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Standard

Matter & Its Interactions

Standard: 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Science Center Objective: Students will be able to determine which materials are best suited for creating a boat by testing certain properties.

Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.

Assessment Boundary: Assessment of quantitative measurements is limited to length.

Observable features of the student performance by the end of the grade:		
		Organizing data
1	a	Using graphical displays (e.g., pictures, charts, grade-appropriate graphs), students use the given data from tests of different materials to organize those materials by their properties (e.g., strength, flexibility, hardness, texture, ability to absorb).
		Identifying relationships
2	a	Students describe* relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough).
	b	Students identify and describe* relationships between properties of materials and some potential purposes (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep materials from breaking, but not good for keeping materials rigidly in place).
		Interpreting data
3	a	Students describe* which properties allow a material to be well suited for a given intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut).
	b	Students use their organized data to support or refute their ideas about which properties of materials allow the object or tool to be best suited for the given intended purpose relative to the other given objects/tools (e.g., students could support the idea that hardness allows a wooden shelf to be better suited for supporting materials placed on it than a sponge would be, based on the patterns relating property to a purpose; students could refute an idea that a thin piece of glass is better suited to be a shelf than a wooden plank would be because it is harder than the wood by using data from tests of hardness and strength to give evidence that the glass is less strong than the wood).
	c	Students describe* how the given data from the test provided evidence of the suitability of different materials for the intended purpose.

Engage

- **Phenomena: Have any of you heard about the Titanic? How could the creators of the Titanic improve their materials to ensure they art the best fit for creating the unsinkable boat? We are going to determine which materials have the properties that are best suited for the purpose by building our boat. Although it will be a smaller model and made out of different materials, you could transfer what you learned to materials that create an actual boat. Let's listen to this crash course of house materials can be improved by changing their properties.** **https://www.youtube.com/watch?v=tGfLhPslEjQ**
- **Background Knowledge:**
  1. **Definition of property: a quality or characteristic that belongs to and is peculiar to an individual or thing**
  2. **Examples of a property: absorbency, flexibility, mass, color, volume, density, strength hardness, texture, ability to float**
  3. **Definition of disassembling: take apart or taking down**
  4. **Definition of absorbing: the ability to take in or soak up something such as water. Show the students an example of how a sponge absorbs water by soaking the sponge in the water and wringing it out in front of the students.**
  5. **What does it mean to immerse something in the water? Dip or submerge in liquid.**
  6. **What does flexibility mean? It is the ability for a material to bend without breaking and return to its original shape or size.**
  7. **What does it mean to be ductile? This is when a material can be molded or deformed, but it does not lose its toughness. The material is not brittle.**

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8. **Now, students may ask you what brittle means? Something that is brittle is hard, but it also is easy to break and shatter.**
9. **Some of the materials the students are using may be neither brittle nor ductile which means they are too tough to be molded or changed, but also to tough to be broken easily.**
10. **What does it mean to be able to float? When something can float, it stays at or near the surface of a liquid. We are going to test if materials can float in water by using a water basin. This means that it does not sink, ending up at the bottom of the water basin.**
11. **What does it mean to take on weight? For the purpose of our challenge, it means that we are able to apply weight to an object while it is still able to float on the water. The weight we are going to apply is pennies. If a material cannot float, you do not need to do the penny test.**
12. **Remind the students to not splash and make a mess while they are using the water basins. Please try to wring out the materials the best that you can. When you wring something out, you squeeze and twist to get as much liquid out of it as possible.**
13. **Students should not remove any of the materials from the challenge locations.**

Center 1

- **Challenge: Which materials absorb water?**
- **Materials Needed:**
  - **Water basin**
  - **Challenge Bucket**
  - **Dry sponges (Cut into small pieces)**
  - **Wooden Blocks**
  - **Small Plastic Blocks**
  - **Pencils**
  - **Tin Foil**
  - **Cotton**
  - **Fabric**
  - **Rubber Bands**
  - **Tissue**
  - **Wash Clothes**
  - **Paper Towels**
  - **Styrofoam**
  - **Wax Paper**
  - **Plastic Toys**
  - **Paper cup**
  - **Plastic cup**
  - **Coffee Filter**
  - **Newspaper**
  - **Cardboard**
- **Learning Documents: Students will place the table in Appendix A into their science journals to record which materials absorb water and which do not.**

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- **Special Directions:**
  1. **Students will take a dry sponge and soak it in the water basin. Although it is obvious that a sponge will absorb water, students will use the wet sponge to compare it to a dry sponge and feel the weight difference.**
  2. **Students will document: Which one is heavier? Which one would be better to use when you are creating a boat, why?**
  3. **They will record the answer in their science journals below the absorbency comparison table and dry vs wet caption.**
  4. **Students will test each of the materials at the table to see whether they are absorbent or not.**
  5. **The students will take the materials and put them in the water basin for at least 3 seconds.**
  6. **When they remove the material from the water, they will observe whether the material has absorbed any water.**
  7. **Students may have to squeeze the material to see if any water was absorbed.**
  8. **For example, the students will take a small plastic block and immerse it into the water for at least 3 seconds. When it comes out they will try to squeeze the small plastic block as much as they can in order to see if it had absorbed any water. They will notice that they are unable to squeeze water out and document what that means on their absorbency table.**
  9. **If the material absorbed water, they will write the name of the material under the column that says absorbent materials.**
  10. **If the object did not absorb water, they will write the name of the object under the column that says nonabsorbent materials.**
  11. **Students will have a list of materials at their stations. It is suggested that they test the materials in order, so they do not get confused about which materials they have tested and which they have not. Along with the list of materials, there will be a set of instructions for the students to follow. (Appendix B)**
  12. **The students will place their wet materials in the bucket provided. Materials can be used more than once.**
  13. **Students should not splash in the water or make a mess. The students will be asked to leave the center if they are doing so. We are going to keep as much water in the bucket as possible. Please try to wring out the materials the best that you can. When you wring something out, you squeeze and twist to get as much liquid out of it as possible.**
  14. **Before the students leave the challenge, they should make sure that all of the wet materials are in the bucket provided and any water that got on the table is wiped up with a paper towel.**
  15. **The students will not have to worry about throwing away materials that cannot be reused. The teacher will take care of that at the end.**
  16. **For student directions, see Appendix B.**

Center 2

- **Challenge: Is the material flexible and ductile?**
- **Materials Needed:**
  - **Challenge Bucket**

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- **Wooden Blocks**
- **Small Plastic Blocks**
- **Pencils**
- **Tin Foil**
- **Cotton**
- **Fabric**
- **Tissue**
- **Rubber Bands**
- **Wash Clothes**
- **Paper Towels**
- **Styrofoam**
- **Wax Paper**
- **Plastic Toys**
- **Paper cup**
- **Plastic cup**
- **Coffee Filter**
- **Newspaper**
- **Cardboard**
- **2 Plastic Containers**
- **Pennies**
- **Paper Cup with a hole on the side**
- **Paper Clip**
- **Duct Tape**
- **Tape**

- **Learning Documents: Students will place the table in Appendix C into their science journals to record which materials are flexible/ductile and which are not. They will also respond to the question stated in Appendix C which will be placed in their science journals with the table.**
- **Special Directions:**
  1. **Students will test the flexibility and ductility of material by creating a bridge.**
  2. **Students will have a list of materials at their table. They should follow the order of materials when they are testing their materials.**
  3. **The two ends of the bridge will be made by using plastic containers. The containers need to be placed so they are at the same height. The lids of the containers stay on and facing upward.**
  4. **The containers need to be at least the material width apart. The length apart will be different for each of the materials.**
  5. **When students are attaching the materials to the container they need to make sure that they are tight and not loosely hanging between the two containers.**
  6. **The material will create a bridge that connects one container to the other container. Students do not want their bridge to be hanging below the two endpoints, so they need to check again to make sure it is tight.**
  7. **They will secure the materials to the endpoints (containers) by either using regular tape or duct tape depending on which is able to hold the material.**
  8. **Students will take their paper clip and bend it to form a hook on both ends of the paper clip. (See picture for example)**

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9. **The students will take the paper cup that has a hole in it and thread one side of the paper clip through the whole. The other end of the paper clip will need to be hooked to the material that is forming the tight bridge between the two containers. (See picture for example)**
10. **Students are not allowed to poke each other with the deformed paper clip.**
11. **The students will add pennies to the cup that is connected to the bridge to see if the material is flexible and ductile.**
12. **If the material does not bend after adding all of the pennies, the students can take the material off of the bridge and attempt to bend it into a new shape themselves by using minimal force. If the material is still not able to bend, they can record that it is not flexible.**
13. **Students should not try to break materials while they are testing for flexibility and ductility. If they are unable to bend it by using a little force, they will be able to conclude that the material is not flexible.**
14. **Students will disassemble their materials and place them in the challenge bucket for the next group.**
15. **Students will answer the question that was placed in their journal with their flexibility/ductility table.**
16. **Question: Which property would be more useful when you are creating a boat, why?**
17. **For student directions, see Appendix D**

Center 3

- **Challenge: Is the material able to float and take on weight?**
- **Materials Needed:**
  - **Wooden Blocks**
  - **Small Plastic Blocks**
  - **Pencils**
  - **Tin Foil**
  - **Cotton**
  - **Fabric**
  - **Rubber Bands**
  - **Tissue**
  - **Wash Clothes**
  - **Paper Towels**
  - **Styrofoam**
  - **Wax Paper**
  - **Plastic Toys**
  - **Paper cup**
  - **Plastic cup**
  - **Coffee Filter**
  - **Newspaper**
  - **Cardboard**
  - **Water Basin**
  - **Pennies**
  - **Yarn**

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- **Challenge Bucket**

- **Learning Documents: Students will place the table in Appendix E into their science journals to record which materials can float and if they are able to take on weight. If they sink when the students add the first penny, they should not be classified as being able to take on weight. They will also respond to the question stated in Appendix E which will be placed in their science journals with the table.**
- **Special Directions:**
  1. **Students will set the material on the water. They do not need to immerse it in the water this time and should not throw it at the water either or their results will be inaccurate.**
  2. **In order to get the correct results, the student needs to gently place the material on the water.**
  3. **Students will need to wait at least 10 seconds to see if the material sinks or floats.**
  4. **Students need to make sure that they test each of the materials by using the material list on the table.**
  5. **They will record if the material is able to float or if it sunk to the bottom of the water basin.**
  6. **If the material sunk, the students can take it out of the water basin, dry it off, and return it to the Challenge Bucket.**
  7. **Students will not test the materials that sunk to the bottom for their ability to take on weight.**
  8. **If the material is able to float, they will start adding weight to the material. In order to determine if the material is able to take on weight, it needs to remain floating after pennies have been added to the material.**
  9. **There is yarn provided for the students in the bucket if the pennies are unable to balance on the material to efficiently determine whether the material is able to take on weight.**
  10. **Students will record if the material is able to take on weight and how many pennies were added before the material sunk.**
  11. **Each of the materials that were able to float should be written in the "take on weight column on the table" unless they were unable to take on at least one penny.**
  12. **When the students are recording the number of pennies the material could hold before it sunk, they need to make sure the number is written across from the object that is on the take on weight column.**
  13. **Once the material starts to sink the students will no longer need to add pennies.**
  14. **There will be up to 10 pennies for the students to use during the test.**
  15. **Students are not allowed to splash or play in the water.**
  16. **When the students are done with their testing, they can return the materials back to the challenge bucket. They do not have to worry about throwing away the material that cannot be reused because the teacher will do that at the end.**
  17. **Students will answer the question that was placed in their science journals under the table for this challenge.**
  18. **Question: Why is important for a boat to be able to float and take on weight?**

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19. For student direction, see Appendix F.

Wrap-Up Session

- **Challenge: Create a boat using a strong/flexible material that does not absorb water. Your boat needs to be able to float while holding at least five pennies.**
- **Materials Needed:**
  - **Wooden Blocks**
  - **Small Plastic Blocks**
  - **Pencils**
  - **Tin Foil**
  - **Cotton**
  - **Fabric**
  - **Tissue**
  - **Wash Clothes**
  - **Paper Towels**
  - **Styrofoam**
  - **Wax Paper**
  - **Plastic Toys**
  - **Paper cup**
  - **Plastic cup**
  - **Coffee Filter**
  - **Newspaper**
  - **Cardboard**
  - **Water Basin**
  - **Pennies**
  - **Scissors**
  - **Tape**
  - **Kid's Pool (Weather Permitting)**
- **Learning Documents:**
- **Special Directions:**
  1. **Students will put together the information they found from the three challenges above.**
  2. **The students will determine which properties will work best when they are building a boat and write them as the headings in there in the table provided.**
  3. **Students will go back into their science journals to copy the materials that are under these headings onto the new sheet.**
  4. **From looking at the different materials in each box, the students will circle which materials they are going to use to create their boat.**
  5. **The students will be given time to draw a model of their boat. Well, they are drawing, they need to label each of the materials they are going to use.**
  6. **The materials need to be taken from the list above or approved by the teacher. If the student has a good reason to use a different material, they will have to test it at all of the challenges before it is approved. New materials need to write on the table in a different color, so it catches the teachers attention.**
  7. **The students will be given time to create the model of their boat. The teacher should remind the students to circle all of the materials they used to create**

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their model in the table that was provided for them. If the students decide to make any last minute changes, they need to circle those materials as well.

8. **The students' boats need to be able to hold five pennies (people). The pennies need to stay in the boat without support from anyone or anything around them.**
9. **The students will be given points based on the creativity of their boat. Students are encouraged to take risks. They are not going to be graded on whether their boat can stay floating or sinks. They will be graded on their reflection of the experience.**
10. **Students will be given the opportunity to test their boat in the water basin once before testing it in front of the class.**
11. **After they have tested their boat, they can go back and make any changes.**
12. **If the student decides to get rid of a certain material, they should not erase the circle on their table. They may just cross off the material that was circled. If they decide to use a different material, they will need to circle it.**
13. **While we are testing the boats in front of the class, the students will be given time to explain why they chose their materials and the changes they made after they tested their boat if there were any.**
14. **If it was nice out, I would set up a little pool outside for the final test.**
15. **Students are allowed to take notes on what their classmates used to create their boat. The students should note anything that they liked about their peers' boats that they would like to add to their own.**
16. **After all of the students have tested their boats, they will write a reflection.**
17. **Included in the reflection: materials that were used and why you chose them, changes that you made after testing your boat and why, why you think your boat was able to float or sunk to the bottom, anything you would change after seeing your peers' boats, what you think are the best-suited properties to use to create the boats and why, your overall reflection on the experience**
18. **The reflection will be used as the summative assessment.**

Big Idea

- **Science Content:**
  1. **We have all used a paper towel, right? You should all be saying yes because we just used them in our challenges. Are the paper towels you have at home more absorbent than the ones we have at the school? Could we do a test to see what paper towel works the best?**
  2. **When we are considering what kind of materials to use for an intended purpose, we may need to test the materials to find which work the best. Do you think that they had paper towels in the past? No, they did not even have toilet paper! So, someone tested different materials to find what worked best to clean up liquid spills.**
  3. **As we created our boats, we tested different properties to find which properties were best-suited for creating our boat. Why do you think this is so important?**
  4. **What would happen if someone created a boat that soaked up water? Eventually, the boat would become too heavy and sink to the bottom of the**

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river or the ocean. What about if someone created a boat that did not have flexible/ductile material? Would a boat still have its shape? We need flexible/ductile material so are able to mold the boat into the shape intended without it cracking or breaking. The material also needs to be hard and strong.

5. **If we used a material that soaked up water and was brittle, would these properties be the best fit for the intended purpose of building something that floats on water, is able to hold materials, and does not crack when it is shaped.**
6. **What about for the purpose of building a home? Do you think that we use the same materials that were used in the past or have we tested new materials and found that they are a better fit for the purpose of building a safe shelter?**
7. **It is so important to test different materials when you are searching for the best fit for an intended purpose.**
8. **If we did not use the correct materials, we could have buildings crumble to the ground or cars with no safety features. What would happen if the airbags in a car were made of metal? Would metal be the best fit for the intended purpose of an airbag?**
9. **What if a hockey rink was made of carpet or when we wrote with our pencil, it did not show up on paper?**
10. **What is the purpose of a hockey rink? For the hockey players to skate, do ice skates work on carpet? What about the purpose of a pencil? The purpose of a pencil is to have something to write with. Can we write with a pencil that does not show up on the paper?**
11. **The important takeaway/big idea of this lesson is to remember that we cannot just start creating something out of any material and expect it to work for the reason it was created.**
12. **If we want something to work, we create it with a purpose. We have to test different materials to see which ones work better. Then we create a model, so we can see the materials that we used and how we want to put them together. When we test the model, we need to decide if the properties were the best fit for the purpose we created it or if we need to change anything.**
13. **If we go back to the video we watched at the beginning of the lesson, we can recall that people are constantly looking for ways to improve materials to enhance their purpose.**
14. **Do you think you could find a way to create an unsinkable boat?**

- **Learning Supports:**
  1. **I provided the students with tables and a set of directions at each Challenge.**
  2. **The students were able to watch a crash course before the lesson.**
  3. **I introduced the students to new vocabulary words before they began working on the challenges.**
  4. **On a challenge that I thought may get confusing for some kids, I provided a picture of what it was expected to look like.**
  5. **For the summative assessment, I provide the students with questions to answer instead of just asking them for a reflection. This leads the students that**

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struggle with writing reflections to have a question to work with and help them get ideas.

6. **For my students that struggle with reading and writing, I would provide the option for them to work on iPads or computer where they can use spell check and the words can be read to them. I would also provide them with a word bank that lists any words they may need to understand in order to be successful. Once the students were done, we could print out their work and transfer it to their science journals.**
7. **For a student that may have a sensory processing disorder, I would either pair them with another student to observe or create a video of another student completing the task of the challenge to make their observations. When it was time for them to test their boats, I would place their boat in the water for them and let them watch from a distance.**
8. **The students that are above grade level could start with tables that have no headings and create their own headings based on the name of the challenge and the activities.**
9. **For the students that struggle with science content, I will provide more detailed instructions.**
10. **For my EL students, I will provide the instruction in English and the language that they speak or I will have their translator complete the assignment with them if they have one assigned to them.**

Assessment Plan:

- **Formative: Observe students as they are completing the challenges. Collect students' science journals after they have completed all of their challenges. (Appendix A, Appendix C, Appendix E)**
- **Summative: Students will write a reflection of their observations and experiences. (Appendix J)**

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Appendix A

Absorbent Materials	Nonabsorbent Materials

Wet Sponge vs. Dry Sponge Observation:

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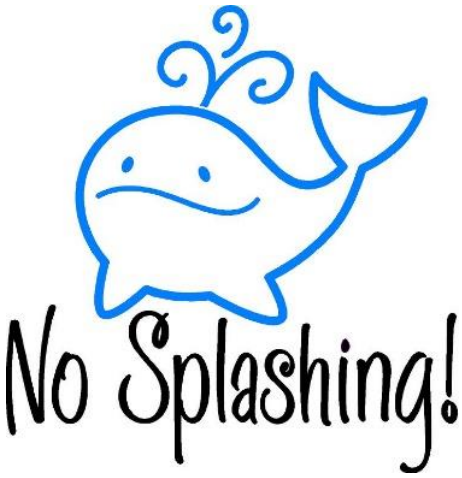
Appendix B

Absorbent vs Nonabsorbent Materials



1. Place the dry sponge in the water basin and push it down into the water for at least three seconds.
2. While holding the wet sponge in one hand, place a dry sponge in the other. In the place provided for you in your science journals, record the answers to the following questions: Which sponge is heavier? Which material would be better for creating a boat, the wet sponge or the dry sponge? Why?
3. Test each of these materials listed below to see if they are absorbent (absorb water) or nonabsorbent (do not absorb water)
4. Place the material in the water basin and push it down into the water for at least three seconds.
5. Remove the material from the water and check for absorbency. Place all materials back in Challenge Bucket.
6. Record whether it was an absorbent or nonabsorbent material in the table provided for you in your science journals.

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Appendix C

Flexible/Ductile	Not Flexible/Ductile

Which property would be more useful when you are creating a boat, why?

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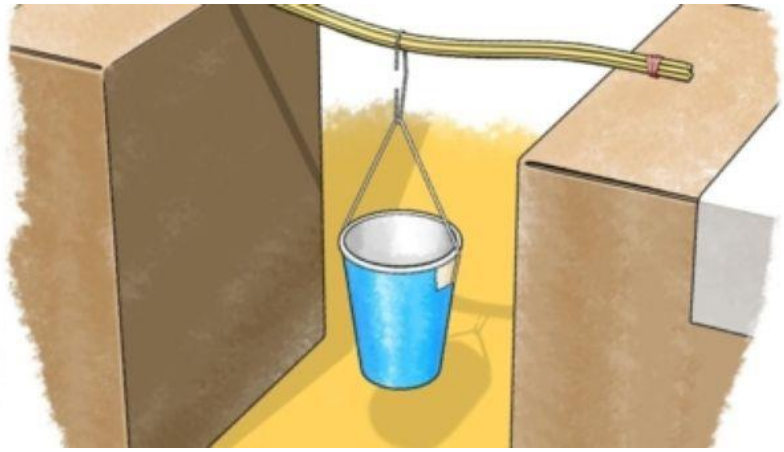
Appendix D

Is it Flexible/Ductile?

1. Place the two plastic contains so the lids of the containers are facing upward.
2. Take one of your materials and secure it to each of the contains by using tape/duct tape. Make sure the material is tight!
3. Bend your paper clip so each of its ends is in the form of a hook. See picture.
4. Place thread one hook through the paper cup that has a hole on the side and hooks the other to the tight material that is creating your bridge.



5. Start adding pennies to your paper cup. Is your material bending? If you have added all of the pennies and your material has not moved, disassemble your bridge and using little force try to bend the material.
6. Record if the material was flexible/ductile and answer the question provided for you in your science journal.
7. Disassemble materials and return them to the Challenge Bucket.

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Appendix E

Sink	Float	Take On Weight	Number of Pennies

Why is it important for a boat to be able to float and take on weight?

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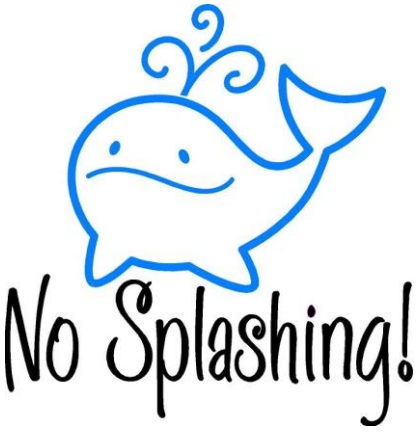
Appendix F

Can it Float and Take On Weight?

1. Gently place the material on the water. Do not immerse it in the water.
2. Wait at least 10 seconds to see if the material sinks or float. Record your observation in your science journal.
3. If the material sinks, dry it off and place it back in the Challenge Bucket.
4. If it floats, begin adding weight by placing pennies on top of the material. If the pennies do not stay on top, use the yarn to tie the pennies onto the material.

5. The material must be able to keep floating with at least one penny added to "be able to take on weight." Record your observations and the number of pennies the material can hold in your science journals. No more than ten pennies.
6. Make sure that you write the number of pennies the material was able to hold across from the name of the material in the other column.
7. Return your materials to the Challenge Bucket and respond to the question that was placed in your science journal.



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Appendix G

Boat Challenge

1. Choose the properties you would use to create your boat: Absorbent, Nonabsorbent, Flexible/Ductile, Not Flexible/Ductile, Sink, Float, Take On Weight

*You should use at least one property from Challenges 1 and 2, and two properties from Challenge 3.

2. Write each of the properties you chose in the heading section on the table provided for you.

3. Go into your science journal and write the materials that are listed under the properties you chose and add them under the correct heading.

4. Circle the material that you believe would work best when you are creating your boat. If you have an idea of a different material in the classroom that you could use, come see me.

5. Draw a model of your boat using the materials that you circled. These materials need to be labeled. BE CREATIVE, TAKE RISKS!

6. When you think you are ready, you may grab your materials and begin creating your boat.

7. You only get one opportunity to test your boat before presenting it to the class.

8. After you have tested your boat, you may go back and make any changes. Make sure to cross out materials you decided not to use and circle the ones that you may have added.

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Appendix H

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Appendix I

REMINDERS

1. CIRCLE THE MATERIALS YOU USED!
2. CROSS OFF THE MATERIALS YOU DID NOT USE!
3. LABEL YOUR MATERIALS ON YOUR DRAWING!
4. USE YOUR DRAWING TO CREATE YOUR MODEL!
5. GIVE YOURSELF ENOUGH TIME TO TEST YOUR BOAT AND MAKE CHANGES BEFORE PRESENTING IN FRONT OF THE CLASS!
6. HAVE FUN!!!
7. BE CREATIVE!!!
8. DO NOT BE AFRAID TO TAKE RISK! YOU NEVER KNOW IF SOMETHING WILL WORK UNTIL YOU TRY!!!

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Appendix J

Boat Challenge Reflection

Respond to the following questions in your science journals:

1. What materials did you use, why?
2. What changes did you make after you tested your boat, why? If you did not make any changes, more to the next question.
3. Why do you think your boat was able to stay floating or sunk to the bottom?
4. What would you change to improve your model now that you have seen all of your peers' boats?
5. What properties were best-suited for creating the boats, why?
6. What is your overall reflection on the experience? What did you like? Is there anything you would change?

Hand your science journals to Ms. Schaner when you are done.