defender Convinced" so your opponent is convinced by your argument and does not oppose it.

Defense

Opponent		Your Result
2	-	+4

The result is a -2 for the defender. The table shows a -2 means "+2 Attacker Mental Stress" – your opponent is at their mental stress limit, so they leave the meeting.

Name:

Title: Director & Marketing Team Lead

Background: You represent the marketing department for the YS project.
The target for the YS is the young buyer who wants a sporty vehicle that is unique. Vehicle dynamics and uniqueness are critical to theses buyers. These buyers have been moving to competitor products because our dealers had no such product. It is critical that this product go into production as quickly as possible but also that it meets the price target to be competitive.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
Stubborn (resist)	+3
Intimidate, Persuade	+2
Marketing Jargon, Reson	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **1**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Senior Vice President & Purchasing Team Lead

Background: You are a Company VP and Team Lead for the Purchasing Department. The component cost on the YS project has gotten out of hand. The goal for a "unique vehicle" has been taken to an extreme on this project and the engineers have taken advantage of this requirement to tack on unnecessary fan-boy equipment. You and your manager have identified their latest, an unnecessary suspension piece (that they call a "sway bar") that they gush about but will delay the project, the customer won't even notice and will definitely push the YS's cost way past its competitors and doom sales.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

Intimidate	+4
Business Jargon, Reason	+3
Stubborn (resist), Persuasion	+2
	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **3**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: VP of Sales & Sales Team Lead

Background: Your dealer network needs a cheap, sporty car to compete with product from your (normally much less successful) competitors. They got the jump on you with their products and you need something on dealer lots now and the YS was designed to be that vehicle. The engineering and marketing folks have gotten all caught up in their fancy ideas and are trying to make the project too expensive and too fancy, just like they have with everything in the last few years. Your company is #1 in sales but your competitor's are on your heels and you are weak with the all-critical young buyers that will keep you in first place. The YS will fix that but only if it comes out on schedule.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

Persuasion	+4
Reason	+3
Stubborn (resist), Business Jargon	+2
Intimidate	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **3**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Chief Engineer & Quality Team Lead

Background: You are the Chief Engineer in Quality Engineering and their Team Lead. Your latest product launches have started with poor quality that has hurt sales in subsequent years. Engineering keeps wanting lots of geeky pieces and lots of variation to satisfy other car geeks. Quality is what are known for and it is what keeps customers coming back. Marketing, engineering, and sales always want to add complexity until the quality problems happen (because of their choices) and then you are stuck cleaning up their mess.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
Business Jargon	+3
Persuasion, Stubborn, Reason	+2
Intimidate	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **2**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Purchasing Manager

Background: You are in charge of the Purchasing Department. The component cost on the YS project has gotten out of hand. The goal for a "unique vehicle" has been taken to an extreme on this project and the engineers have taken advantage of this requirement to tack on unnecessary fan-boy equipment. You and your VP have identified their latest, an unnecessary suspension piece (that they call a "sway bar") that they gush about but will delay the project, the customer won't even notice and will definitely push the YS's cost way past its competitors and doom sales.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

Reason	+4
Stubborn (resist), Business Jargon	+3
Persuade	+2
	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Reputation: Your character's reputation in the company **2**

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Plant Manager & Manufacturing Team Lead

Background: You are the Plant Manger at the YS factory and the Manufacturing Team Lead. You are ready to get the YS into production with none of the manufacturing stumbles that have slowed your previous new-model launches. The plant needs fewer parts and less product variation to learn to make the new YS quickly. You want to make sure your assembly line isn't overwhelmed with learning to produce a brand new vehicle with unnecessary extra parts and unnecessary variation. Marketing, engineering, and sales always want to add complexity – they aren't the ones who have to build it and get it to customers quickly.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

Intimidate	+4
Stubborn (resist)	+3
Reason, Persuasion	+2
Techno Jargon, Business Jargon	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **2**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Engineer 2 & Chassis Team Lead

Background: You are an engineer in the Chassis Group and the Chassis Team Lead. Your team is confident that adding a suspension sway bar is critical to the success of the YS by appealing to its critical young buyer. With it, the handling of the YS will be the superior to all of its competitors. Without it, your team has determined that the YS could be dangerously unstable, especially in the extreme handling conditions to which the younger buyers will certainly subject it. Adding the sway bar to the YS will delay production a bit but, when it comes out, it will drive better than any of its competitors.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
Techno Jargon	+3
Stubborn (resist), Reason	+2
Persuade, Intimidate	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **0**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Chief Engineer & Body Team Lead

Background: You are the Chief Engineer for the Body Group and their Team Lead. You are concerned about the noisiness and harshness of the YS. You have recently done testing with reduced tire pressure in the front tires compared to the rear, giving it a quieter ride than its competitors. You suspect this will be shot-down but you are certain prospective new buyers will prefer the quieter ride and, as a bonus, it handled well, even without the sway bar that chassis group has proposed.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

Persuasion	+4
Techno Jargon	+3
Reason, Stubborn (resist)	+2
Intimidate	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **2**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Engineer 2, Body Team

Background: You an engineer in the Body Group. You are concerned about the noisiness and harshness of the YS. You have recently done testing with reduced tire pressure in the front tires compared to the rear, giving it a quieter ride than its competitors. You suspect this will be shot-down but you are certain prospective new buyers will prefer the quieter ride and, as a bonus, it handled well, even without the sway bar that chassis group has proposed. Work with your team lead in the meeting.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
Techno Jargon	+3
Reason, Stubborn (resist)	+2
Intimidate	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **1**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Engineer 2 & Suspension Team Lead

Background: You are an engineer in the suspension group and Suspension Team Lead. Your team is confident that adding a suspension sway bar is critical to the success of the YS by appealing to its critical young buyer. With it, the handling of the YS will be the superior to all of its competitors. Without it, your team has determined that the YS could be dangerously unstable, especially in the extreme handling conditions to which the younger buyers will certainly subject it. Adding the sway bar to the YS will delay production a bit but, when it comes out, it will drive better than any of its competitors.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
Persuasion	+3
Techno Jargon, Reason	+2
Resist	+1

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Reputation: Your character's reputation in the company **1**

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Name:

Title: Engineer 1, Suspension Team

Background: You are an engineer in the suspension group. Your team is confident that adding a suspension sway bar is critical to the success of the YS by appealing to its critical young buyer. With it, the handling of the YS will be the superior to all of its competitors. Without it, your team has determined that the YS could be dangerously unstable, especially in the extreme handling conditions to which the younger buyers will certainly subject it. Adding the sway bar to the YS will delay production a bit but, when it comes out, it will drive better than any of its competitors. Work with your team lead in the meeting.

Aspects: Key aspects of your character's personality

	+1
	+1
	+1

Skills: Your characters primary capabilities

	+4
	+3
Techno Jargon, Reason, Persuasion	**+2**
Resist	**+1**

How to Challenge or Defend:

Roll 4 Dice + **Add an Aspect** + **Add a Skill** → **Result**

Add an Aspect
Choose an aspect that describes how your character acts in their challenge or defense

Add a Skill
Choose the skill that your character uses to challenge or defend

Reputation: Your character's reputation in the company **0**

Add Reputation?
Use a reputation chip (or chips) to re-roll or add +2

Try to intimidate and fail? Were you intimidated? → Mental Stress: 1 ☐ 2 ☐

Appendix 5
“How to Teach a Game”
Modified from *Nightwitches* by Jason Morningstar

TEACHING THE GAME

(adapted from *Night Witches* by Jason Morningstar, Bully Pulpit Press, 2014)

As the game master (GM), it's likely that you'll be responsible for teaching the game to others. Teaching something like this can be difficult! What order should you teach things in, and how much information should you give them all at once? The key considerations to have in mind when teaching are:

. Teach the mechanics in a concentric way.
. Teach the context as you teach the mechanics.
. Use examples and demonstrations.
. Teach as you go.
. Teach what they need in order to make informed decisions.

TEACH THE MECHANICS IN A CONCENTRIC WAY. It's easy to get caught up in the details, or how everything fits together. After all, you're knowledgeable about the game, so that's the level at which you're processing this information. But new players are at a different level, and that kind of information can be overwhelming to them. Start with the most basic piece of information, and state it as simply as possible. Then introduce the next piece of information, one that builds on what you've said already and expands their knowledge. Start simple and expand out. This is called concentric teaching. With Moves, the simplest thing you can say is, "You can just say what your character does. Sometimes, what they're doing counts as one of these Moves, and then we'll have to roll dice and follow some rules." Start with that, and then expand out concentrically from there.

TEACH THE CONTEXT AS YOU TEACH THE MECHANICS. There's a reason why Night Witches has all of these rules. It's because they all do something to help create interesting stories with interesting characters. It's important that as you teach players about the mechanics, you mention what these mechanics do for the story. When you explain the Mission Pool, don't just talk about how you earn and spend it. Talk about what it means to work together in combat, and what the Mission Pool can represent.

USE EXAMPLES AND DEMONSTRATIONS. People need examples in order to confirm and solidify what you're teaching them. Use short examples throughout any explanation that you give. When you explain how to roll dice for moves, pass two dice to someone. Say, "Let's say you've got Skill +2, and you're rolling to find a target in the dark. Go ahead and roll. Great. Add those four dice together, and add in your Skill +2. What's the total?" This will help make what you're saying concrete, and will clarify any misinterpretations.

TEACH AS YOU GO. If you spend the first hour of a game explaining the entirety of the rules, you'll lose buy-in from any players who aren't excited about the intricacies of game design. So avoid doing that. Instead, teach as you go. Trust that it's okay to teach your players some of the details now and the rest later. Many people have a limit to how much knowledge they can absorb in a single period. They need to be able to put their knowledge into action before they're ready to learn more.

TEACH WHAT THEY NEED IN ORDER TO MAKE INFORMED DECISIONS. While giving players too much information can overwhelm them, giving them too little information will lose their trust and confidence. Give players the information they need in order to make informed decisions. Make sure they understand the choices that they are making. If someone makes a bad choice early on, like picking a character Move that they later realize they'll never use, be generous and allow them to go back and change their decision.

Avery Mcdaldno

Appendix 6
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