_____ Period:__2W___

Penny Bridge

Problem Statement

I need to design, construct, test, and perfect a bridge to cover a span of 14" to hold the greatest number of pennies. The bridge may only be constructed out of one sheet of computer paper, and be free standing.

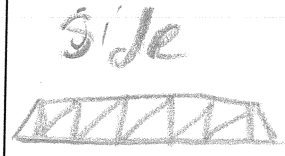
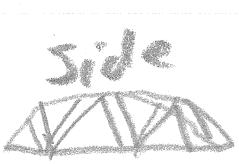
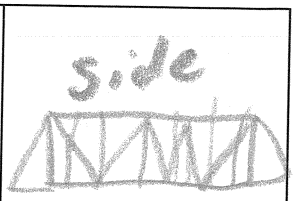
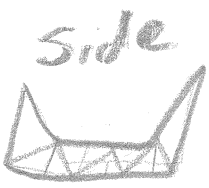
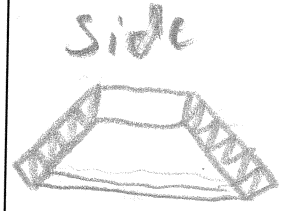
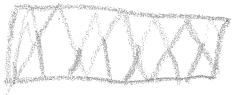
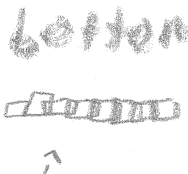
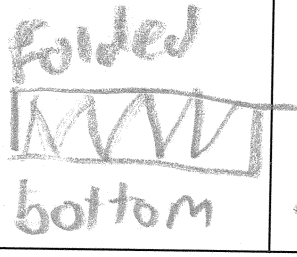
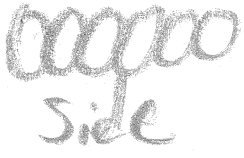
Constraints

- Must be greater than 14" and less than 21".
- Must be made from ONLY one sheet of computer paper.
- Must be free standing.
- May not touch the plexi-glass sides of the tester.
- May not touch the bottom of the tester.
- No Peirs/pylons may be created.

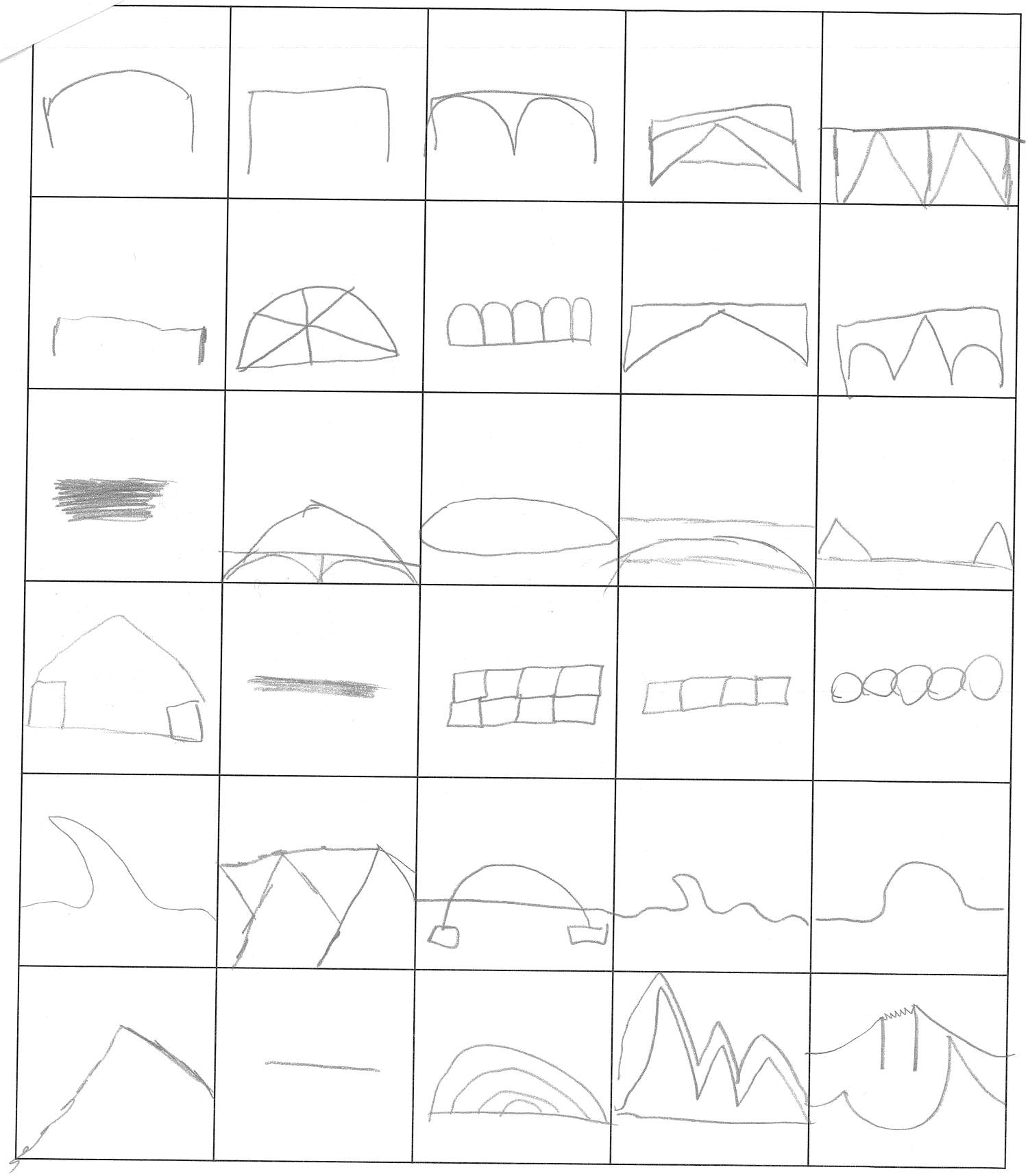
Research:

Span:	The distance of the gap being covered.
Girder Bridge:	A Girder is the metal bean under the bridge which is there for structure, so a Girder bridge is a bridge with metal beams under it for support.
Truss Bridge:	A Truss bridge is a bridge that uses metal beams or chords on top of the bridge that connect to nodes which are the joints of the bridge and the Truss is used to distribute the force of whatever weight is on it.
Arch Bridge:	An arch bridge uses supports in the shape of an arch that go down into the gap and hold it up from underneath the structure.
Static Load:	A static load is a force that moves slowly to a structure and is predictable, like putting a penny onto a piece of paper it slowly sinks down.
Dynamic Load:	A Dynamic load is a force that changes over time and is mostly caused by movement or impact, and is sudden and unpredictable like jumping.

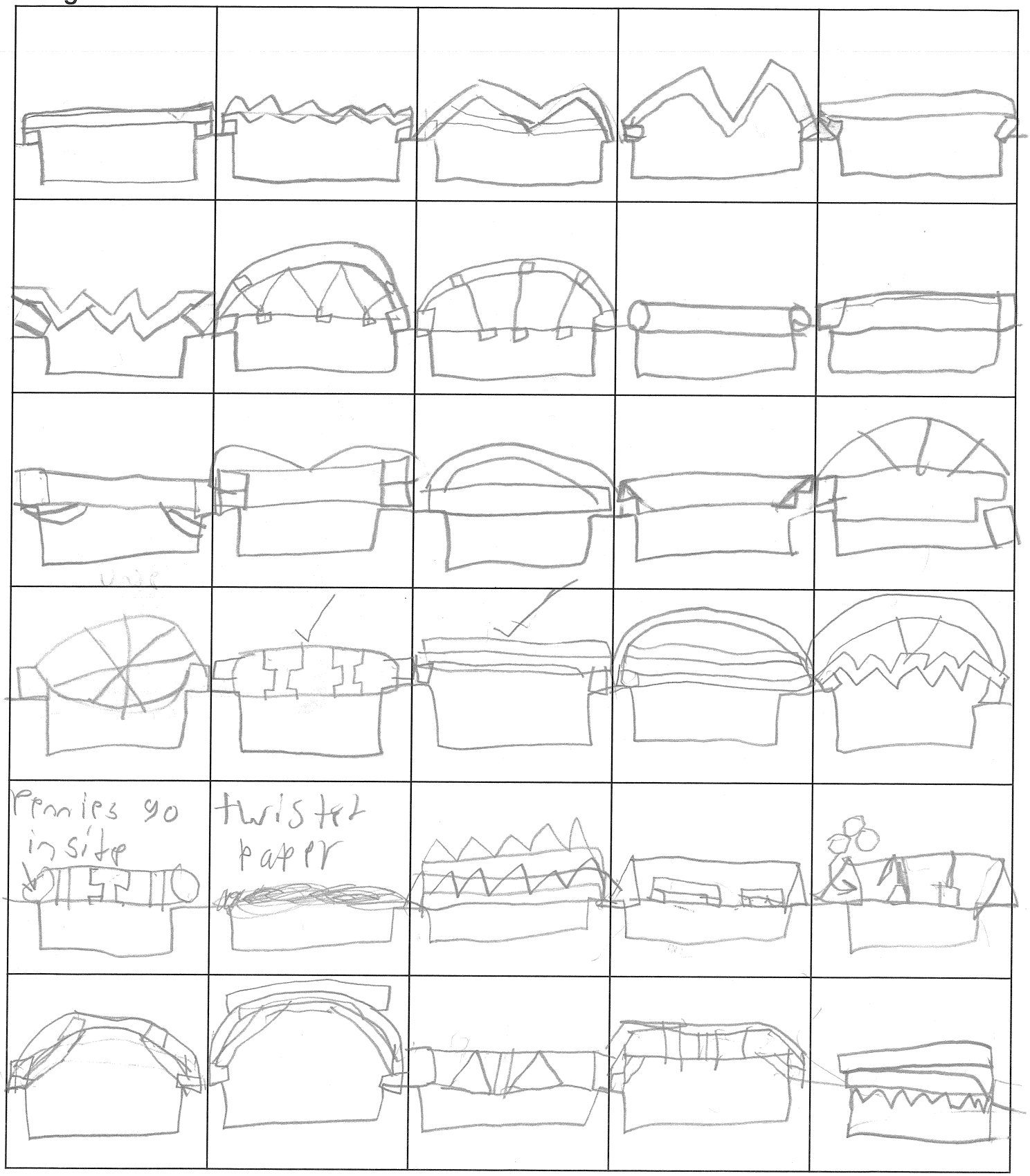
Rough Sketches

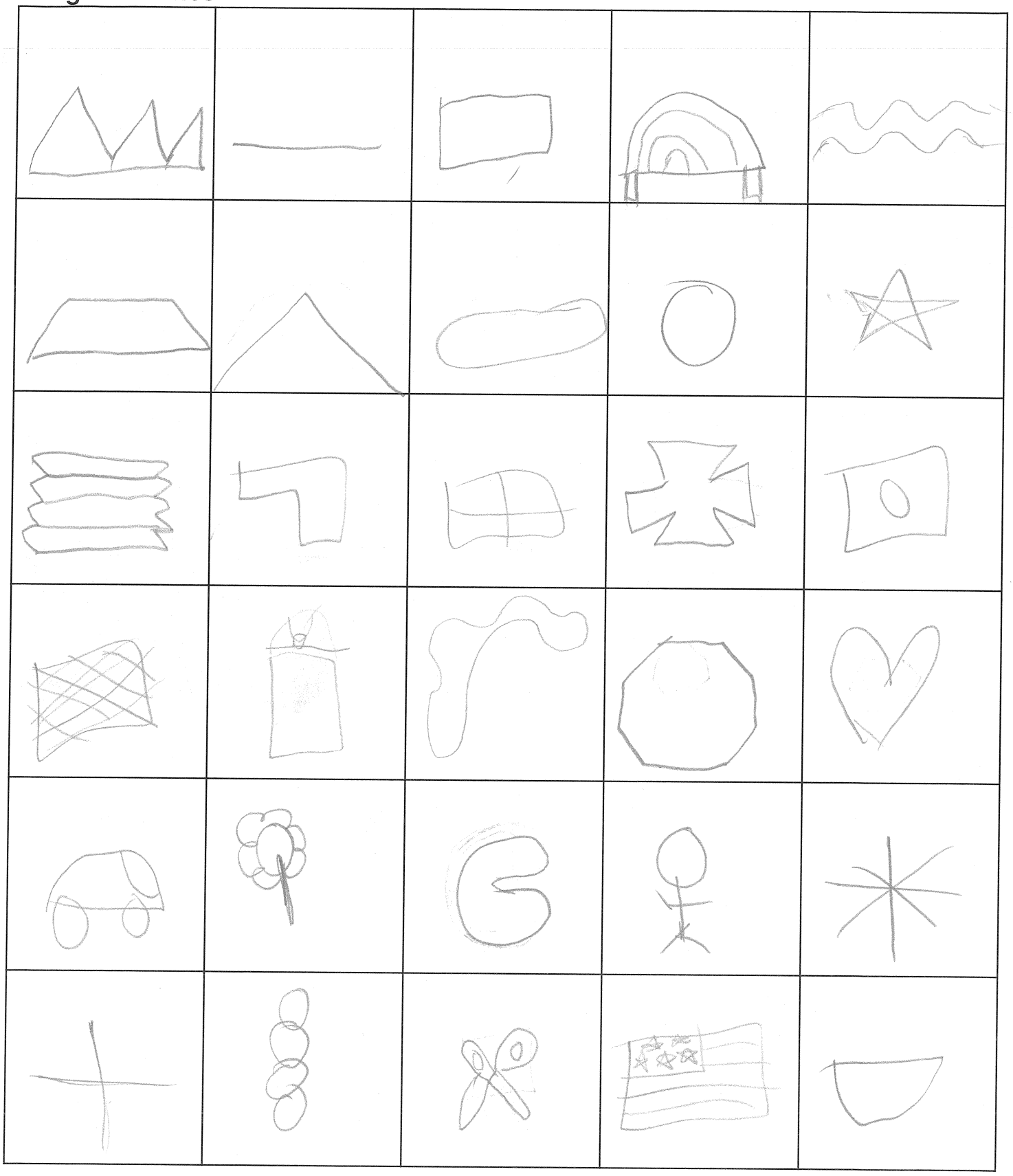
Sketches



Rough Sketches



Rough Sketches



Name: _____ **Period:** 1W

Project: penny Bridge **Attempt #:** 1

Sketch:

Success:	Reason For Failure:	Solution:
1. 37	It had too much weight on one side and tilted	Spread the pennies out and try again for now
2. 8	It broke apart so I tried again but it was unstable	I folded it tighter and redid the sides.
3. 20	There was a bump in the middle so the pennies fell to one side again and it collapsed (I was also going faster than the first time)	I would get rid of the bump and put the pennies on gently

Name: _____ **Period:** 1W

Project: _____ **Attempt #:** 2

Sketch:

Success:	Reason For Failure:	Solution:
1. 3	The middle wouldn't stay together and the bottom flaps	I'm going to fold them [added] together a different way.
2. 3 5	The middle bent again and the bridge fell out of shape	I'm going to create it again because it's been handled too much.
3. 35	it bent on the spot where the pieces overlap on the right. I'm so	I will add more support to the bottom.

Name: _____ **Period:** 1W

Project: Penny Bridge **Attempt #:** 3

Sketch:

Success:	Reason For Failure:	Solution:
1. 24	The accordian part flattened out a bit.	I'm going to add dual accordian pieces, although I don't think accordian pieces help
2. 5	It was way too thin and kept curving at the sides	Im going to add double layers, and make it thicker.
3. 32	I tried two more times and got 17@32, and it kept curving where one layer met another.	The second time, I distributed the ends of the layers a bit and it worked better, so I would do that again.

Name _____ Period: 1W

Project: Penny Bridge Attempt #: 4

Sketch:

Success:	Reason For Failure:	Solution:
1. 36	The bridge spun and fell because the bottom supports didn't hold it up well.	I'm going to take the supports and curve them into make a box.
2. 42	This time the bridge caved in the middle, but held up longer	Im going to make it a flat plank instead of a box.
3. 40	It worked well and didn't cave until the end, when I tried to get a penny from underneath and hit it	I shouldve added sides for the bottom so it didnt tilt over to one side. and possibly barriers, but then it wouldnt be very lightside down"

Name: _____ **Period:** 1W

Project: Penny Bridge **Attempt #:** 1

Sketch:

Success:	Reason For Failure:	Solution:
1. 2	Bottom fell down and didnt hold.	Secure everything better.
2. 18	Started falling apart, then the middle Colapsed.	Make sure every thing is tucked in tightly.
3. 55	Collapsed right in the middle because it couldnt hold anymore weight	Make the middle of the bridge more Sturdy.

Name: _____ **Period:** _____

Project: _____ **Attempt #:** 3

Sketch: (Make it Wider to hold more Pennies)

Success:	Reason For Failure:	Solution:
1. 67	It Collapsed because it couldn't hold anymore weight.	Add more support to the middle.
2. 30	It keeps collapsing from all the weight.	Add paper in between the hole to add more support. Keep the sides neat too.
3. 28	The sides aren't being supported so it's causing the whole thing to collapse	Fold the sides more neater and add Paper inbetween to add support.

Name: _____ **Period:** 4W

Project: Penny Bridge **Attempt #:** 1/4

Sketch:

Success:	Reason For Failure:	Solution:
1. 6 Pennys	it was not strong enough and it was crumpled in middle	make it like a tarrand Make the paper folded
2. 7 Pennys	it had to much going on the out side and not support in middle	add/use all the paper i can
17 Pennys	it was stroger in the middle and sides where sliping	try to hole new idea

3

V3.54

Name: **Period:** 4/W

Project: Penny Bridge **Attempt #:** 2/4

Sketch:

Success:	Reason For Failure:	Solution:
1. 67 Pennys	it was to small on the sides and had no room	to make the parts Biger
2. 61 Pennys	the middle came unlached and did not stay together.	fold the insides better and add more paper
49 Pennys	made it the middle the Seame and did not try anything else	go to the next one and learn from mistakes

Name: _____ **Period:** 4W

Project: Penny Bridge **Attempt #:** 3/4

Sketch:

Success:	Reason For Failure:	Solution:
1. 6	it was thin and had no support any Whure	Make the sides stronger and add more Paper
2. 30	it was to small on the side and ~~[illegible]~~ had no room	make it biger and hold more Pennys
22	it was way to small and it could not stay up	go to the next one and make it bigger

Name: _____ **Period:** 4.W

Project: Penny Bridges **Attempt #:** 4/4

Sketch:

Success:	Reason For Failure:	Solution:
1. 12	their was no Place to put the Penny's	to make it wider and stronger
2. 35	it was good But it did not have support in the Middle.	to add more folds in the middle
80	it was only supportive in one spot.	go to final and rock it

Name: [illegible] **Period:** 2 W

Project: Bridge 1 **Attempt #:** 1

Sketch:

Success:	Reason For Failure:	Solution:
1. 17	It slide off the edge	extend the ect of it
2. 23	the coins didn't stay	fold walls on either side by making small cuts
3. 17	the foot slid in, and made the middle colapse	make sure the fold are straight and not bent or it will fall

Name: _____ **Period:** 2W

Project: Bridge 2 **Attempt #:** 2

Sketch:

Success:	Reason For Failure:	Solution:
1. 18	1: the foot fell sideways 2: the whole thing tipped over	move the weight by fixing the folds or make it longer
2. 14	the fold in the middle was too weak, it fell in	fix the fold in the middle by something different
3. 4	the fold in the middle snapped	change the middle fold

Name: _____ **Period:** 2

Project: Bridge 3 **Attempt #:** 3

Sketch:

Success:	Reason For Failure:	Solution:
1. 2	middle hit the bottom; fold was to weak	put supports inside the middle.
2. 12	middle hit the bottom supports didn't work	add another support and put in middle
3. 4	middle was super flimsy, just dont do this design	do a diffrent design

Name: _____ **Period:** 2

Project: Bridge 4 **Attempt #:** 4

Sketch:

Success:	Reason For Failure:	Solution:
1. 27	the middle fell in	Strenghten the middle fold with supports
2. 5	the to sides came apart	Use cuts to make fold strongr
3. 8	folded in because it cut the wrong part	more the cuts more to the borders.

Name: _____ **Period:** _____

Project: _____ **Attempt #:** 4

Sketch:

Success:	Reason For Failure:	Solution:
1. 3 Pennies	I noticed that the weight on the bridge was not distrubted	try to distibute more to the end of the bridge
2. 13 pennies	I felt like I did better on distrupting but I feel this way is too much weighs	try to fold it another that weighs less
3. 11 Pennies	the left side ripped and collabsed.	try to be more care full while making it

Name: _____ **Period:** _____

Project: _____ **Attempt #:** 3

Sketch:

Success:	Reason For Failure:	Solution:
1. 1 Penny	It was way to floppy	try to make it less crumply by being more careful on folding it
2. 55 pennies	one side was to wide	try to mak that side tighter but without losing surface area
3. 34 pennis	the side i was try to make smaller was to small	try to find a perfect medium

Name: _____ **Period:** _____

Project: _____ **Attempt #:** 2

Sketch:

Success:	Reason For Failure:	Solution:
1. 5 pennies	I saw that the bridge was to v shaped	try to take the weight from the fold and push the weight to the end
2. 16 pennies	did. really good just noticed the left side gave out	try. to fold up the left side more but it might mak it hold less
3. 12 pennies	there wasnt enough surface aera to hold anymore	try to fan out the end but also try not to weaken the base

Name: _____ **Period:** 4W

Project: Penny bridge **Attempt #:** 4

Sketch:

Success:	Reason For Failure:	Solution:
1. 36	The folds were too loose	make them tighter
2. 44	It fell in the middle	Spread out Pennies evenly
3. 52	It fell to one side	dont have to many on one side

Name: _____ **Period:** 4W

Project: Penny bridge **Attempt #:** 3

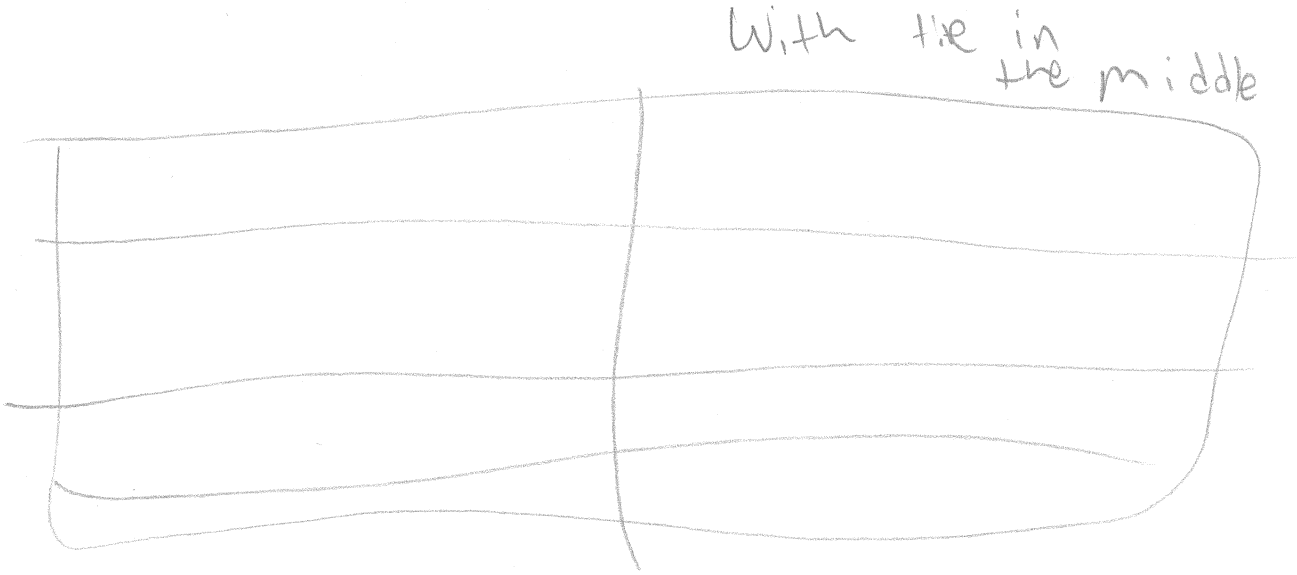
Sketch:

Success:	Reason For Failure:	Solution:
1. 6	It wasn't sturdy	Make it stronger
2. 34	one side was shorter than the other side so it fell off	Make folds even
3. 55	too many on one side	Make Penny even.

Name: Mayla Capen **Period:** 4W

Project: Penny bridge **Attempt #:** 2

Sketch:



Success:	Reason For Failure:	Solution:
1. 21	All the pennies fell into the middle	Make the pennies more even on each side
2. 23	one or the ends wasn't tall enough so it tipped over	make the folds kind of even
3. 21	I was putting a lot of the pennies in the middle so the middle got weak	even out the pennies

Name: _____ **Period:** 4W

Project: Penny bridge **Attempt #:** 1

Sketch:

Success:	Reason For Failure:	Solution:
1. 16	The middle got weak	make it a little bit starderg in the middle
2. 8		
3. 9	Middle wasn't connected well	Connect it better

Making A Decision: Rank your designs on the Trade-Off Matrix
1= Worst 2= OK 3 = Better 4 = Best

Trade-Off Matrix				
	Idea 1	Idea 2	Idea 3	Idea 4
Success	3	3	4	2
Structural Support	2	2	4	1
Simplest	1	3	4	4
Your Best Constructed	2	3	4	3
Lowest Cost	2	3	4	3
Total Score	10	14	20	13

Apply Solution: Doing For Real (Come and get the official test paper.)

Observation During Final Test: Take notes about your observations of your final test.

During my final test, I got 39. I started off by adding pennies to the ends, then slowly towards the middle. This made the ends of the bridge more weaker quicker. The bridge starting falling in and flexing in different ways. I should've added a little of something more to help the ends from flatting and then giving out as easily.

Answer the following questions with at least a complete paragraphs (three complete sentences), question 1 NEEDS to be one sentence and questions 2 NEEDS to only be a numbers. Sentence structure, spelling, and grammar count.	
1. How many pennies did your bridge hold? In number and mass? 1 Penny = 3.1g So take the number of pennies you held x 3.1= the mass of all the pennies.	my bridge held 22 Pennies so it held 68.2g of mass.
2. If a piece of paper has a mass of 5g how many times it's own mass did your bridge hold? Your mass from the last question/5=	my fridge held 13.64x the amout of its own weight.
3. What did you do well?	the middle fold it wouldn't break even it i tried to force it.
4. What did you do poorly?	the ends i didn't fold them so they slipped off.
5. What did you observe during the testing of your artifact?	the only thing that touched the bottom was a tiny peice that fell off
6. What should you have changed about your artifact before you tested it?	add folds to the ends so it wouldn't slip.
7. What did you learn from doing this project? (Process/Construction/Testing)	how to fold paper into something that can hold 13x its weight
8. What would you change if you had to do this again?	add folds to the ends and support in the middle.

Answer the following questions with at least a complete paragraphs (three complete sentences), question 1 NEEDS to be one sentence and questions 2 NEEDS to only be a numbers. Sentence structure, spelling, and grammar count.	
1. How many pennies did your bridge hold? In number and mass? 1 Penny = 3.1g So take the number of pennies you held x 3.1= the mass of all the pennies.	My penny bridge held 158.1 grams.
2. If a piece of paper has a mass of 5g how many times it's own mass did your bridge hold? Your mass from the last question/5=	31.62
3. What did you do well?	I felt I disrupted the weight well. This shows on attempt three. During the first test, I accidentally put too much stress on the middle of the bridge, which made it collapse in on itself, and it only held one penny. On test two of attempt three, I noticed that I needed to add extra weight to the ends of the bridge, so I folded them up to add more weight, which really helped. It's shown that it helped, as I scored 55 pennies on this test.
4. What did you do poorly?	I felt that I made my bridges too poorly and flimsily. This made my bridge hold less weight and made it collapse more. I noticed this when the bridges with more creases and bends held less weight. But the bridges that held over ten pennies had a lot fewer creases and looked a lot better. One example of this is on my fourth attempt, when on the first test, there was a rip in the bridge, which, in my opinion, was the reason it went faulty. Because the same bridge without a rip on test two held more pennies than test one.
5. What did you observe during the testing of your artifact?	I observed that the placement of your pennies affected your scores. I noticed this during the whole project that if u add multiple pennies at a time instead of one, in my opinion, gives you an advantage. Also, if u end the pennies to the ends instead of right in the middle. You just have to make sure you don't put too many pennies on one end of the bridge.
6. What should you have changed about your artifact before you tested it?	One thing I should've changed and I regret now is not taking more time to make my final bridge. I felt I could hold an extra ten pennies if I took the extra minute to make sure it was perfect. I am still satisfied with the project, and I feel I did the best of my ability, but I have this nagging feeling that I could have done a little better.
7. What did you learn from doing this project? (Process/Construction/Testing)	I learned to be patient and to try multiple times to figure out what works. I noticed this from my third attempt on test three, where I tried different bridges, and my amount of pennies just kept getting better. I also learned how to graph my work and to reflect on what happened.
8. What would you change if you had to do this again?	One thing I would have changed was to try an idea way out of the box. I am curious about what a crazy idea could do. I thought of this because Mr. Bishop told us that the girl who has the record used a bridge that nobody thought of.

Answer the following questions with at least a complete paragraphs (three complete sentences), question 1 NEEDS to be one sentence and questions 2 NEEDS to only be a numbers. Sentence structure, spelling, and grammar count.	
1. How many pennies did your bridge hold? In number and mass? 1 Penny = 3.1g So take the number of pennies you held x 3.1= the mass of all the pennies.	i heldd 96 pennys witch when you times that By 3.1 it is the mass of 297.6.
2. If a piece of paper has a mass of 5g how many times it's own mass did your bridge hold? Your mass from the last question/5=	59.52g of weight/from 297.6 ÷5=59.52 grams heleed.
3. What did you do well?	i thik what i did well was taking my nowlege from the other trys and using that to make a ~~better~~ last Bridege
4. What did you do poorly?	I think what i did poorly was only using one idea for every thing and only using all that i know for the ~~last~~ one
5. What did you observe during the testing of your artifact?	i observed that when i made the folds smaller it ended to hold on to the side of the Bridge Better.
6. What should you have changed about your artifact before you tested it?	i would change about usin Less Paper Because it was a lot of foleding and took up a lot of room
7. What did you learn from doing this project? (Process/Construction/Testing)	i learned ~~that~~ taking your time will make you/one understand better and have better luck with it
8. What would you change if you had to do this again?	i would change the amount of paper i used and lower it to smaller Bridge.

Answer the following questions with at least a complete paragraphs (three complete sentences), question 1 NEEDS to be one sentence and questions 2 NEEDS to only be a numbers. Sentence structure, spelling, and grammar count.	
1. How many pennies did your bridge hold? In number and mass? 1 Penny = 3.1g So take the number of pennies you held x 3.1= the mass of all the pennies.	182.9 My bridge held 59 Pennies,
2. If a piece of paper has a mass of 5g how many times it's own mass did your bridge hold? Your mass from the last question/5=	36.58 times itself.
3. What did you do well?	I think I did good building my bridge by folding it semi equally. I also think I did a good job Put on the Pennies
4. What did you do poorly?	I think some of my ideas were Poor. I think some things I did were Poor.
5. What did you observe during the testing of your artifact?	I observed that a shape that works well it like the fold thing or the fan.
6. What should you have changed about your artifact before you tested it?	How wide the folds are
7. What did you learn from doing this project? (Process/Construction/Testing)	I learned that You need to have different ideas because multiple max work
8. What would you change if you had to do this again?	I would make some different shapes to see if they work better.

Answer the following questions with at least a complete paragraphs (three complete sentences), question 1 NEEDS to be one sentence and questions 2 NEEDS to only be a numbers. Sentence structure, spelling, and grammar count.	
1. How many pennies did your bridge hold? In number and mass? 1 Penny = 3.1g So take the number of pennies you held x 3.1= the mass of all the pennies.	My bridge held 53 pennies, which was 164.3 grams of
2. If a piece of paper has a mass of 5g how many times it's own mass did your bridge hold? Your mass from the last question/5=	32.86
3. What did you do well?	I did multiple tests before the purple paper so I knew what to alter. I think I wrote decent responses as well. I also had a good final test.
4. What did you do poorly?	I definitely didn't hold a lot of pennies. I wasn't able to build what I thought the bridges should look like on number 3. Finally, my alterations didn't help much.
5. What did you observe during the testing of your artifact?	I saw that there were often weak spots where the bridges overlapped, or dead center of the bridge. It was better to stack pennies on the sides.
6. What should you have changed about your artifact before you tested it?	I should have made it thinner because it was too flimsy while it was wide.
7. What did you learn from doing this project? (Process/Construction/Testing)	I learned that when weight is in the middle, it's more prone to collapse, and I learned ways to link papers together by folding it.
8. What would you change if you had to do this again?	I would change the way I added the pennies, and take more time exploring basic, simple, sturdy options than extravagant ones.