Going Up?

The Wild Blue Yonder

"You can never tell where the winds will blow you, what fantastic good fortune they can lead you to. Long Live Balloons!"

Design your balloon!

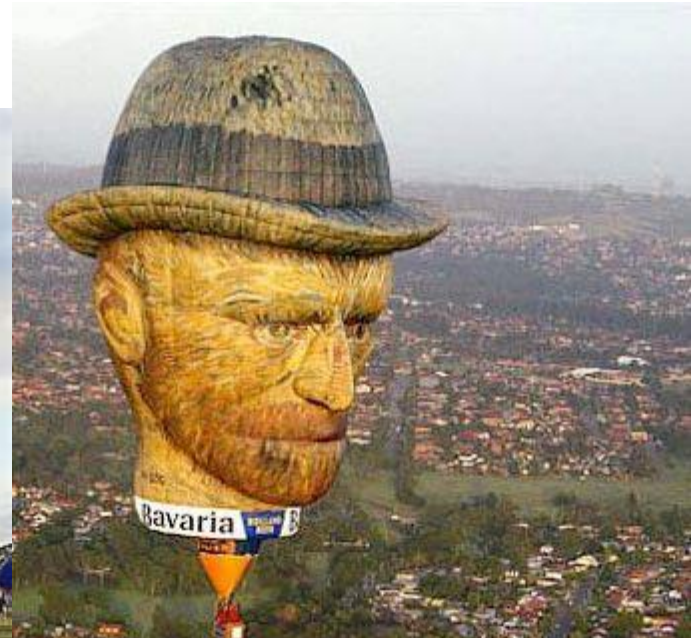
Inspire students with a video showing a plethora of designs from rockets to elephants, monster trucks, and even the Old Lady Who Lived in a Shoe, such as this…http://vimeo.com/4399471

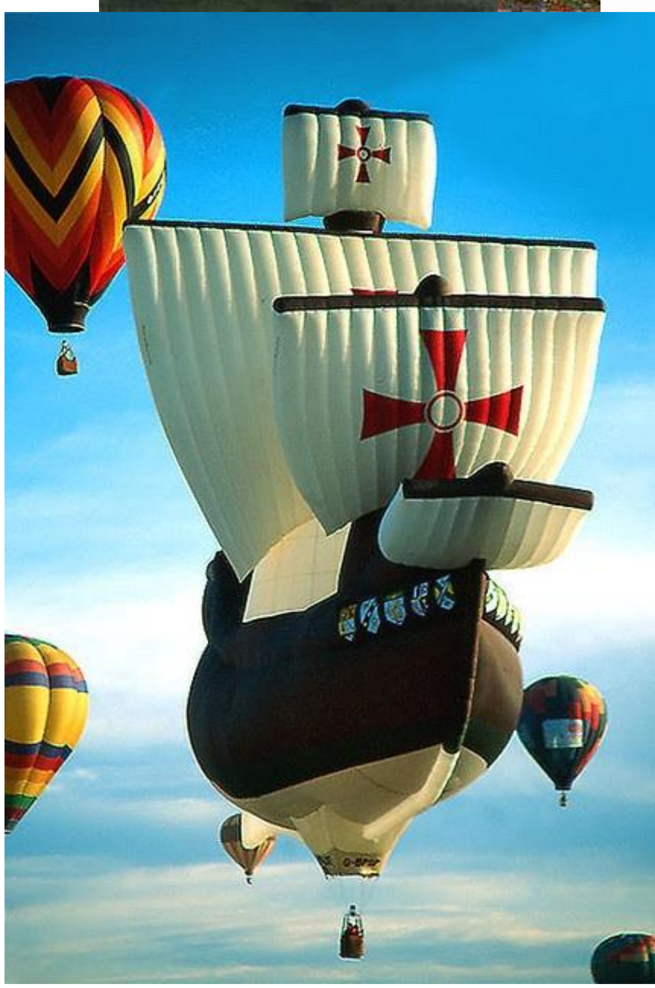
If we're setting off like Professor Sherman, we need our own hot air balloons! A hot air balloon is an incredibly personal representation of style, personality, image, performance and more. Deciding what your own balloon should become can involve limitless design possibilities - it can be as simple or complex as desired. Not sure where to start? Not surprising! But that's all right, it all begins with the balloon.

Image Credit: Dave Pimentel Find this image and more of his amazing art at http://drawingsfromamexican.blogspot.com/2010/07/hot-air.html All

Choosing the Shape

To begin with, what is the preferred envelope style that you might want? Most hot air balloons are designed using a shape which minimizes the stress on the fabric.

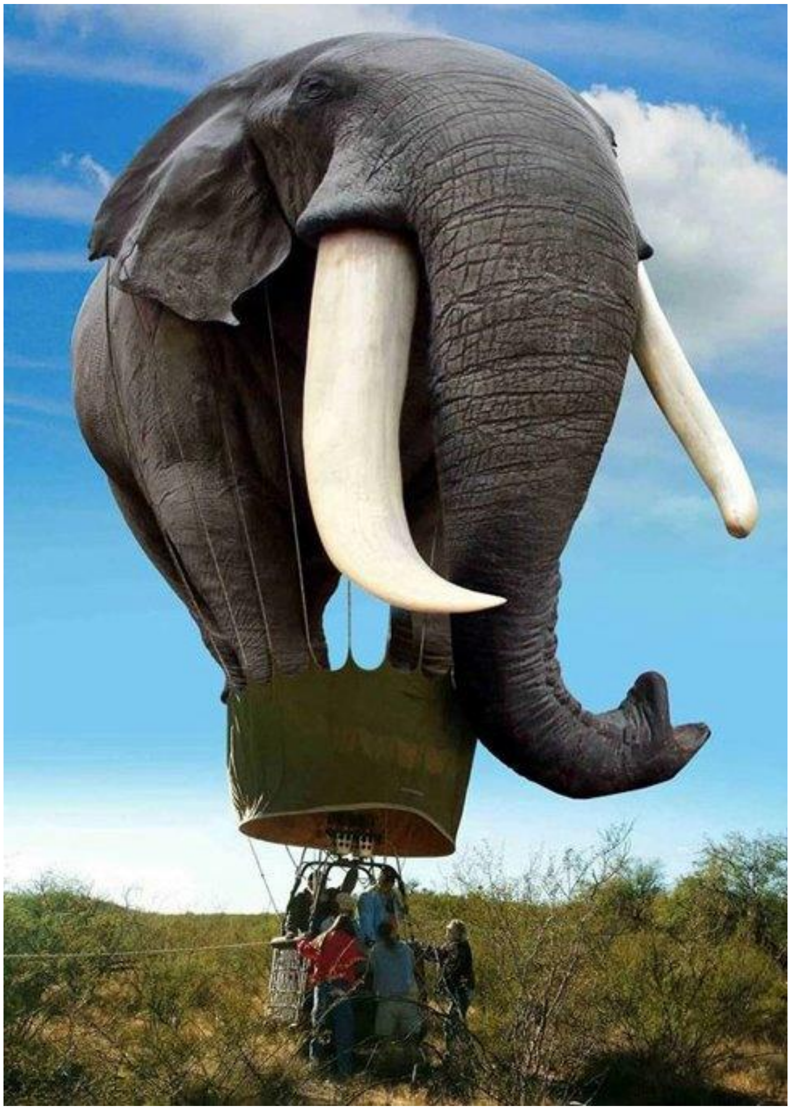




In the early days of upper atmosphere research using helium balloons it was common for the balloons to burst when they neared their intended float altitude. These failures were traced to the shape of the balloons loading the thin material until it ruptured. The US military commissioned a company called General Mills to devise a shape which minimized the fabric stress.

A design that is similar in appearance to one of the mainstream manufacturers' models might serve as a reasonable starting point - but students should feel free to customize to their heart's extent- even if it's very unique, a little oddball, or even close to full-blown crazy. Check out the 3-gore design in the chart, or these pictures of real-life balloons!

You should consider the number of gores you'd probably like (8, 12, 16, 18 & 24 are common numbers of gores), the shape of the gore (bulbous, semi-smooth, or flat to any degree), and the orientation of the different panels comprising each gore (horizontal, vertical or diagonal). Quickly draft a 3D rendering of what the balloon will look like based on your design preferences. Tip: **For help with how to draw a basic hot air balloon go to and watch: http://www.drawingnow.com/tutorials/view/how-to-draw-a-hot-air-balloon/**



12-gore Half-Gore construction

16-gore Flat Panel construction

20-gore Half-Gore construction

3-gore Extremely Bulbous!

8-gore Bulbous

16-gore Semi-Bulbous

24-gore Semi-Bulbous

18-gore Zig-Zag Bulbous

18-gore Zig-Zag Spiral Bulbous

Rising High! Choosing Your Colors

Art and design influence so much of the world around us, and such creativity can lead to a career.

Before that balloon was born, an artist had to make all those decisions about what it looked like.

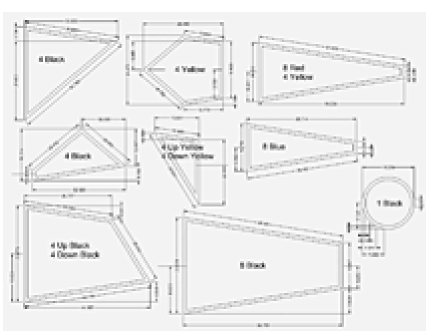
Any type of artwork or logos can be integrated into the design of your envelope, whether inlaid or overlaid (appliqué). Inlaid cuts of any angle, curvature or complexity can be added to change fabric colors within any panel at any location in the envelope.

Painting directly on the fabric is sometimes useful for smaller accents, and is a technique often used to add detail to special shapes

Each student must create three separate balloon designs and complete one original drawing of their final balloon concept, using Sharpies, colored pencils, crayons, and/or colored markers; and an autobiographical worksheet

Discuss with students the difference between coloring a balloon and designing one. Have them use symbolism and imagery to tell something important about themselves, "There are a trillion things that make you you!" Be quick to praise a storytelling burst of creativity, and just as quick to have students push their ideas further, and not be satisfied with just a pretty color scheme.

Show students examples of color scheme swatches from books or cards.



The developed pattern dimensions for an inlaid parachute design

Sewing the center panel of the parachute

...And the finished product!

Envelope Sizing & Intended Use

How big was the Professor's balloon? Why did he choose that size? (p. 40 in the novel).

The most important consideration - apart from what your balloon will look like - is what you plan to do with it. It makes no sense to decide on a 56,000 cubic foot envelope and then later realize you wished you could be able to fly pilot plus two heavy passengers at all times of the year and temperature ranges. In the warmer months, that objective would be difficult to accomplish in a balloon that small without overheating.

Have students put thought into at least the following considerations:

- **What is the maximum number of passengers I plan to carry at all times in addition to the pilot?** Consider 200-225 pounds per occupant a reasonable average, which includes clothing and the normal personal cargo.
- **What temperature extremes will be expected in the typical area of operations?** Of most importance is the maximum average temperature in the summer.
- **How high would I normally want to fly with a full payload?**
- **How long do I hope to be able to fly for with a full payload?** Simply adding more fuel tanks is not necessarily as beneficial to your flight duration as increased envelope size can be. A larger envelope flying at cooler temperatures will use less fuel than a smaller envelope with the same payload or weight.
- **How heavy will my envelope and basket be?** The type of fabric and materials chosen can have a significant impact on the system weight.

How long does a balloon last?

Depending on the care it is given, a balloon envelope may last 500 or more flying hours. Considering that most sport pilots fly from 35-50 hours a year, balloons can last a long time.

The envelope wears out before the basket and burners. With proper maintenance, a basket will last indefinitely.

Certainly, the larger an envelope is for a given payload (amount of weight), the cooler it will generally fly, the longer the flight duration will be, and the longer the fabric itself will last. It's always better to have a surplus of lift rather than risking overheating the envelope when it gets warm out. **Why?** An envelope flown at 225°F or less will tend to last longer than one flown constantly close to 250°F. 200-220°F is a good target range to stay within for the best combination of longevity and flight handling characteristics. Fuel economy increases at lower internal temperatures.

Temperature and flight altitude are the two most important factors in determining payload for any given envelope volume. In general, a good rule of thumb to follow is that **1000 cubic feet of hot air will create 16 pounds of lift**. In the real world, this figure will certainly differ due to ambient and envelope internal temperature as well as altitude above sea level, but it's a conservative rule of thumb to estimate the gross lift of any given envelope volume at average internal flying temperatures. This allows for a good margin of free lift available beyond the calculated gross weight, which may be important in situations where the balloon is flying hot, heavily loaded, and in situations where a rapid ascent may be required to clear obstacles.

Most balloon manufacturers calculate the gross weight of their balloon envelopes based on a figure of 16 pounds per 1000 cubic feet, but some have chosen to certificate their balloons at a higher gross weight using a figure of 20 pounds per 1000 cubic feet.

Here is a table of common envelope volumes for a given number of occupants:

Capacity	Volume	Gross Lift Range
Pilot Only	21-42,000	350-800 lbs.
2 People	42-65,000	650-1300 lbs.
3 People	65-77,000	1000-1500 lbs.
4 People	77-105,000	1200-2100 lbs.
4-6 People	105-120,000	1650-2400 lbs.
5-7 people	120-150,000	1900-3000 lbs.

Types of Fabric

The amount of fabric in a balloon is obviously dependent on the size of the balloon a typical four passenger balloon has over two thousand square yards of fabric.

Typical Balloon Pricing

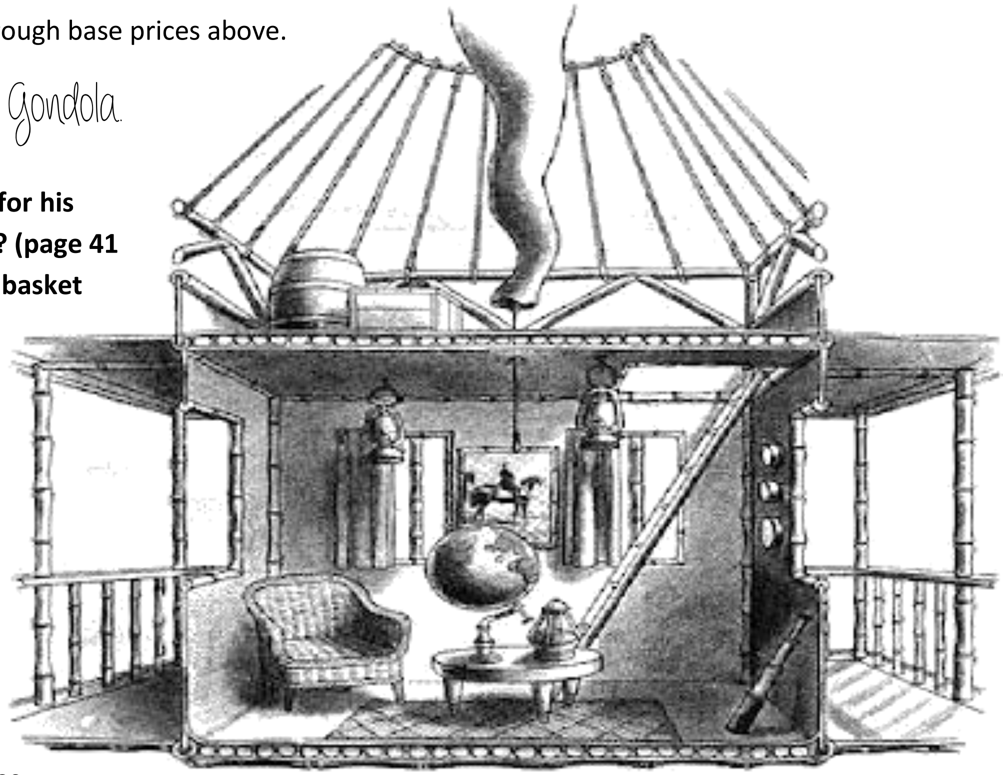
Like cars and boats, new balloons can vary in size and amenities. You can start with a smaller sport model for around $14,000. These balloons typically carry a pilot and maybe one additional person. The larger balloons that can carry two or ten passengers in addition to the pilot will range between $15,000 and $100,000. There are many good used balloons on the market that vary in price due to size, age and flight hours.

The price for a custom hot air balloon will vary considerably depending on the design of the envelope, the many options involved, and the materials chosen. Because of this, all custom-designed balloons are quoted on a singular basis whether fully-constructed, in kit form, or as a set of easy-to-follow construction plans.

The style of envelope design, number of gores, options such as turning vents, Nomex, skirt/scoop, inlaid or overlaid artwork, etc. factors greatly in the determination of the cost.

A rough estimate of a new envelope constructed of first-quality 1.3oz silicone coated ripstop nylon fabric would be in the ballpark of $9,000 complete. A 90 would be right around $10,000. For a precut "kit" build option, the price would be around $6,000, cut out and ready to sew with detailed construction plans included. Options such as fancier fabric or artwork would be extra and added "at cost" to the rough base prices above.

Design your Wicker Basket Gondola



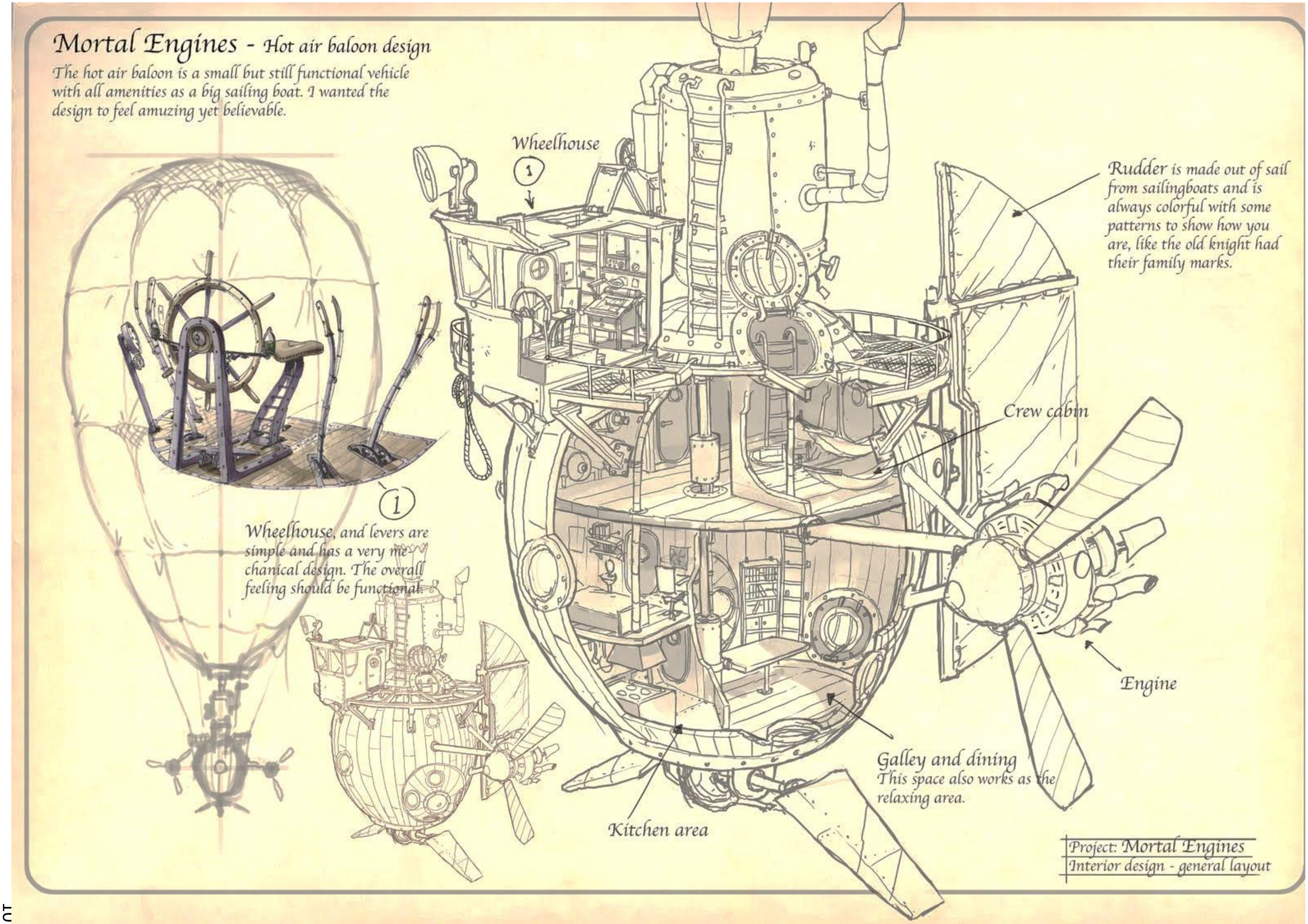
What was Professor's reasoning for his basket? Who was his inspiration? (page 41 in the novel) What ideas was his basket built with? Remember Professor Sherman had two floors, an open air attic for storage and a porch wrapping around his basket. **What was his basket made of? Why did he choose those materials? P. 41.**

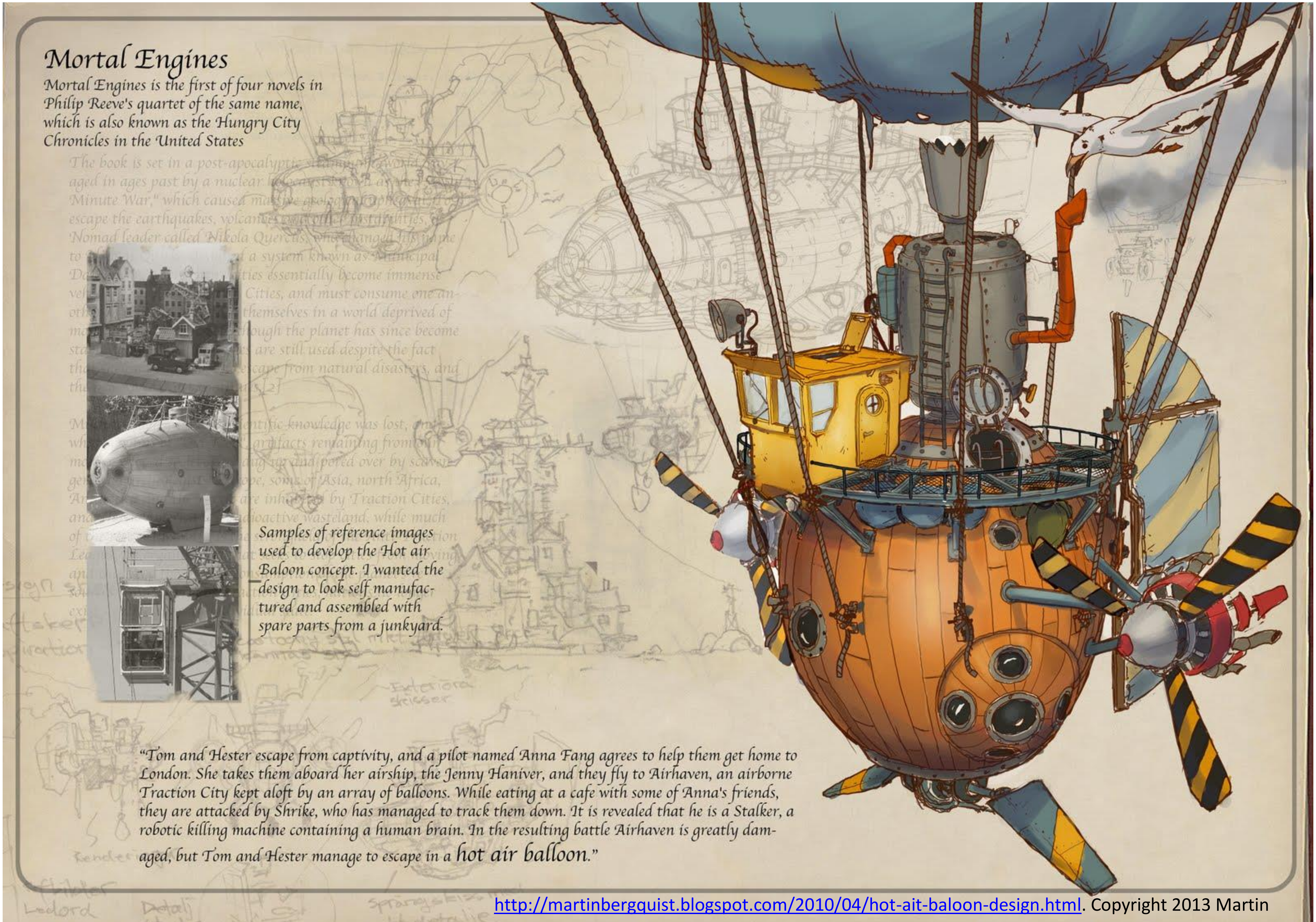
Students don't have to get this elaborate, though it is rather fun, but they need to make room for their passengers, supplies and equipment. Also keep in mind comfort, such as beds, chairs and entertainment. How will they handle laundry? Going to the bathroom? Taking a shower or a bath? (They could use wipes!)
What will the furniture be made out of? What did the professor make his out of? Why? P. 43-44 in the novel. Everything was chosen for the idea of…
Using graph paper provided by your instructor, create a front view of your gondola showing any rooms, stairs, furniture or other designs you decide to add. Now calculate the square footage of the walls, floor and ceiling (if any) of your basket.

This figure will be needed for later, so be sure have students calculate this accurately. They will need to record in their journal what balloon they have decided to use in your travel with an explanation of why they chose this balloon versus the other balloon options. Also include the drawing of their basket gondola with the square footage calculations.

What did the professor use for ballast? What will the students use for ballast? P. 43 in the novel

Samples of Artist Renderings of imaginary Hot Air Balloon Designs follow.


Mortal Engines - Hot air baloon design
The hot air baloon is a small but still functional vehicle with all amenities as a big sailing boat. I wanted the design to feel amuzing yet believable.
Wheelhouse
1
Wheelhouse, and levers are simple and has a very mechanical design. The overall feeling should be functional.
Rudder is made out of sail from sailingboats and is always colorful with some patterns to show how you are, like the old knight had their family marks.
Crew cabin
Engine
Galley and dining
This space also works as the relaxing area.
Kitchen area
Project: Mortal Engines
Interior design - general layout


Mortal Engines
Mortal Engines is the first of four novels in Philip Reeve's quartet of the same name, which is also known as the Hungry City Chronicles in the United States
Samples of reference images used to develop the Hot air Baloon concept. I wanted the design to look self manufactured and assembled with spare parts from a junkyard.
"Tom and Hester escape from captivity, and a pilot named Anna Fang agrees to help them get home to London. She takes them aboard her airship, the Jenny Haniver, and they fly to Airhaven, an airborne Traction City kept aloft by an array of balloons. While eating at a cafe with some of Anna's friends, they are attacked by Shrike, who has managed to track them down. It is revealed that he is a Stalker, a robotic killing machine containing a human brain. In the resulting battle Airhaven is greatly damaged, but Tom and Hester manage to escape in a hot air balloon."

Way Above Water Basket Weaving

Tutorial found at: Craft Passion
http://www.craftpassion.com/2011/05/easy-basket-weaving.html?pid=554#picgallery

Have students become apprentice basket weavers before they leave for Krakatoa! Before we can be trusted to construct large wicker baskets for hot air balloons we must make miniature baskets and become seasoned weavers! We may need those skills later to escape the volcanic island!

This is a wonderful technique to make basket. With this method and concept, basically students can build any shape and size basket that they want. Here, it is shown in three shapes: triangle, round and square, but you can create a rectangle, pentagon, hexagon, heptagon & even octagon with just a little tweak in the design. The height can be modified to suit their preference. One thing they have to take note is that the sum of the “fingers” on the frame must be in odd number. Have students take a closer look at the template, especially the square basket, they should notice that one of the sides has 1 extra “finger” than the other 3 sides.

To make faux wicker baskets, like hot air balloon baskets, use jute twine and they come out very sturdy and rigid!

Note: Students can use any material to weave the frame of the basket, as long as they are “weave-able”, not too bulky and in long soft strips, eg: twine, yarn, fabric strip, ribbon, rope, glossy paper strip, plastic, raffia etc…

Material:
1. Thick Cardboard or paperboard, non-corrugated (around 1/6” thick).
2. Felt for bottom and base (optional)
3. Weaving material, example: twine

Tools:
1. Sharp scissors (able to cut thick cardboard)
2. Hole puncher
3. Tapestry needle (#13)
4. Clothes pin
5. Craft / Tacky Glue
6. Pen or pencil
7. Ruler

Download the basket weaving template (templates for a triangle, round and square) in pdf format or use the following page. *Print it and enlarge 200% to get the size in the example.*
Have students trace their chosen design on thick cardboard.

After tracing the template on the thick cardboard, use a pair of strong and sharp scissors to cut the template out.

Punch the holes with a paper hole-puncher.

Trace base on felt (if desired), cut 2 pieces.

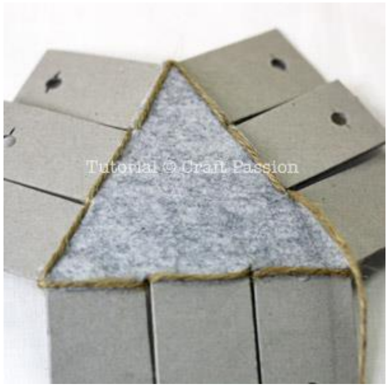
Get the rest of the tools & materials ready.

Option: Brush a layer of tacky glue on the bottom of the basket, press & stick the felt onto it. Repeat the same to adhere the felt to the base. Snip the edge of the felt follows the grooves between the fingers.

1. Being to weave over and under around the fingers of the frame.

2. Push the twine into the grooves of the felt that you have just snipped.
3. Keep on weaving over and under the fingers until the end of first round.

4. When begin the second round, you will notice that you are weaving in the reverse side of the first round. Both sides should be fully wrapped after you finish the second round.



5. Continue weaving and push the twine down to make them closer to each other. This will avoid gaps in between and will also hide the cardboard away. As you go higher, the frame will stand up vertically and form the side of the basket.

6. Continue until you just over the level of the holes. Allow a long length of twine for rim stitching later.

7. Put on clothes pin and allow some room for rim making.

8. To make the rim, insert another type of twine (ex. white cotton twine) through the space between the clothes pin by using a tapestry needle. Since the length is quite long, divide the twine in half and work both ends from middle.

9. Keep going round by round. Be careful on the corners and arrange them neatly.

10. Lay the twine until it fully covers the top portion of the basket.

11. Secure the rim by stitching the original twine through the holes.

12. Stitch again from the opposite direction to form crisscross pattern.

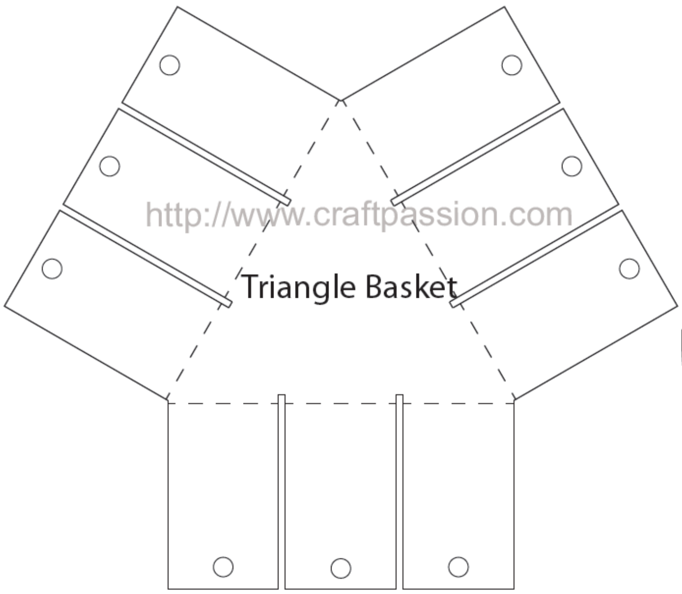
13. When reaching the corner, pierce through the gap and make another stitch there.

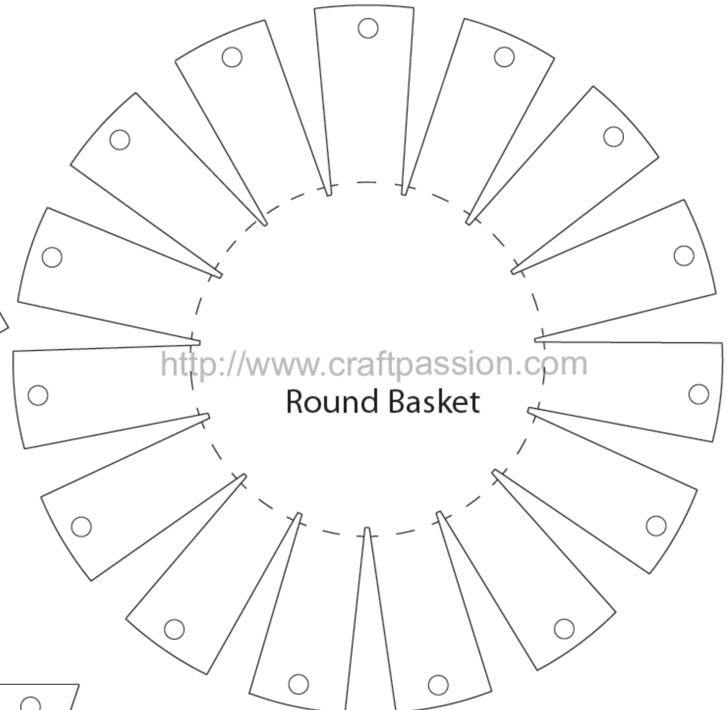
14. Hide all ends into the braid to neaten up the basket. The basket is ready to be used.

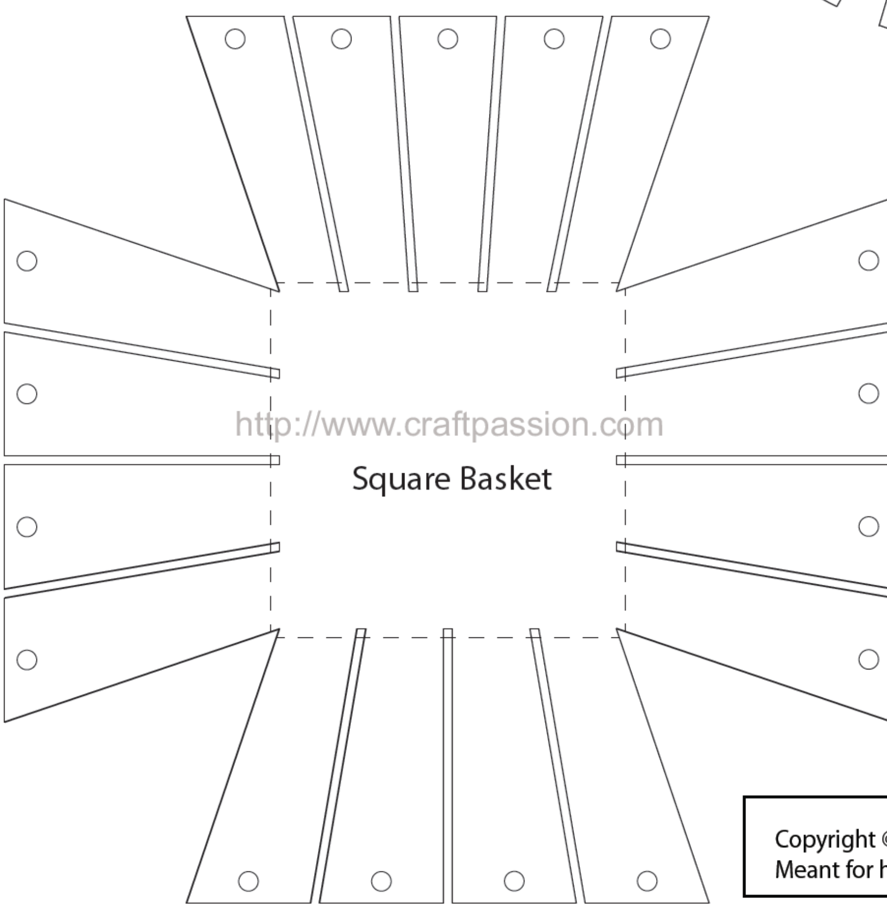
Easy Basket Weaving Template

[detail tutorial @ http://www.craftpassion.com/?p=11533]

Enlarge 200%







Up, Up, and Away?

When thinking about balloons, and the Krakatoan escape vessel with all those balloons, we might think of the Pixar animation movie UP! So, what if we wanted to use helium balloons to travel? Could we really do it?

What is the lifting power of helium? For the sake of time and a more detailed explanation, here's a simple data table that will give you an idea of what it would take to lift (only) a person using a helium balloon. We're assuming standard temperatures and pressures and no significant overpressure.

For reference purposes, you should know that a large tank of helium – the kind you find at a grocery store or party shop, holds approximately 250 cubic feet of helium. Based on the calculations below, you can see that 250 cubic feet will lift roughly 17 pounds.

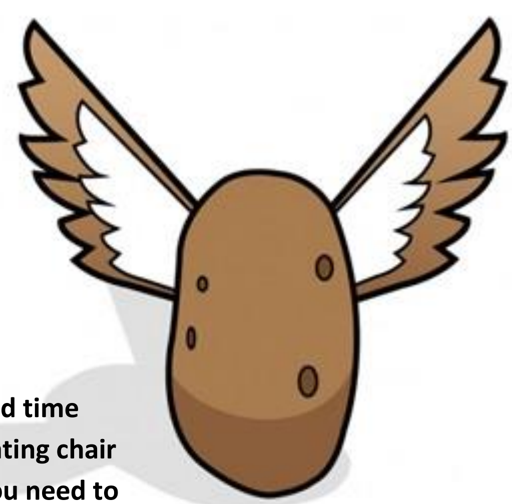
In Steve Spangler's test he found that 250 cubic feet lifted about 8 pounds of potatoes, plus the string and the weight of the 45 large balloons (2.3 pounds). All in total, they lifted just over 10 pounds.

Balloon Diameter (ft)	Volume Cubic Ft	Lifting Power Pounds
1	0.52	0.03
2	4.19	0.27
3	14.13	0.91
4	33.51	2.15
5	65.45	4.19
6	113.10	7.25
7	179.61	11.51
8	268.10	17.18
9	381.73	24.46
10	523.63	33.55
11	696.95	44.65
12	904.83	57.97
13	1150.42	73.71
14	1436.84	92.06
15	1767.25	113.23
16	2144.79	137.42
17	2572.60	164.83
18	3053.82	195.66

Why didn't they lift the calculated weight of 17 pounds? As you can imagine, we're working with lots of assumptions. The company supplying the helium told us that the larger cylinder holds about 250 cubic feet. Each red balloon held approximately 5 cubic feet of helium, and we were able to inflate just 45 balloons (that's 225 cubic feet of gas). To top everything off, we lost 5 of our balloons during the test (a few pops and 3 into the sky). These are the results based on an impromptu science experiment with a single tank of helium. **Do you get different results?**

Materials:

- Potatoes
- Bag
- String
- Helium
- Balloons
- Optional: Chair



Try It!

When the Professor got back to the United States, he had a hard time walking, what did the people do for him? They made him a floating chair using helium balloons. (p. 26-28) How many balloons would you need to make a chair (with the Professor sitting in it) float? What happened to the chair? (p. 30-31)

What about the little boy who tied the helium balloon around his waist in the story? What was the difference between his experience and his little brother's? (pages 21-22) Can students make a sack of potatoes float, first? And then estimate how many balloons it would take to lift the Professor? Have students Record and calculate the results of testing their hypotheses.

Going UP?

When 78-year-old retiree Carl Frederickson's house takes off into the air aided by the help of hundreds of helium balloons in Up!, viewers saw it is a heart-warming moment of pure fiction. But for some people, it became more than that.

So, the conceit of the Disney/Pixar cartoon epic, Up, is that an old guy's house gets attached to a bunch of helium balloons which lift it up out of the city and on a wonderful adventure.

That got Wired Science thinking: Could that actually work? And if so, how many balloons would you need? They called Wolfe House Movers, which specializes in moving old structures and had Kendal Siegrist, a manager, take a look at the images from the movie to see how much the house might weigh.

"A building like that, you'd figure right around 100,000 pounds," Siegrist said. Then they did some calculations. Air weighs about 0.078 pounds per cubic foot; helium weighs just 0.011 pounds per cubic foot. A helium balloon experiences a buoyant upward force that is equal to the air it displaces minus its own weight, or 0.067 pounds per cubic foot of helium balloon.

One more simple calculation — 100,000 pounds divided by 0.067 pounds per cubic foot — and you've got that it would take 1,492,537 cubic feet of helium to lift the house. Of course, you'd need some more balloons to keep getting it higher, but that's the minimum.

Now, let's assume you've got a bunch of spherical balloons three feet in diameter. They've got a volume in 14.1 cubic feet, so you'd need 105,854 of them filled with helium to lift the house. Eyeballing the cluster of balloons above the house in Up, let's say on average, it is 40 balloons across and deep and 70 balloons tall. Do the math and there could be 112,000 balloons in there.

Cluster Ballooning fans actually do this sort of thing, but with people in harnesses, not enormous houses, and they generally use a lot less balloons. They tend to use bigger balloons, say, six feet in diameter. You'd only need 13,208 of those.

But even if you could get the balloons and one very strong cable, could a house be pulled from the top like that? "If you go try picking it up, depending on what you're doing, you can," Siegrist said, "but for the most part, you want the house to bear the weight on its foundation." The way real, professional house movers like to do it is to get into the house's basement and lift from below.

And some engineers…went out and built it!

For the show "How Hard Can It Be?" on the National Geographic Channel, engineers constructed a basic house structure and lifted it into the air for more than an hour by 300 weather balloons.

It made headlines around the world a real-life UP! balloon house soaring more than 10,000 feet in the air. Now, see the full story behind this spectacular flight in How Hard Can It Be? Meet Vin, Paul and Eric, the three ultra-ambitious hosts who came up with the crazy idea to fly a balloon house. From concept to execution, we'll see how the guys mixed off-the-shelf technology and unconventional experiments to bring animation to life.

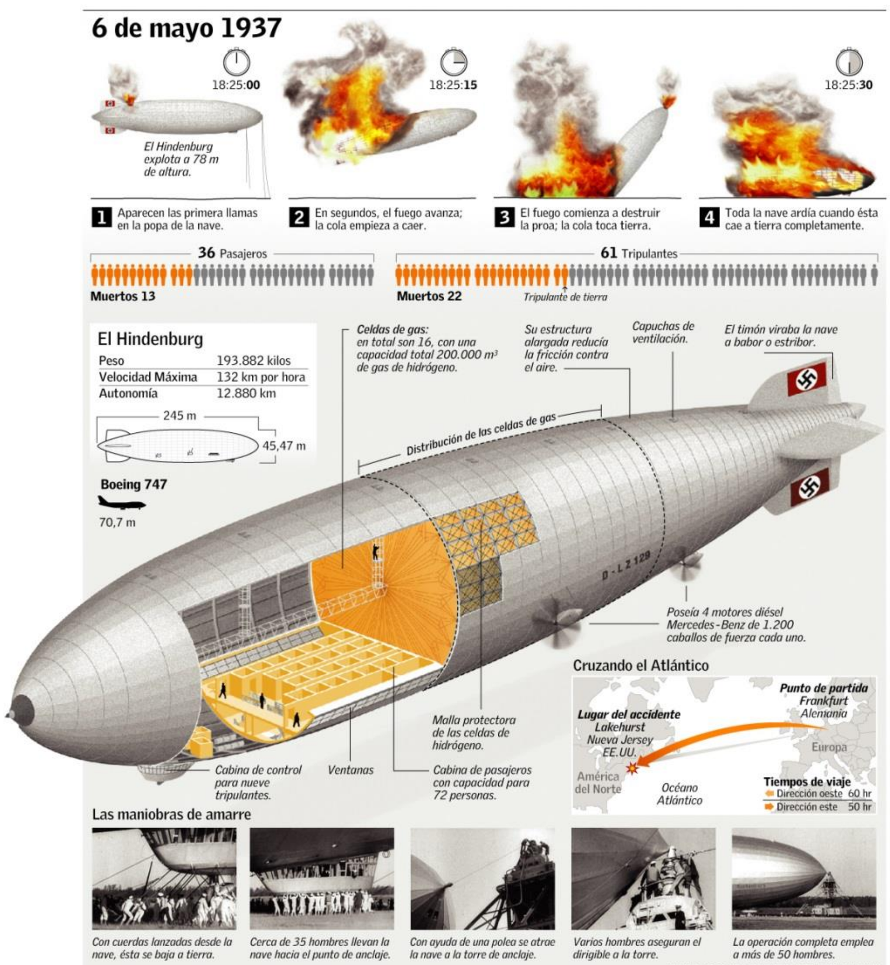
Watch it happen at : http://www.youtube.com/watch?v=rV6rNqin4P8 or at http://channel.nationalgeographic.com/channel/videos/a-house-in-flight/

Visit http://www.InsideTheMagic.net for pictures from the amazing recreation of the flying house from Disney/Pixar's "Up" animated film.

If you're wondering more about the science of helium… Helium is mined, or more exactly drilled for. In the Oklahoma and Texas panhandles are natural gas wells that contain up to 4% or more helium. This natural resource is **very** rare. The gas field must be encased in radioactive rock or no helium is produced. The alpha particle decay in the surrounding radioactive rock over millions and millions of years creates the helium. An alpha particle is just a helium nucleus. When it slows down and regains its two electrons, it becomes a helium molecule. Thus the radioactive rock makes helium, one molecule at a time, to accumulate in the same pocket as the natural gas.

In the 1930's Germany asked the USA many times for helium for its Zepplins (large passenger carrying blimps). The US was concerned that helium had other military uses and horded it as a strategic material. For this reason, the Hindenburg was still lofted with explosive hydrogen gas on its last disastrous flight, instead of being converted to helium as Germany had been trying to do for years. Helium is a natural byproduct of the liquefaction of the natural gas for pipeline shipment from these special gas fields. Helium liquefies at a much lower temperature than natural gas, close to absolute zero (4 degrees Kelvin). The volume left over after liquefaction is mostly helium ready to be stripped off and sold to the US Government Bureau of Mines. Few people seem concerned that this is a non-renewable and expendable natural resource, tied to very few gas wells in the world.

According to the National Public Radio (NPR) report by Ailsa Chang, there's a global shortage of refined helium, and it could get worse if the federal government doesn't stay in the business of selling helium. The Senate is considering legislation to prevent a global helium shortage from worsening in October of 2013. That's when one huge supply of helium in the U.S. is set to terminate. The House overwhelmingly passed its own bill last month to keep the Federal Helium Program going. That was a relief to industries that can't get along without helium. The gas is used in MRI machines, semiconductors, aerospace equipment, lasers and of course balloons.



To understand how we got here, we need to go back to nearly a century ago to World War I. Germany started building huge inflatable aircraft, and to keep up, the U.S. started stockpiling helium. That federal helium reserve is located outside Amarillo, Texas.

Sam Burton of the Bureau of Land Management helps manage the supply. Burton says "he lives and breathes helium," adding that he's a "total helium geek." Burton says there are now 10 billion cubic feet of the gas stored in this federal reservoir — enough to fill about 50,000 Goodyear blimps. And it's all kept under a wide-open prairie dotted with coyotes and jack rabbits.

"Imagine a layer cake being several thousand feet thick, layers of rock several thousand feet thick, you'd get an idea of how the gas has been stored in one particular layer," Burton explains.

Over the decades, private companies learned how to extract helium too. But they weren't extracting that much of it, partly because the government was selling helium so cheaply it didn’t seem worth the effort.

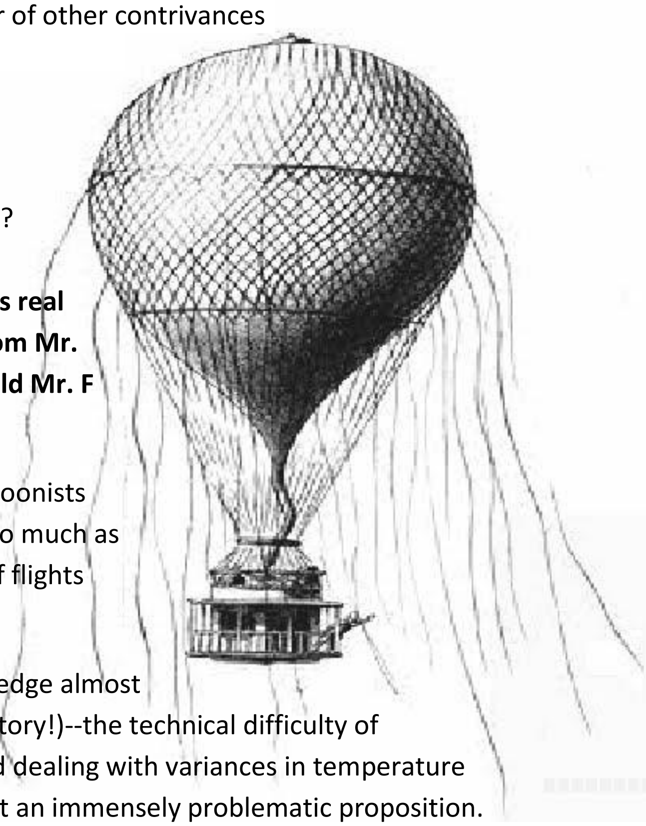
Then in 1996, Congress decided it was time to get the federal government out of the helium business so it wouldn't compete with private industry. Congress passed a law that would effectively end the helium program this October. The problem is, private companies haven't caught up with demand, and a big hole would be left in the market if Washington suddenly cut off supply as scheduled.

Besides a Balloon what else do you need to go flying?

- A “chase vehicle is required to transport all but the tiniest balloons, Balloons travel with the wind and can cover considerable distance depending on wind speed and flight duration.
- A gas powered fan is required to cold inflate the envelope.
- Toy balloons and a helium tank are required unless you always fly with other pilots who have them. Pibals (pilot balloons) are critical for pre-flight studying the winds aloft.
- A quality hand held compass to read Pibals is important. If you really want to be accurate a stopwatch, and an inclinometer, will allow you to determine the exact wind speed, and direction, at specific altitudes.
- Helmets are a good Idea and are required equipment for some manufactures
- Gloves to minimize the transfer of skin oils during envelope handling and to prevent rope burn from handling lines are a good idea. Pilot gloves that have long cuffs and offer protection from open flame and raw liquid propane frost burns are smarter still.
- A Tie down line that has a simple reliable release under considerable tension, yet can restrain a balloon with the equivalent of over 5000 square feet of sail area, is a must.
- It’s a good Idea to have an aviation Radio particularly if you fly in the vicinity of an airport. Some airspace is only accessible with a radio.
- Ground communication between balloon and chase, including radios and cell phones are suggested both from a safety prospective and a “where are you” prospective.
- Some Balloonist invest in tether systems, which allow a balloon to be flown up and down while tied to the ground. The maximum height and wind tolerance of these systems vary considerably. As does the associated price.
- If a pilot desires to fly in the winter, special equipment (tank heaters or nitrogen fuel pressurization) is required to insure adequate fuel pressure.

- Depending on where you fly a two wheel cart in the chase vehicle might be the difference between having willing crew, and crew who need to wash their hair when it's flyable. At Sky Sail Balloons we employ electric four wheel cart, the ultimate crew assist device.
- One other accessory that is nearly universally hated by crew but is sometimes a necessary evil is a tarp to lay out the envelope on. Dusty, damp, muddy or snowy landing fields can really take their toll on balloon fabric.
- Crew preference also may dictate having an envelope "squeezer" to milk the air out of the envelope after flying. Like kitchen gadgets for cooks there are any number of other contrivances to help minimize labor and keep things orderly.

In Case of Emergency…



Challenges: What will we do in an emergency? What's our plan? **What things did the Professor do to address his in-case-of – emergency needs? P. 44 in the novel. What did he do during his real emergency? Pages 55-60 in the novel. What did he find out from Mr. F on page 72 of the novel? If the bird hadn't pecked, what would Mr. F have done? Why would he have done that?**

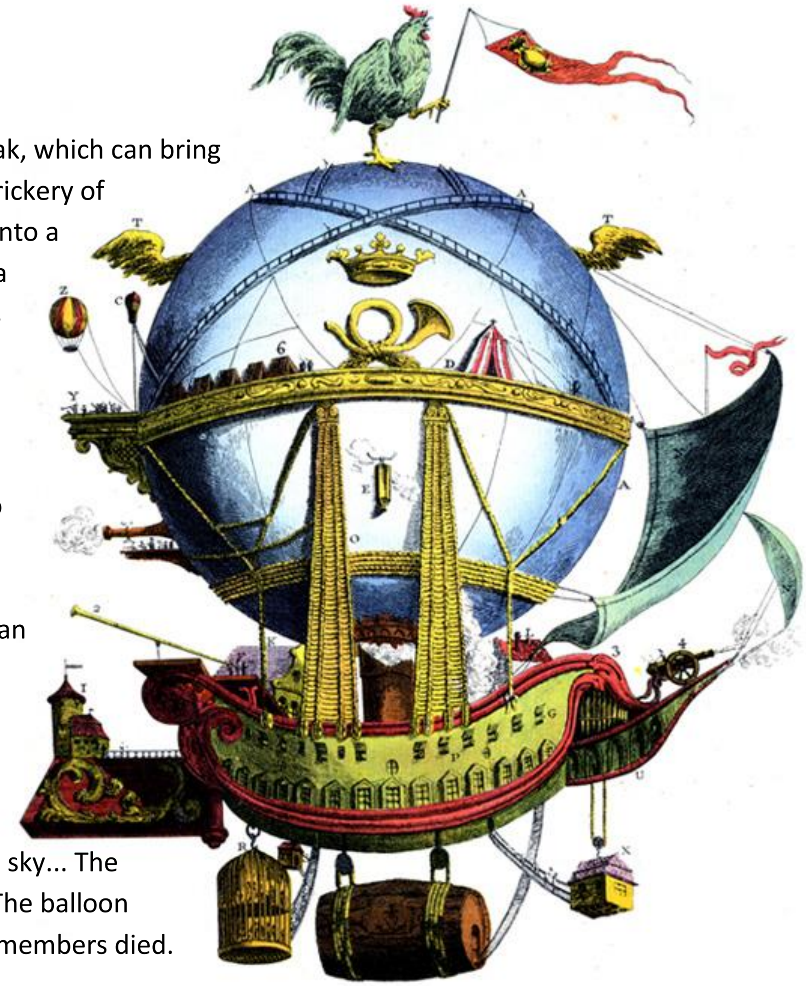
Like presidential candidates and stock-car racers, adventure balloonists tend toward the optimistic. This is not a matter of predilection so much as necessity, since, as we've learned, the overwhelming majority of flights result in two outcomes: ditch or splosh.

Even if everything goes right--which experienced pilots acknowledge almost never happens (look at what happened to the Professor in our story!)--the technical difficulty of searching out the right winds, staying at the proper altitude, and dealing with variances in temperature and weather make any flight, but especially a long distance flight an immensely problematic proposition. Many balloonists, not just imaginary ones, have run into some serious problems.

Take Atlantic crossings, for instance: 14 sploshes (splash downs into water) and five deaths before Maxie Anderson, Ben Abruzzo, and Larry Newman's Double Eagle II finally made it across in 1978. Look at trans-American attempts: four ditches before John Shoecraft and Frederick Gorrell landed Super Chicken III on the Georgia coast in 1981.

It's not simply that you crash. It's the way you crash. Accidents almost never happen suddenly. They unfold slowly, with precision and elephantine (lumbering) grace. It is significant that balloonist vocabulary lacks the term "crash landing." It's redundant, when you land, you crash.

One of the dangers is called icing, for instance: You drift into super-cooled clouds, the envelope is covered by a thick rime of ice whose weight pulls the balloon earthward, toward warmer air in which the ice melts, drenching the occupants and dumping the weight, launching the balloon upward like a jack-in-the-box, only to be covered by more ice, only to sink again...boing, boing, ditch, splosh.



Or there’s the danger of the tiniest pinhole leak, which can bring a balloon down in three or four days. Or the trickery of swirling storm systems, which suck a balloon into a slow whirlpool, spinning irretrievably toward a storm. Or lightning, which can toss balloonists out of the sky wholesale--five killed in a single 1923 race.

Or simply altitude: Drop too much ballast (weight) to fly high, and there's nothing left to slow your descent, as happened to the Soviet balloon Osoaviakhim in its 1934 return from a record altitude of 72,178 feet. As the three-man capsule dropped toward earth, buffeted by turbulence that eliminated any possibility of parachuting out, Soviet ground control received a final radio broadcast.

"The bright sunlight... The gondola... Beautiful sky... The ground... This... The sky... The balloon... It..." The balloon finally ripped under the strain. All three crew members died.

There are mechanical difficulties that we might have to face. Trying to avoid crossing the East German border in a 1983 race, Maxie Anderson and Don Ida were forced to ditch in the Bavarian Alps. Touching down, they flipped the switch that fired the explosive bolts to release the now-useless envelope from the gondola and safely release the basket from the balloon, and nothing happened. The switch malfunctioned, the wind gusted catching the balloon, and suddenly they were up in the air again, floating high above the ground. Suddenly the bolts fired (broke) and the basket dropped. Neither survived the fall.

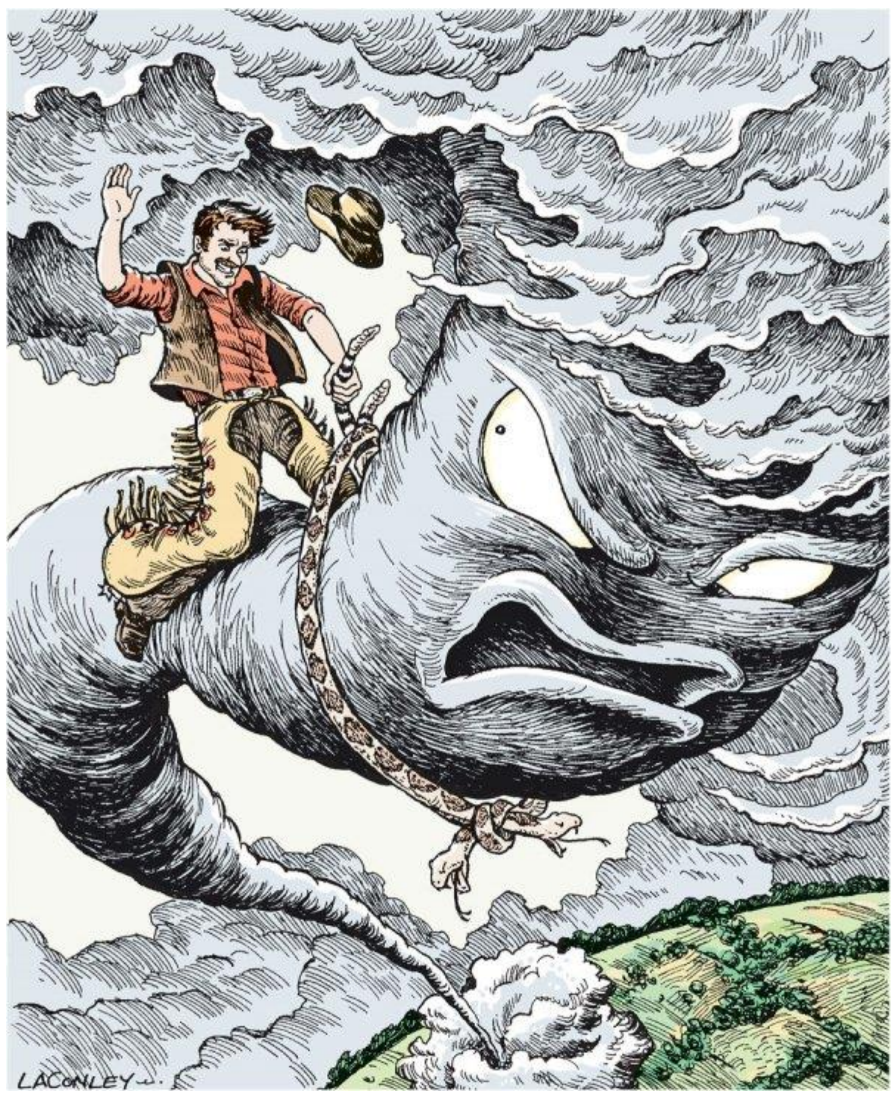
Then there is the more delicate wiring of international relations.

September 1995, after then end of the Cold War, while participating in the Gordon Bennett Cup long-distance race, American balloonists John Stuart-Jervis and Alan Fraenckel were shot down and killed when their drifting balloon came too close to a missile launch site in Belarus. The mild stir that followed ended with the usual diplomatic serve-and-volley: The United States expressed its sincere outrage and the Belarussians pledged a "full investigation." Translation: Sorry guys, but what do you expect, playing kick-the-can above the trigger-happy countries below?

All of these problems are symptoms of the real hazard of ballooning: the wind. Balloons are blown into clouds of ice crystals, across unfriendly borders, and into storms. So, what's our plan to keep safe and avoid trouble? What kind of emergency gear do we need to make sure we take?

Riding the Wind

But the wind is also the boon of ballooning. Balloons are perfectly enmeshed in the breeze, not holding steady against it, but moving along at exactly the same speed. In fact, because balloons travel at the speed of the wind, passengers don't actually feel any breeze at all! Even if you're zipping along, even roaring along at 200 mph in the jet stream the ride feels surprisingly safe and serene.



Long-distance balloonists seek control of the wind through a constant feed of information from meteorological forecasts about the winds, which have different names depending on where you are. The Arabians have the nafhat, there is the beshabar of the Caucasus, and the Samiel blowing from Turkey; North Africa's solano, California's Santa Ana, and the sirocco of the Sahara, which can blow such quantities of red sand to Europe that rains of blood were reported in Portugal and Spain in 1901.

Winds are part of legends and superstitions around the world. As late as the 1920s, sailors of the Shetland Islands purchased benevolent winds from old women for a sixpence. The Payaguas of South America beat the air with their fists to frighten oncoming storms, and Herodotus tells of a Saharan army that attempted to halt the simoom, or poison wind, by donning its battle gear and marching directly into it. Though the aeronauts are able to seek out favorable winds by fine-tuning their altitude, and though they can master the Byzantine mathematics of trajectory plotting, their control over their destiny remains, to put it kindly, limited. Once aloft, other forces take control. They travel by the whim of the winds. On a long trip like ours, or the Professor's, it really does come down to luck. But, If Pecos Bill could ride the winds , why not us?

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