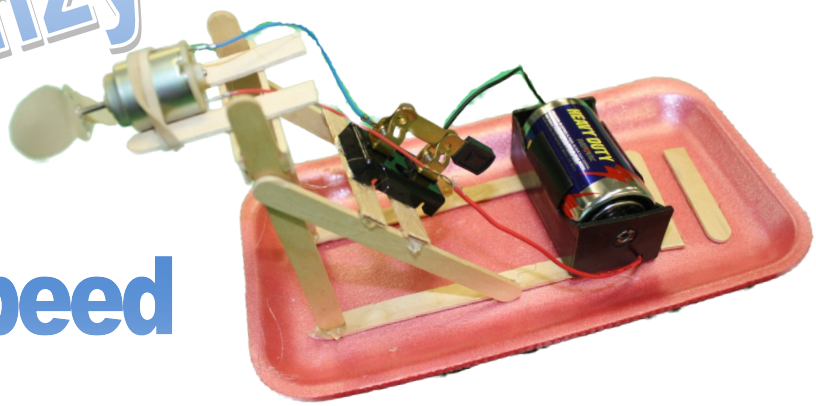
Fanboat Frenzy



A High Speed STEM Competition

The Goal:

The overall focus of this investigation is to get students actively engaged in a project that reflects the overall Common Core State Standards for the first quarter of Fifth Grade Science. This project combines basic electricity with forces and motion in an investigation that engages students in the content area of Science, Technology, Engineering, and Mathematics.

Building the Air Boats:

Each student's air boat should consist of the materials found on the materials list on the second page of these directions. The only allowance from the list is the switch and battery size. Commercial switches are allowed, but student created switches are preferred. Students may use any materials to make the switch. A switch is necessary; it saves battery life. The smallest battery that can be used is a "AA." Any battery that has 1.5 voltage rating can be used, but nothing smaller than a "AA." Students may use as much foam as they wish, but it must be the foam trays that came with the supplies or similar product. If a classroom needs more, please contact us, and we will get you more. The foam needs to stay consistent due to different buoyancy ratings of the foam. Students may use as much of any supply on the list in creating their fan boat, but materials must be from the list. This insures the design of the fan boat is the most influential variable being competed against and not the materials.

The quickest and easiest way to build the fan boats is to use hot glue. There is the opportunity for a student to suffer a small burn, but if low temp guns are used the danger is minimal. Students are allowed to use any design they wish, but there are a few things that need to be considered. The motor needs to be mounted, the radius height of the propeller, off the water. Consider gluing two craft sticks to the inside of the foam hull that run parallel to the length of the hull. This allows to strengthen the foam, but allows you to have an area to glue the motor and propeller supports to them and not the foam. When you glue to the foam, it will not come off with out ripping the foam apart. The glue usually pulls off the stick easily.

The following pages are to help develop the investigation and are not necessarily needed for the competition. The investigation is designed for three propellers, but for time we are only allowing students to compete with one of the propellers. All three propellers are include in the materials being supplied. Other propellers can be created out of tag board and glued to the motor shaft.

Any questions or concerns about constructing the air boat contact:
Bob Thomson (Sanborn Elementary)
(989) 358-5809
thomsonr@alpenaschools.com

Lesson Overview:

This investigation is a more focused guided inquiry lesson with one stated question to answer, but the underline success of that question lies in the engineering of the boat. So there really are two investigation questions. What is the best boat design and what propeller works best with your design? However you wish to proceed is up to you and what you think your students can use to their advantage to achieve success.

Materials:

1. Students materials are listed on the investigation sheet.
2. Stopwatch
3. Stream table or some type of rectangular tub to hold water.
4. Glue guns and glue sticks
5. Rulers and balance or scale that measures in grams.

Time Allocation (estimated)

Science 150 minutes
Math 60 minutes
ELA 60 minutes

Day 1: 30 minutes
Day 2 & 3 60 minutes
Day 4 60 minutes
Day 5 60 Lab Conclusion
(Time and days can be easily adjusted to fit schedules)

CCSS:

Math:

5.OA.2
5.NBT.2
5.NBT.7
5.MD.2.3,4,&5

In this investigation simple expressions for finding area and average speed will give student a practical application for using formulas. Along with formulas students will be using and applying decimals in many applications for the purpose of collecting data and using data to support or disclaim a hypothesis. This investigation is rich in math application for simple computations to representing and interpreting data through line plots and graphs.

Science:

P.FM.M.2,3,&5
S.IP.05.11 to 19

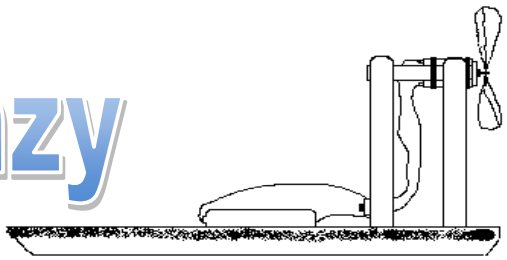
Science standards reflect current Michigan GLCEs for fifth grade. This investigation is meant to be the third in a series of four investigations with each lesson scaffolding toward open inquiry and more difficult engineer problems.

ELA: (Inquiry Analysis and Communication)

S.IA.05.11 to 15
W.5.2.A to E
W.5.7 & 8
W.5.10

The conclusion to this investigation allows for further practice in writing an essay using the question of the investigation as a focus and the student's hypothesis as the thesis. The students can use both the quantitative and qualitative observations to support their hypothesis or use the data to disprove it and use the essay to support a new theory.

Fanboat Frenzy



Lesson Guide:

Engaging: Background

Depending on the time you want to put into the investigation, background could take three to four thirty minute sessions. One session focused on forces and motion to introduce vocabulary, the second focused on review simple circuits, and scientific theory in designing the boat with contact and non-contact forces as the focus of the build. You could spend a fourth session on just the motor and how the non-contact force of magnetism is used to make the motor work. You will have to gauge your students background knowledge in order to get the full impact of the investigation. Use the build as a focus of engaging the students in order to build the fastest fan boat possible.

Exploring: Build and Design

The time on this phase is really student dependent. It may take students just an hour to design and build the boat to have it ready to test. Other students may not even have a chance of finishing it without design and building support. It just depends on the students crafting background. The best part of this is that the students that are usually at the lower end of the academic spectrum really have the opportunity to shine because they are most likely the best builders. It is always fun to watch the straight "A" student struggle and need the student, that is usually not successful at school, to help build the boat. During this phase no water is needed. It is just build the boat and make sure you can make the motor spin. If the student designs the boat light enough, it will actually move across the desk if the propeller is installed correctly.

Using the investigation sheet have the students use their background knowledge to come up with a defendable hypothesis. You want the students to put some thought behind their design and to know why they built the fan boat the way they did. Once students have a defendable hypothesis, then I let them build. Once built, they will need to run the first time test on it and record wait and average speed.

Explain: What next

Sit the students down and discuss initial design success and what changes could be made to make it better. This is the point where you find out if it really works. Again, you can follow the investigation lab sheet or you can wing it. You will find success either way with this investigation. Loads of data can be collected at this point. It is all about what you want your student to come away with from this investigation. I have students test each propeller and design three times and average the speeds. We collect averages and compare it against the class. This really offers a great opportunity to discuss what worked and what didn't work.

Elaborate/Extension

After sitting down and reviewing the success and failures of the first design, ask the students, "How could you redesign it to make the fan boat go even faster?" Have students re-tool their hypotheses or stick with the original one and make changes.

Again have the student record change and take new data. The goal is that the more data that is collected the better the boat design should be, but fifth graders can start to get a little overboard and loose perspective of the investigation. So, it's not necessarily good data they are collecting. You will still need to guide them and continue reinforce how forces are playing a role in directing the design and that those forces such as gravity, friction, displacement, and the forces of motion are connected. You will have to keep a handle on the re-design and test otherwise this will be come nothing more than a street drag on water.

Evaluate: The Conclusion

After all data is collected. I have my student complete an essay that focuses back on their hypothesis and what worked and didn't work. They use the data to support or disprove their hypothesis. This includes both qualitative and quantitative observations.

Things you must know and know how to do in order to conduct this investigation:

1. You will have to be able to accurately calculate average speed (A.S. = D/T).
2. Basic circuit design with a switch to open and close the circuit.
3. You will need to know the difference between potential and kinetic energy.
4. You will need to know Newton's three Laws of Motion.

Notes:

1 Calculating average Speed

2 Design your circuit with the motor, switch, and battery labeled.

3 Contact Force-

Non-Contact Force-

Potential Energy-

Kinetic Energy-

4 Newton's Three Laws of Motion

1.

2.

3.

Field Assignment:
Fan Boat Investigation

Name:
Date:
Language Arts/Science/
Math

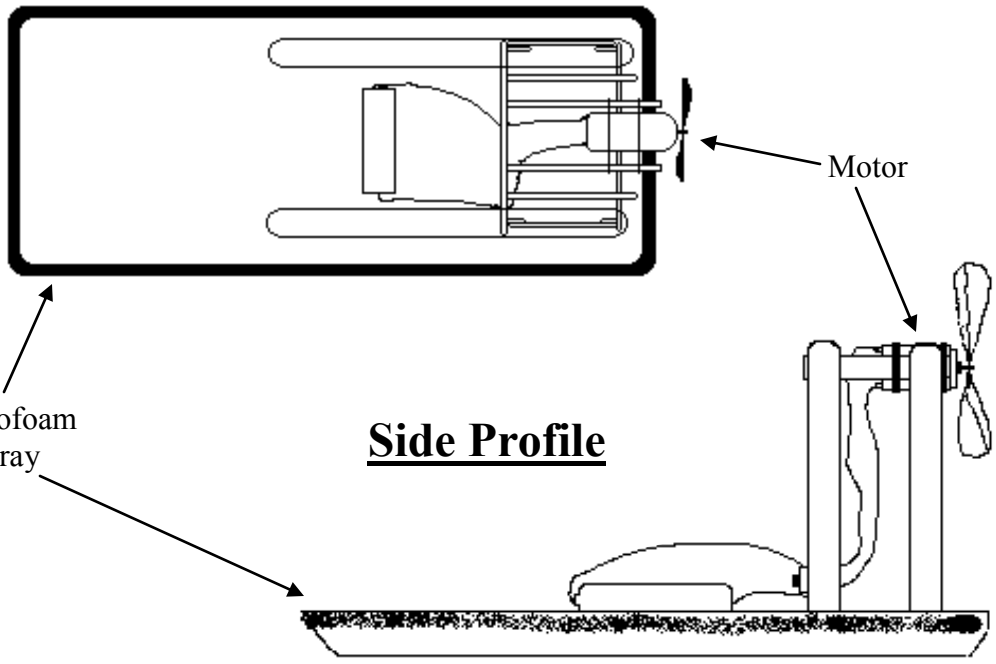
Materials:
Hot Glue
Masking Tape
Scissors
Basic Hull
Tag board
Paper
Craft Sticks
Paper Clips
Wire
Rubber Bands
Plastic Propellers

Questions:

- What size propeller would effectively push or pull the air boat down the river the fastest?

Before you develop a hypothesis, it would help if we created an fan boat and designed a way for the fan boat to propel itself over the water. Two things to consider when creating the fan boat is how much friction you will have between the water and the hull of the fan boat and the size of the propeller.

Top View



Name:
Date:
Language Arts/Science/
Math
Lab Sheet

Forming a Hypothesis:

What do we know already? (problem solving strategies)

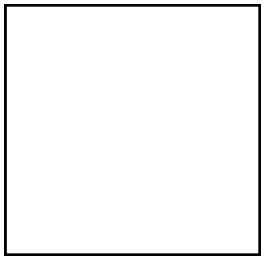
The materials you will want to use:

_____

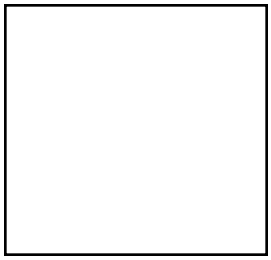
_____

Possible Fan Boat Design to support you Hypotheses:

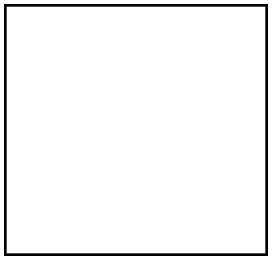
Size of propeller you will use to test in you investigation: (Draw a diagram of your propeller with dimensions, length and width of paddle)



Propeller #1 Length:_____



Propeller#2 Length :_____



Propeller #3 Length:_____

Hypotheses: (Your hypotheses should contain information on your choice for propeller size.) example: I think the medium sized propeller that measures four centimeters will propel my fan boat with the greatest average speed.

_____

_____

_____

_____

_____

_____

_____

Racing Conditions:

1. Must travel the whole length of the track (stream table).
2. You can not touch the boat after the timer is set.
3. Nothing else can be used except for what is on the material list.

Data Table:

Attempt #1

Notes:

_____
_____
_____
_____
_____
Average Speed:_____

Sketch boat and propeller measurement (cm):

Time: _____ Distance Traveled:_____

Attempt #2

Notes:

_____
_____
_____
_____
_____
Average Speed: _____

Sketch boat and :propeller measurement (cm)

Time: _____ Distance Traveled: _____

Attempt #3

Notes:

_____
_____
_____
_____
_____
Average Speed: _____

Sketch boat and :propeller measurement (cm)

Time: _____ Distance Traveled: _____

Classroom Quantitative Data Review

Student	Overall Weight	Propeller Size	Hull Area	Average Speed