12/5/16

GLIDER ROCKET REPORT

BY: Abby Ridgeway, Edward Shenault, Julianna Mendez, and Savannah Pluma

Abby Ridgeway - Design:

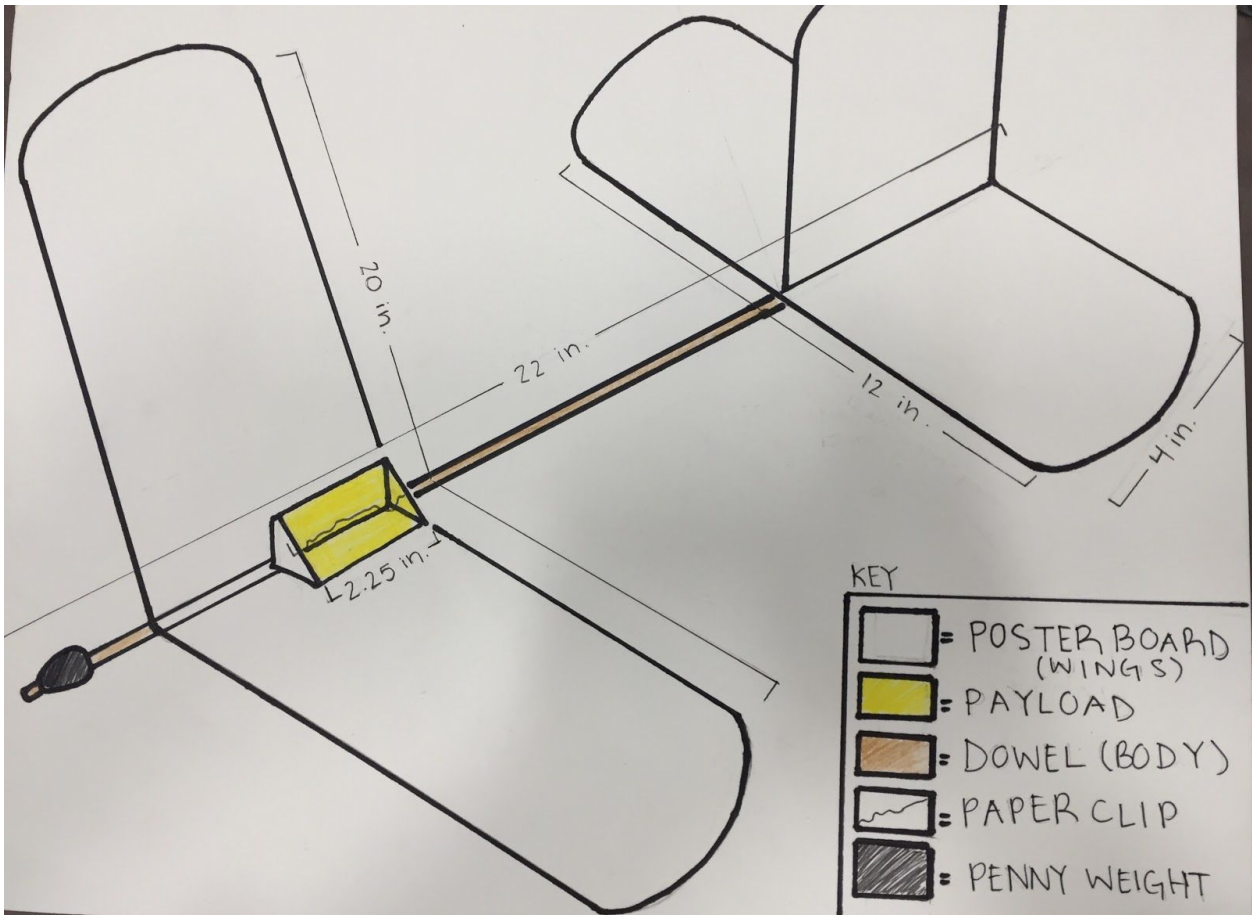

FIGURE 1

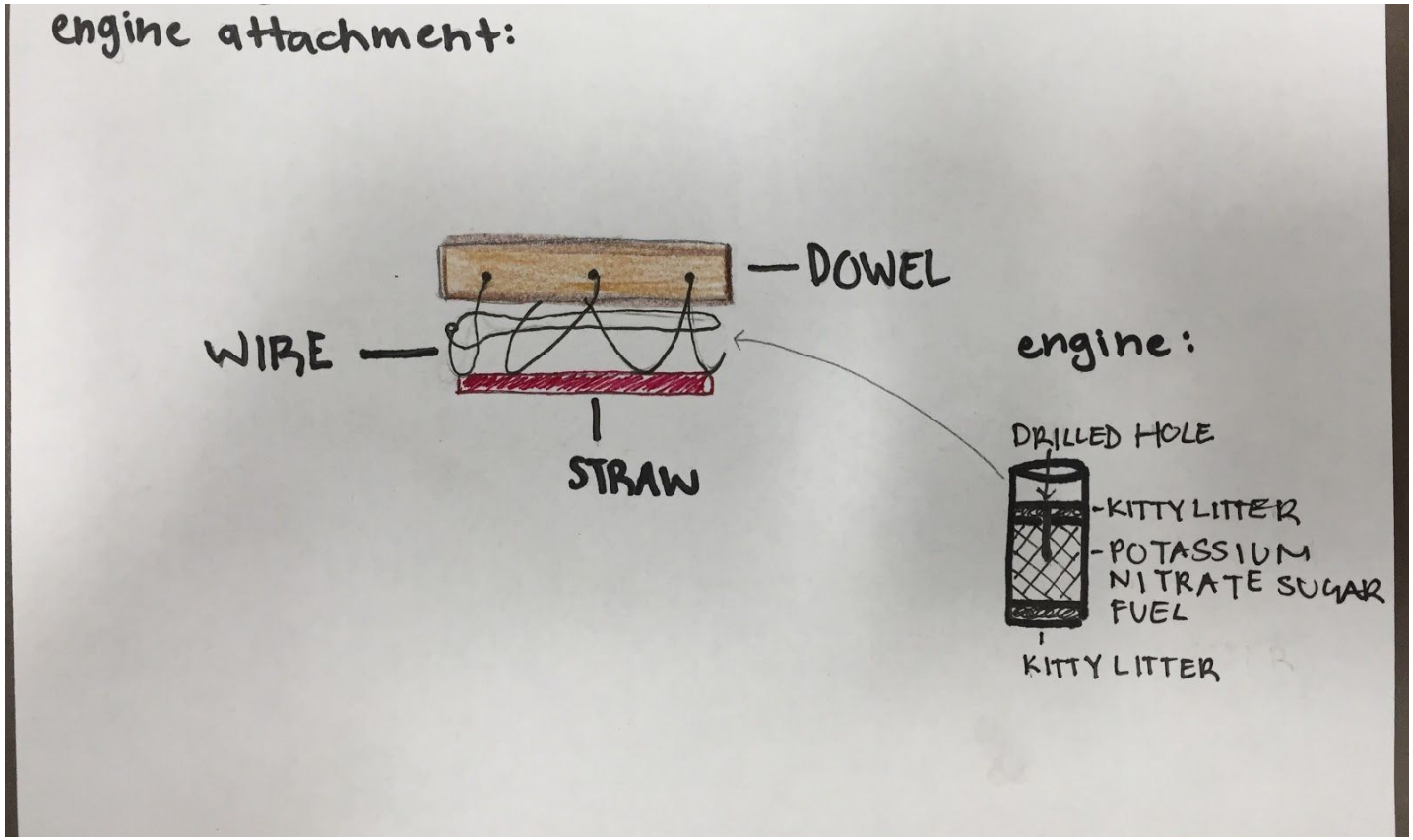
engine attachment:
DOWEL
WIRE
STRAW
engine:
DRILLED HOLE
KITTY LITTER
POTASSIUM NITRATE SUGAR FUEL
KITTY LITTER

FIGURE 2

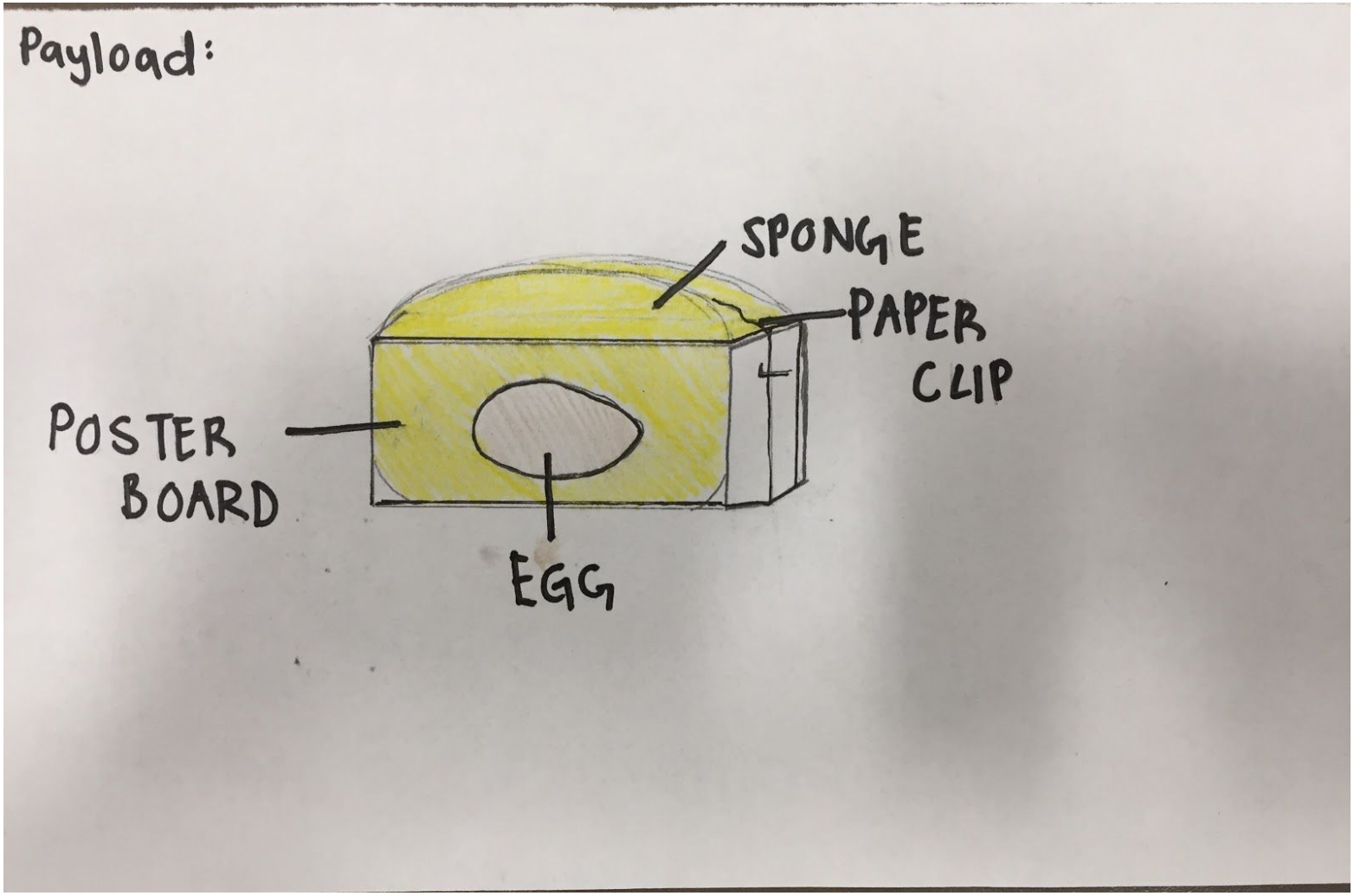

FIGURE 3

FIGURE 4

FIGURE 5

PHYSICAL DESCRIPTION

I. The major components that completed our design were the body, wings, payload, weight, and rocket engine. Our glider design needed to be under 50 grams to provide the right amount of heft necessary for a rocket engine, so we decided to use simple, thin, and durable materials that we knew would work well with the engine. The body was built using a small wooden dowel which provided enough support for the wings and was light enough to use with the rocket engine. We also duct taped a couple of pennies onto the front of the dowel to provide weight and drag. Both wings were constructed using thin white poster board, which ended up being lightweight and sturdy enough to reuse for testing and also provided enough lift. We achieved the dihedral of the main wing by cutting a slit halfway through the foam to keep it durable. The main wing was attached towards the front middle half of the dowel and the tail wing was attached to the very back using hot glue. (See FIGURE 1)

II. Our payload (quail egg) was protected with a yellow sponge and was laid inside of a small hot-glued poster board cube on top of the main wing, which also provided drag (See FIGURE 3). To provide more stability for the egg, we poked a bent paper clip through both sides of the cube which kept the top of the egg secure. We attached the payload to the lower half of the main wing using hot glue, so the

weight of the rocket engine would counter-weigh it, making the center of gravity in the correct place.

III. Lastly, the rocket engine was made using potassium nitrate sugar fuel which was compacted with kitty litter inside of a butcher paper casing. We attached the engine under the front half of the main wing using a piece of wire intertwined in the dowel to have the center of gravity exist in the correct spot (See FIGURE 2). We chose to build our design based around a small rocket engine because we knew it would provide a great amount of thrust, and we felt that this was the most interesting and unique concept to include in our design. We thought that using a rocket engine would deliver a positive outcome and would be fascinating to learn more about since we had very little knowledge about them. After a few bumps in the road, we realized that rocket engines are very meticulous when it comes to the overall weight and design of anything you make. Our first design failed to meet our expectations because the glider was much heavier than the limit and we didn't have a clear idea on how to attach the engine. After acquiring more knowledge about rocket engines, we became more clear as to why the rockets needed to be in a certain place, and how they needed to be attached. Eventually, after many difficulties, we were able to construct something that fulfilled our needs due to perseverance, communication, and creativity.

OPERATIONAL DESCRIPTION

I. Our glider is operated by a ramp and rocket ignition. The launcher is made out of two thin sturdy wood pieces that rest at a 45 degree angle. Both pieces are stuck into the ground with a hammer and some shoveling. We left a small gap between both pieces for the engine to fit through, and to guide the glider straight.
(See FIGURE 4 and 5)

II. In order for the entire thing to operate, you would first need to lay the glider onto the two pieces of wood. After this, all you need to do is double check the engine to make sure everything is precise, and slide the glider into place with a flat piece of wood behind the glider, to prevent it from sliding. Once the glider is ready and set up, you would need to ignite the engine by lighting the green fuse. Soon after the fuse is lit, the rocket engine will fully ignite. This can be reusable because it is made out of durable materials, but it most likely won't last very long because it's a very simple design, it isn't very large, and it is not a permanent structure. This launcher was also put together in a short amount of time and its main purpose was mostly just to fulfill our groups needs and had very little thought and detail put into it. Overall, our glider was made in the simplest way we thought it could have been made, and the final design fulfilled most of our needs.

Testing

Julianna Mendez

Testing the gliders was a big component to every glider. Our main goal for the gliders was to see if it would fly steady just hand throwing them. It was a way of testing to see if it would go to the next level which was attaching rocket engines.

I. Prototype

During our project, we made three prototypes. We started off with about a 1.5ft body. It weighed 375g. We never attached a rocket engine to it because we observed that it was unsteady and it wouldn't stay in air long enough. We tried putting weight on the nose to move the center of gravity (CG) closer under the wings, but it couldn't achieve stableness when in flight.

Figure 6

Here is a picture of our 1st prototype. Made out of all foam.

We originally planned on using two rockets under each wing, but testing showed that it wouldn't work. We got help from a chemist advisor that using two rockets would be difficult because of the probability of one going off

before the other. A lot of the time when testing we would throw it but holding the end and it would nose dive or stall.

We realized it was too heavy, due to the amount of foam being used, for a rocket engine to carry so we had to switch our materials and design. One rocket engine can, at max, carry 100g which was what our chemist advisor said.

II. Prototype

For our second prototype we had to take more precautions to keep the glider steady and weigh under 100g. We put two pieces of pink foam together that weighed 64g . The wings weigh 30g and tail wing weighs 24g. The complete weighs 118g. It was definitely a more sturdy one due to the pink foam we used.

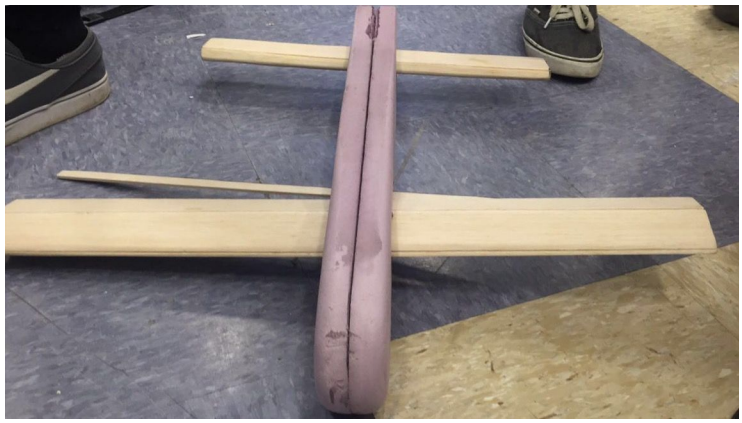

Figure 7

Here is our second prototype. We used pink foam for the body, and balsa wood to create the wings.

We thought it would work well. When we hand tossed it was saw there were a lot of major errors. Such as a lop of gaps in the slots for the fings. We tossed it and it just flew back flipped and landed upside down. We

panicked because who knew how much time we had to make a new one. We began to run out of ideas.

III. Prototype

We had less than a week to have a somewhat complete glider and we had nothing. We started scrambling the room looking for materials to use. We came across pieces of paper foam and a dowel. We made a simple glider that was perfect weighing at 68g. We measured a quail egg and it weighs approximately 11g.

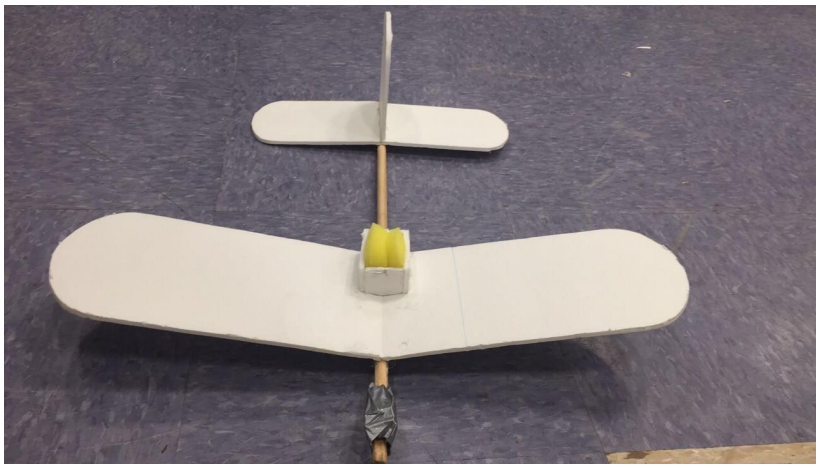

Figure 8

Here is our third prototype. Created with paper foam and a dowel.

We hand tossed it and it glided perfectly. The wind was the only thing that affected it. We tossed it once and it just went straight down. Second time we hand threw it it went straight up then down. We hadn't worried yet because we knew it was just the wind. We waited for the wind to go down a bit and we hand tossed it and it glided straight and seemed to go about 15m. With a slingshot as a head start and a rocket launcher to kick in after a few seconds it should work fine.

Subsystem testing:

Once we were done with every prototype we had to test without the rockets. We only had a limit of engines because they take up time to make it, and include a lot of instructions. We decided not to waste them and came up with an alternative which was to hand throw them to see how well they glide. For our first glider we hand threw it and it seemed very unsteady and fragile. When we threw it we saw the weak spots and noticed the center of gravity was too far back. We tried adding weight to the nose to make the COG closer under the wings, but it almost seemed impossible. We asked how many grams a rocket engine can carry and we found out the max was 100g. We already knew we needed some new design with the same concept.

That is how we came up with the second prototype. We originally thought that the pink foam would weigh less. It was easier to use the pink foam because it wasn't as messy sanding it down compared to the other foam. Our initial plan was to make the body round but it didn't work out so well. When we finished the prototype we threw it to see how well it glided. Every time we threw it, it would just backflip and land upside down. We saw a big gap for the slot of the wings that really affected the way our plane flew. We never used a engine because it could only carry 100g and because our glider wasn't stable. We again had to change our design and quick.

For our third prototype we needed to get something that was complete and stable. We had to find any materials people weren't using. We came across paper foam, a dowel, and a sponge. We made dihedral wings to help keep stable and a tail wing. We hand threw it and there was a major effect on wind. The wind caused a lot of the movements to our glider.

When the wind was strong it either went straight down, up then down, or it would glide for a while with the wind. We had to wait for the wind to calm to throw it and when we did, it flew a decent length. We threw it and it roughly went 15m. That was without our launcher or engine. I'd hope or imagine that it would go far.

Final Test:

Figure 9

Here is our final prototype resting on our wooden ramp at 45 degrees waiting for engines to go

Our third prototype is the only one where we got to do a final test. While we were waiting patiently for the engine to make the glider go, we heard the sizzle. That was the noise of the engine burning out. Our glider had not moved a tad bit. The only conclusion we thought of for the reason it

didn’t work was because the glider was to heavy. There are plenty of actions we could have done differently. We found it a very challenging process that we wished had worked. Testing a lot more, using the actual engine would have been useful.

Prototypes	Range (Hand Glide)	Observation
I.	~3m	We noticed that our glider kept nose diving, but the COG was too far back which was confusing
II.	~1m	The second prototype flew straight and then curved backwards
III.	~15m	It was light and small. We observed that the wind had a big effect that would determine the way our glider worked.

Prototype Flight Performance

Through this project I realized that testing and the design of the glider are the most important and main components to have a working glider. For only testing once with a rocket engine, we had an error in the system that we weren’t expecting. It also would have been helpful to know the design of our glider because we struggled coming up with an idea and determining if it would actually work. We had about three weeks, give or take, to work on this and I felt like my group in particular struggled coming up with design ideas. Also a lot of the time we would stop and realize that our glider was way to heavy for an engine to carry.

Sales Pitch, Cultural Context, and Sales Pitch:

Cultural Context

Savannah Pluma
12.5.16

There are many causes I feel passionately about, each just as important as the next. Being a world of different ideas, religions, views of right and wrong we come across a large amount of problems which is expected when opposites come into play. Diversity is well appreciated but some of us believe it to be almost sinful. For example under the authority of a dictator many rights you have as a person are eliminated. You would think the ability to speak your mind is a given, we are encouraged to say what we feel by our neighbors everyday but that isn't the case for people living under the power of someone _____. An independent person with thoughts and opinions has a chance of overthrowing the “greatest power” but as a sheep what more can you do then follow even the wrongest of paths? The game of a dictator is a game of loss.

Health and Aid is very much lacked under the control of someone who turns a blind eye to their people. It is also something I would really like to involve myself in and in different circumstances that's something my group and I would have worked on creating a model that can deliver services worldwide to those in the most pain. Instead our current model with some modifications could maybe deliver services to local homeless. Like blankets and hygiene related items. We have a rather large number of people living out on the streets and as time passes it seems to be harder for them to get back on their feet. Though I wish the objective could be to bring them back

to a hefty lifestyle I find that a delivery system best works for delivering aid to people who need it most. Another Idea for sending out local help would be bringing help to those who have lost a lifetime in a wild fire. For example I know we recently suffered a fire in Oakland, killing 36 people. I feel the next best step for an unfortunate event like such is to show your support and even lend a hand to those who were severely affected. The aftershock of any fire can leave some in the worst conditions and I feel that it is important to be able to deliver some kind of stability whether that is something as small as band aids to other miscellaneous items.

In an ideal picture of helping fire victims we would need to modify our plane size, payload amount/security, and as well as even rethink our engine. With our current model we are restricted on weight due to the size of the rocket motor only being able to hold around 100 grams. If we were to use a larger rocket motor than our plane could be 4x the size with a much heavier payload. The plane would need to travel a far distance without any assistance from our team but if we could transport our plane half ways to its destination then we may have a chance of getting it to the right place. It would be difficult to be able to deliver something a far distance if the vehicle is without a control system, like a drone. Also since we have a rocket engine they turn out very fast and all you are left with is a smooth sailing glide which lasts you a minute or two. In the situation where we were able to get it all the way there with a rocket engine we would still need a guarantee the items would be able to get there without any damage meaning once the rocket engine gave out and the plane began to glide

down wards we would need some kind of parachute to keep the payload from smashing into the ground. In this ideal situations once the payload arrived which would consist of your typical aid and health supplies. The payload would be determined by what is needed for the community that suffered the fire. In conclusion it would have been incredible to work on a real problem and tackle it as a class to make a significant mark on someone's life.

Sales Pitch:

Savannah Pluma
12.6.16

As a group have come up a with a unique, interesting glider that is not only low cost but also durable. The design is thin yet sturdy and we guarantee it is reusable because of strong poster board material we used. It took many tries to get to this design which we are proud of. Previous models did not suit the requirements needed for the rocket motor to launch the plane but this prototype would be considered just right because of it completion. We also guarantee a safe flight with a durable sponge compacting the payload (Quail egg). Like all models there are a few things we could improve such as the distance it can fly. With more thought and calculation we could work on a model with a larger motor and a slight variation of our current model, giving it a farther distance and larger payload. Compared to its competition it may look small but we assure you it's one of the lowest costs and its simple design really pulls through when it comes to its objective. It has a long glide with its only obstacle being the wind since it's so small but under good conditions an impressive flight is in order. Parts of our plane like the

engine holder are tightly wrapped with coiled wire to ensure stability of the motor and safe keeping during flight. The payload holder is tightly glued and centered according to the center of gravity, the egg holder has wire supporting the egg and a sponge that engulfs the quail egg. We are very happy with our design we all worked very hard to get what we have. I believe my team to be hard working and it was a pleasure creating each and every design though not all of them worked. Never did one of my group members quit on the project, every time we struggled and one of the designs failed we looked at everything went wrong and built off from there. Now you know we are a hard working team that strives for one another's.
Quad Chart:
https://docs.google.com/drawings/d/1EKm1NgBGTyO5azmr2F6Zs3abXNZ8yzWtXvtvzhVFqek/edit

Update of flight:
Due to miscalculations we are devastated to say our rocket glider was unsuccessful this time around. The amount of weight the small motor was able to carry was less than what we anticipated. Admittedly it a is mistake on our part for not double checking our own materials and doing more tests. Though this demo did not work we have thought through our design and realized that a motor of the same material but larger is able to carry the glider. We have full faith that it would work but due to lack of time there is no way to prove it.

Materials

Materials Spreadsheet

My section is about the materials we used to build the glider. In this section you will read about why we used certain materials, how much they cost and how much of each material we used.

The materials we first started off using were the sheet of poster board foam. We used this because we thought that it would be pretty easy to cut and sand. During construction we noticed that using sharp blades and good technique was critical to getting good results while cutting the foam board. So we then had to build another glider that was completely different. In this glider we used one sheet of purple foam and we used two sheets of balsa wood. We used this because this was much easier to cut and shape. We used the balsa wood because we knew this would be easy to shape for the wings and it wouldn't add as much weight as regular wood would add to the glider. When we were 80% done with this version we realized that it was going to be way to heavy and our rockets would not be able to carry that. So as we were starting to get way behind we had to think on our toes and work really fast and make another completely different glider and launcher. On our final version we just used a ⅜” x 38 dowel and the paper foam. We used the dowel for the body because as we saw on Amilio's example he just had the thin body and the wings. We used the paper foam as the wings and tail because we didn't want our plane to be too heavy and because we thought that type of foam would be the best to use as wings because the purple foam is too heavy and stiff and the white foam is too weak.

Our dowels are kind of reusable because they would for at least 15-20 flights but after a while they would start to get a little weak and eventually break. Our rocket is not reusable because each rocket only holds enough fuel for one launch. For us the foam board cost $3.00 because we only used one. The foam is also kind of reusable because it will start to bend out of place after about . We used 2 wood screws so that cost $0.20. We used 2 8x14 scraps of plywood so that cost us $2.00. My group only used 1 glue stick so that cost us $0.18. We used 1 m of duct tape so that cost us $0.24. We 1 roll of steel wire to hold the rocket engine and that cost us $1.00. The dowel that we used is $1.70. And our rubber bands were used to launch the glider and those cost us $0.09. So all together our plane cost $18.78.
I think most of our glider would be biodegradable. The parts that would be biodegradable are the wood and the sugar rocket. The parts that wouldn't be biodegradable are the duct tape, the wire, the poster board, the hot glue and the sponge. If we were to scale this aircraft up to be biodegradable I think we would have to use plywood for the wings and egg holder. We would use plywood because it is almost the same weight as the foam board.
In conclusion we learned that before we start building we should think about what materials we need to use and how much we need because sometimes we didn't have materials so we were just sitting around doing nothing and sometimes when we did have materials we didn't know how we were going to make our glider.