



Teacher's Guide for: **Sunken Rafts**

Note: All activities in this document should be performed with adult supervision. Likewise, common sense and care are essential to the conduct of any and all activities, whether described in this document or otherwise. Parents or guardians should supervise children. Rock-it Science assumes no responsibility for any injuries or damages arising from any activities.

NOTE: This is the transcript of a lesson that was videotaped during an actual Rock-it Science class with real students, not actors. The students' brainstorming comments are included on the video but are not transcribed here because they're not part of the lesson presentation.

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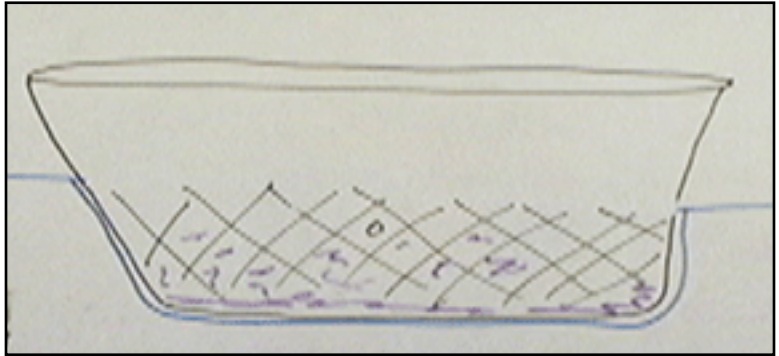
Sunken Rafts
A Rock-it Science Lesson
Filmed May, 2012

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Intro Quick Recap:

- Some boats are made from wood, some from steel. Why can a steel ship float?
- You have water, and here's a hole in the water in the shape of a boat. All the water is gone from that hole.
- Then put a steel shape in the hole, and that's the ship.
- The whole area that used to be water is now air. The air produces buoyancy to hold up the big steel ship.
- If you put a hole in the ship so the water flows in and replaces the air with water, the ship will sink.
- It's tricky to figure out how to make a boat that floats at just the right level. You have to calculate how much the boat will weigh and how big a hole it will make in the water.
- Today we're going to make a boat that will float, and then we're going to sink it on purpose, to see how much weight it takes to sink it.



Experiment Quick Recap: "Sunken Rafts"

- Instructor demonstrates how to build a boat out of aluminum foil and test it in the water.
- She uses one square of aluminum foil and some masking tape.
- Instructor molds the foil around her hand to make a canoe-shaped boat and uses a strip of masking tape to hold the sides up.
- She places the boat in the wading pool and slowly fills it with gravel to see how much it will hold before it sinks.
- Once the boat sinks, the Instructor carefully picks it up to avoid spilling the gravel, empties out the excess water, and places the boat on a scale to weigh the gravel.
- Then she dumps the gravel into a bucket and crumples up the foil and tosses it into another container.
- On a whiteboard she writes her initials, the weight of the gravel her boat held, and the shape of her boat.
- Then the students make and test their own boats. For each boat, they can only use one sheet of aluminum foil and as much masking tape as they need. They can make the boat any shape.
- Students can use containers such as pie pans or plastic tubs to help mold their boat shapes, or they can just mold them freehand.
- After they test their boat and record the results, they build another boat. They can build and test as many boats as time allows.
- At the end of the experiment, the Instructor tells the students to wad up a sheet of foil as tightly as they can and throw it into the water to see if it will sink.



Equipment List: "Sunken Rafts"

Items needed for Instructor:

- Wading pool, about 6' diameter
- Scale
- Whiteboard & marker
- Gravel, pea size
- Plastic containers for gravel, shallow
- Buckets, plastic, 5-gal, 2 ea.
- Garden hose

Items needed for Students:

- Aluminum foil sheets, about 12" square
(We used pre-cut sheets 12" x 10.75")
- Tape, masking, 1/2"

Prep Work:

- Inflate wading pool, fill with water
- Set up scale and whiteboard



Aluminum foil sheets, 12" x 10.75"



Wading pool and plastic containers.

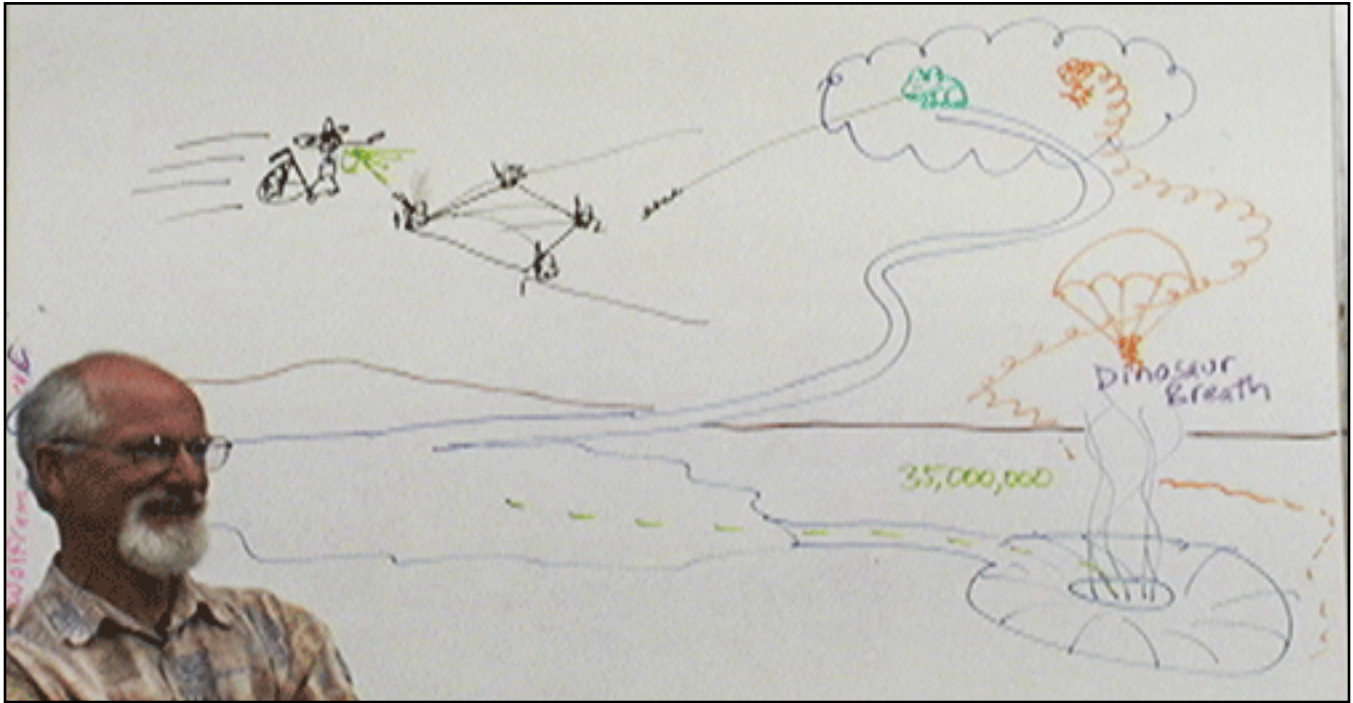


Scale



Gravel in plastic container.

Story Recap: "The Baseball-Eating Frogs"

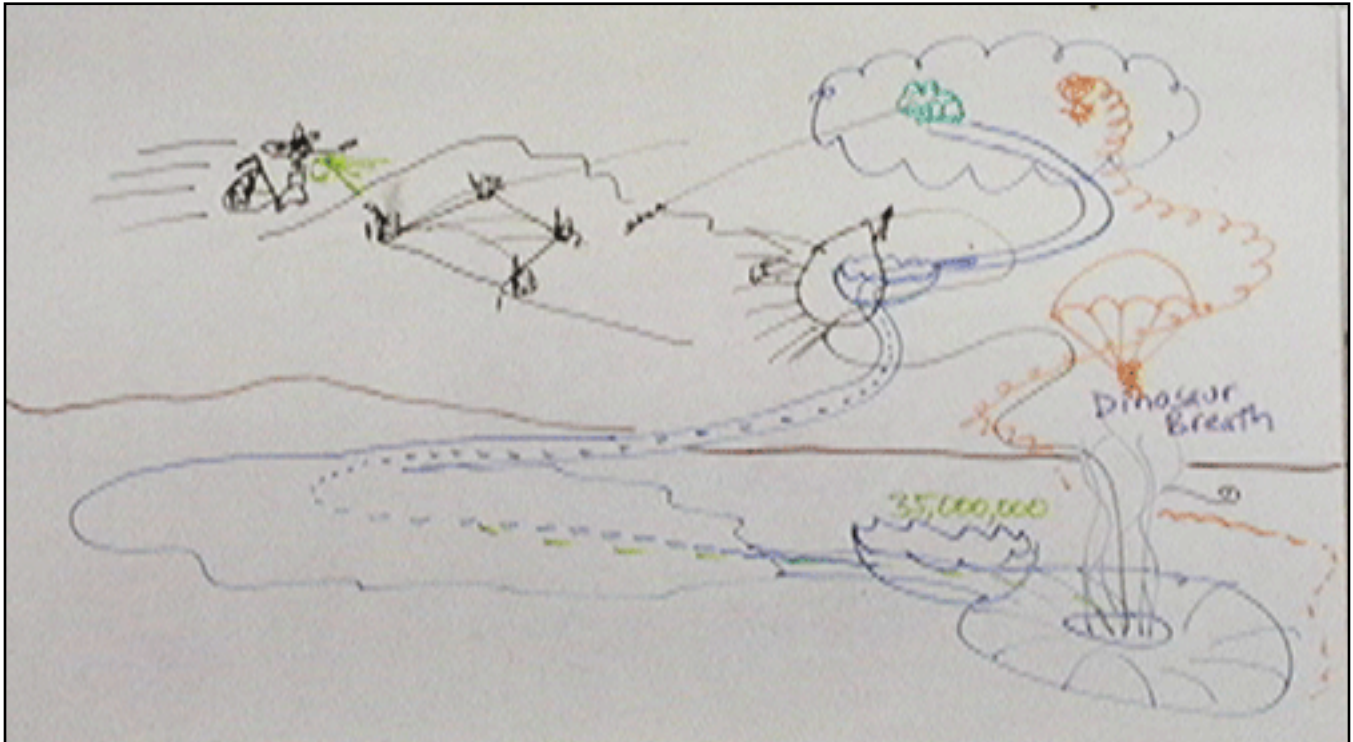


Part 1:

- There was a cloud with a river flowing out of it that came down to the ground, formed a lake, then flowed out the other side and went down a deep hole to the center of the earth.
- There are fire-breathing dinosaurs down there. That's what makes the earth warm.
- Jack and Jill wanted to investigate the cloud, so they made a parachute. They threw it over the opening in the earth, and the hot dinosaur breath made it rise up to the cloud.
- There were frog people living on the cloud. They ate flies, but only the kind that came from baseball games.
- There were floating baseball diamonds where Evil Mister Fred's minions played baseball with their baseball bats. They had no rules. They just hit lots of balls all over the place.
- The frogs would stick out their long sticky tongues and grab the baseballs out of the air, and sometimes they would grab the minion and swallow it, too.
- Evil Mister Fred didn't like that, so he hovered around on his flying vacuum cleaner to try to keep the frogs from eating his minions.
- He ordered frog repellent from the Acme Store of Everything and sprayed it on the minions and baseballs. When the frogs tasted it, they hated it. It tasted so bad, they couldn't stand to eat any of the food in their cloud. They started to starve.
- Jack and Jill ordered some food for the frogs from the Acme Store of Everything. The Store said Jack and Jill would have to pick up the food from the core of the earth and fly it back up to the cloud in some kind of boat.

Story Recap (cont.): "The Baseball-Eating Frogs"

- Jack and Jill swam down the river, across the lake, and down into the hole. The dinosaurs had the frog food there, which was thirty-five million cheeseburgers. They said Jack and Jill had to take all of them.
- Jack and Jill had to find a way to carry all those cheeseburgers and float them up to the cloud. All they could find underground was aluminum foil.



Ending:

- Jack and Jill used aluminum foil to make a parachute, fastened all the cheeseburgers to it, and floated it up to the opening where the water was flowing in.
- Then they flipped the parachute upside down to make a boat, filled it with the cheeseburgers, and started swimming upstream, pulling the boat behind them.
- Before they reached the cloud, Evil Mister Fred saw them and flew over and started sucking up the cheeseburgers with his vacuum cleaner. There were a few minions inside the vacuum cleaner bag, and they didn't like this, because they like M&Ms, not cheeseburgers.
- The bag kept getting bigger and bigger until it burst. Cheeseburgers and minions went flying all over the place. Then the bag went zipping around like a balloon, right down into the hole to the core of the earth.
- They all heard a scream, then saw a piece of mustache float up out of the hole.

Transcript: Intro

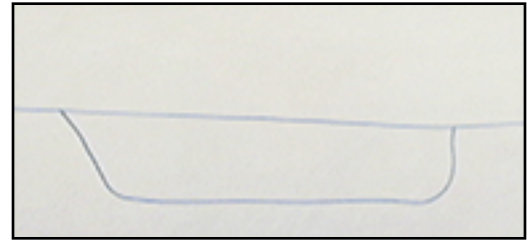
What do you know about boats? Some boats are made out of wood, some boats are made out of steel. If they're made out of steel, they're usually big and they call them ships. Does steel sink or float? Well, steel sinks. So how come a steel ship can float?

Well, if we take a look at it, let's put a bunch of water here. And here is a hole in the water in the shape of a boat. And all the water has gone out of that hole. And let's put a steel shape that fits in the hole, and we'll call that our ship. There.

And once you put a hollow steel thing in a hole, this whole area here that used to be water is now air. And as long as that's air, it's producing some buoyancy to hold up the big steel ship. If you put a hole in it and water flows inside, and it starts to fill up, replacing the air with water, then it'll sink.

Now, trying to make a boat so that it floats at just the right level isn't easy. You've got to calculate how much that entire boat is going to weigh just to see how far it'll go down into the water, how big a hole it makes. And once you've figured out how much it weighs and you've figured out how much of a hole it makes, you can find out whether it's going to float. And they make mistakes on this all the time.

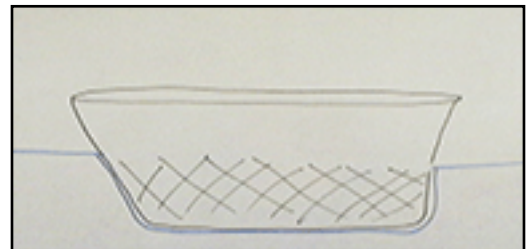
And today we're going to be trying to make some boats that'll float. But then we're going to sink them on purpose, just to see how much weight it takes to sink them. But first we need a crazy story.



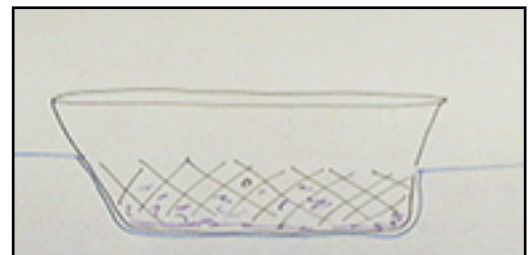
Hole in the water.



Steel shape in the hole.



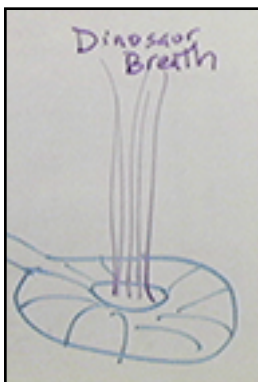
Air replaces the water.



If the air is replaced with water, the boat sinks.

Story: "The Baseball-Eating Frogs"

Once upon a time there was a cloud. It had a river flowing out of the cloud that came clear down to the ground. And the river came to a lake. And then it came out of the lake and went down a deep, deep hole, clear down to the center of the earth. This is the hole. Like that. Okay, and the water flows down into this hole in the ground, clear to the core of the earth, where there's a bunch of dinosaurs down there.



Dinosaur breath.

And the dinosaurs breathe fire.

Most people think that the core of the earth gets hot because of the uranium and the thorium creating radioactive heat that heats up the core of the earth, but not on this planet. On this one, the core is heated up by fire-breathing dinosaurs. And coming out of the center of the hole where the water goes down is dinosaur breath.

We need a horizon here. And Jack and Jill had heard about this cloud up in the sky. They wondered what it was, but how to get up there? So in investigating, they discovered the dinosaur breath

flowing out of the ground. So they made a parachute, and all they had to do was throw the parachute over the opening, and then the hot air would help them rise up to the cloud.

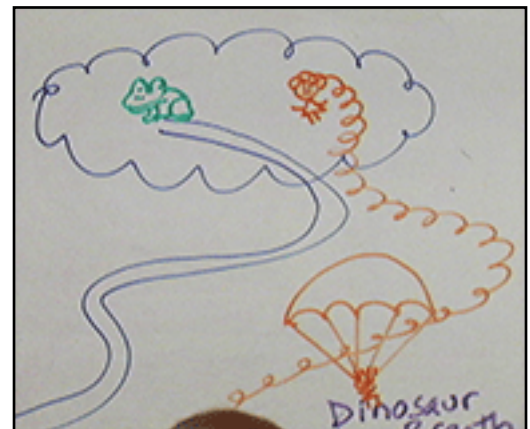
And once they got there, they found a whole bunch of people living on the cloud. Well, we've got frog people up there living on the cloud. These frogs eat flies, but the flies have to come from baseball games. And luckily, on this particular planet there are baseball diamonds that fly through the air. Here's home plate, here's first base, second base, third base. Here's the outfield.

These are the minion baseball players, because they always have baseball bats. And in minion baseball there are no rules. And there's more than one baseball in a minion baseball game. In fact, there's hundreds of them. And they're all busy throwing the baseballs around and hitting them back and forth.

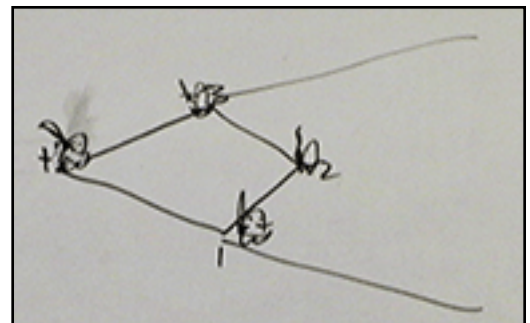
And when the froggy guys come by and the baseballs are all flying, they have these really long tongues. They go zzzhhhhht! And they unroll, and they're all sticky, and they catch the baseballs. And they sometimes accidentally grab the entire minion and eat him. And



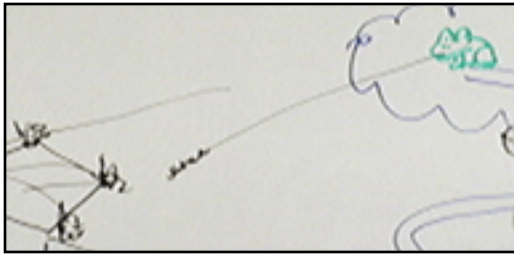
Cloud with river, lake and hole in earth.



Parachute and frog.



Minions playing baseball.



Frog's long sticky tongue.



Evil Mister Fred sprays frog repellent.

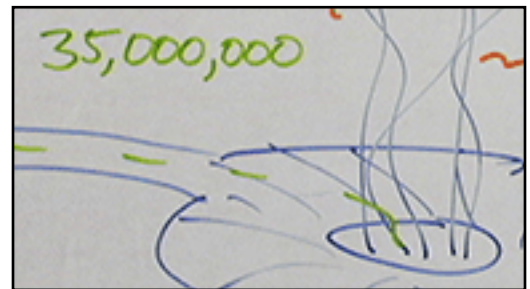
Evil Mister Fred doesn't like it when the frogs eat the minions. So he hangs around on his vacuum cleaner to try to prevent the frogs from eating his minions and their baseballs.

When Evil Mister Fred discovered that it was these frogs that were eating the baseballs and the minions, he decided to do something about it. And he said, "From now on, I'm going to put frog repellent on my minions." So he called the Acme Store of Everything and ordered a can of frog repellent spray. And he sprayed it on the baseballs and on the minions. And the first time a frog grabbed one of the baseballs and it touched his tongue, he went, "Aaaaaaahhhh-ptooey!" and spit it out because he didn't like the flavor of it.

And the frogs said, "Oh, that's a horrible flavor -- ooohhhh!" And nothing that was up there in their cloud could they eat after that. And they started to starve. And Jack and Jill said, "Oh, we've got to save these frogs. We can't have them starve

like that." And they said, "Frogs, we've got to find something for you to eat." And so Jack and Jill called the Acme Store of Everything and they ordered some food for the frogs to eat. And the Acme Store of Everything said, "Well, we have a lot of that, but in order to get it, you have to go down to the core of the earth to pick it up and then fly it back up to the cloud." And Jack and Jill said, "Cool. We can do that. We'll just jump in the river, swim across the lake, and down we'll go to the core." And they said, "Yeah, but you have to bring it back up on a boat of some sort."

So Jack and Jill said, "Fine." They dove into the river, into the lake, swam across the lake, all the way down to where the dinosaurs were. And they found the super-duper frog food. And the dinosaurs said, "Well, we've got lots of frog food here for you, but you can't take just a little of it. You have to take all of it." The frog food happened to be cheeseburgers, by the way. "There happens to be thirty-five million cheeseburgers. And you have to take them all."



Jack and Jill thought, "Well, how are we going to carry thirty-five million cheeseburgers and float them?" And they looked all around, and the only thing they could find down there was aluminum foil. What are you going to do? *[Student: Make a boat out of aluminum foil.]* Yeah.

Imagination and Brainstorming Time

[Students make suggestions] (THERE ARE NO WRONG ANSWERS! Whatever they say, you should reply: "That's a good idea," "They might do that," etc. After brainstorming, proceed with the experiments, then finish the story.)

We'll leave this "To be Continued . . ."

Experiment: "Sunken Rafts"

[Note: What follows is just an example of one way to make a boat. Students can use their foil any way they like to make their boats.]

This piece of aluminum foil is all the aluminum foil you have to carry all your cheeseburgers up. That is it. So, what you do is you need to figure out how you want to make your own type of boat and make it. You have this sheet of aluminum foil, and you can use tape, and that's it.

So what I'm going to do is, I rip my aluminum foil in half. We'll use some tape straight across. *[Student: How many pieces of tape can you use?]* As much as you need.



1. Fold and tear foil sheet.



2. Tape it to make one long piece.

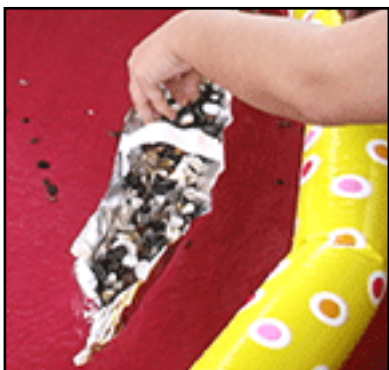


3. Mold foil around hand to make canoe shape.



4. Join ends of tape across center to hold up the sides.

Then using my arm I'm going to make *[molds ends of foil around hand]* . . . to make a canoe-like looking thing *[fastens tape across the width to hold the sides up]*. All right. And now I have my boat. And now I'm going to go outside.



Adding rocks to the boat.

[Instructor places the foil boat into a wading pool and picks up a handful of gravel.] I have in my hand the cheeseburgers. And I'm going to put as many cheeseburgers as I can on this boat, as evenly as possible, and see how many I can put on before it sinks.

[Student: Do we have to count them?] Yeah, you have to count every rock. *[Students: Awww!]* No, you're actually going to weigh them. Be hard to count them all. *[Instructor continues to add rocks to the boat until it sinks.]*



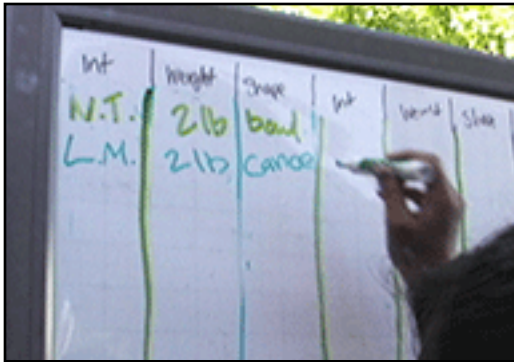
Sunken raft.

Now I'm going to take what I just sunk, pull it out, try to empty out most of the water, and then we walk over here to this scale. Put it on the scale. Weighs about two pounds. And then I'm going to take all the rocks and dump them *[in a bucket]*. Just the rocks. And then the aluminum you're going to crumple up and throw there.

Now, after you do that, you walk over here *[to whiteboard]*, write your initials, it weighs two pounds, and it was canoe-shaped. And then you go



Weighing the rocks.



Write initials, weight, and shape of boat.



Various containers may be used to mold the foil into different shapes.



Testing different shapes of boats.

back inside and try another one. You can make any shape you want.

[Each student gets a sheet of foil and starts making a boat. There are some items such as pie pans and small plastic tubs that they can mold their foil over if they want to. When they finish their boat, they take it outside, fill it gradually with rocks until it sinks, then weigh it and enter their info on the white-board. Then they go back inside and build another one. They can make and test as many boats as time allows.]

[As a demo, the Instructor makes a vertical tube-shaped boat to show how few rocks it takes to sink it.] And that is why they don't make boats tall and skinny.

In your last minute, take a piece of aluminum and try to wad it up so tight it will sink. *[Students toss their wads of foil into the pool.] [Student: It floats!]* It floats. In fact, it floats really well. More than half of it's out of the water. It's hard to make a sinky foil.



A tall narrow boat sinks quickly.

End of Story

**** DO NOT * present this part of the lesson until after the experiments!***

So Jack and Jill had to journey down to the core of the earth to get thirty-five million cheeseburgers. And dinosaur breath doesn't smell all that good, by the way. There were thirty-five million cheeseburgers stacked up, all ready to go. And a bunch of rolls of aluminum foil. So Jack and Jill made an aluminum foil parachute first, and they fastened all thirty-five million cheeseburgers to the parachute, which got them right up to the opening where the water was falling in. And then they had to flip the parachute upside down and fill it full of cheeseburgers and then swim upstream, pulling it with them. And then they had to swim across the lake and up into the sky.

And Evil Mister Fred saw them. And he said, "Noooo! Cheeseburgers! The only thing that those frogs can eat after I sprayed them. We've got to stop them!" And Evil Mister Fred was on his flying vacuum cleaner, and he zoomed down to try to stop Jack and Jill. Oh, dear.

And he was sucking up the cheeseburgers with his vacuum cleaner. And there were a few minions inside. And they didn't like all those cheeseburgers because they eat M&Ms, not cheeseburgers. And the bag kept getting bigger and bigger and bigger until Evil Mister Fred's vacuum cleaner looked about this big, and the bag was about that big.

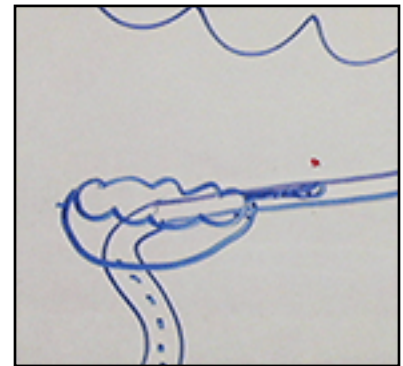


Vacuum cleaner bag explodes.

And then the bag burst. Cheeseburgers shooting out all over the place, and minions flying out. But the thrust of the breaking bag was like a balloon, and Evil Mister Fred went bbbbbbrrrrrrmmmmmm, down to the dinosaur hole. And they heard a scream, and a little bit of mustache came floating out of the hole. And they all lived happily every after, except Evil Mister Fred.



Parachute flipped over on river.



Evil Mister Fred saw the boat before it got to the cloud.

End of Lesson

If you have questions about this lesson, please ask them through the online [Teacher Support Forum](#) on our web site.