

# Fly Solar Balloons

Everything You Want To Know About  
Making and Flying Your Own

by Jonathan Boehme

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## A Super-Cheap, Super-Fun Hobby

Solar balloons have been around for years, and can be easily made at a low cost. They provide hours of fun - whether flying like a windless kite, towing a video camera above the local park, or even free-flying hundreds of miles.

Surprisingly, however, solar balloons never gained much popularity. I'm not sure why this is so, but over the past couple years I've been spreading the word about solar balloons across the World Wide Web. You may find a few useful sites on the Internet, as well as some companies that sell tube-shaped



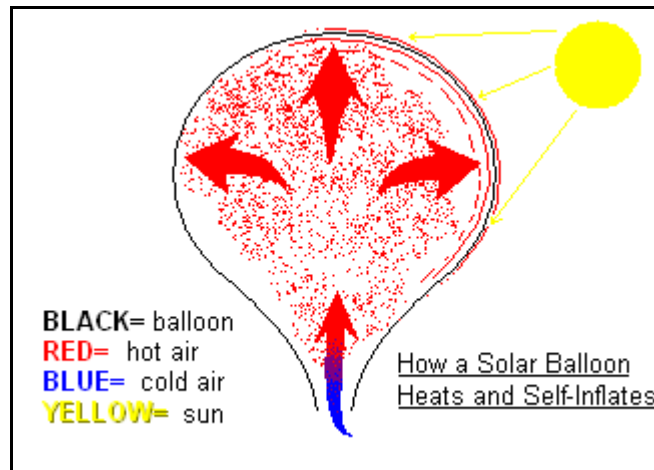
solar balloons; but in general, they are not a well-known invention and have not become nearly as popular as one would think they might.

Using two simple materials – trash bags and tape – you can make a balloon that can fly several hundred miles in a day. In this eBook, I will teach you everything you need to know about making your own solar balloons. You will also learn the ideal weather conditions for flying solar balloons, as well as special designs you can make, how to record a hundred-mile flight, and more.

You may still be wondering how solar balloons work. In the next section, I will explain the concept of solar-powered hot air balloons and how it is different from any other flying machine.

## How Solar Balloons Work

Solar balloons are heated by the sun; hence, the name “**solar** balloon.” The plastic they are made of must be a very dark color to heat up in the sun; this is because dark colors readily absorb heat, while lighter colors reflect heat. When the sunlight hits the black surface of the balloon, the dark-colored plastic quickly becomes very warm (but not hot enough to burn). The heat generated by the sun radiates from both sides of the film. Heat that radiates away from the balloon is quickly lost, while the heat that radiates into the balloon warms up the air in the balloon.



After a short while, the air in the balloon is warm enough to lift the balloon off the ground. If the balloon isn't completely full of air, it will eventually become completely inflated by itself.

### Self-inflating

How does a solar balloon finish inflating itself? It's fairly simple. The hot air already inside the balloon expands and pushes upward and outward against the sides of the balloon (see illustration above). This creates a weak vacuum that draws cold air into the opening at the bottom of the balloon. The cold air quickly heats up as it enters the balloon. This is the reason a solar balloon can fly

continually without losing its air and coming back down. The sun keeps it hot all day long, and leaving an opening in the bottom of the balloon allows for the balloon to reinflate itself should a gust of wind knock air out of it.

### **Free flight**

How can a solar balloon fly 500 miles in only one day? To start, the balloons maintain their heat all day by a constant supply of full sunlight. This keeps them continually rising until they reach their maximum altitude. The maximum altitude is where the air becomes too thin for the solar balloon to lift itself anymore. Solar balloons have been recorded at altitudes up to 50,000 feet above the ground! At staggering heights like this, the wind travels at a high speed, usually over 100 mph. This is referred to as the upper jet stream, and sometimes may even reach 200 mph.

A balloon traveling at its maximum altitude will stay at that level until the sun becomes too weak to sufficiently heat the balloon. This usually happens shortly before sunset. As the balloon loses heat, it loses altitude and its ability to self-inflate. Once the sun is down, it completely loses heat and will become partially deflated as it floats back toward the ground.

I'll use a flight in my home state as an example. During the winter in Middle Tennessee, a 5-foot balloon will land around dusk. I released a balloon of this size on December 27, 2006 from Franklin, Tennessee, with an attached note containing information on the flight and how to contact me. That same evening, I got an email saying the balloon had been found. Its finders had seen the balloon floating down just after sunset. I use this incident to calculate the approximate landing time for all of my released balloons.

## Different seasons & climates



Different climates and times of year may affect how a solar balloon will fly and when it will land if released into free flight. Generally, summer sun is better for heating a balloon, but the surrounding air may be too hot itself to allow the balloon to lift well. Winter sun will heat a balloon enough in most places, and the cold surrounding air will make a greater temperature difference, resulting in greater lifting capacity. I have had the most flying success during the winter in Tennessee, and have had trouble flying small balloons in hot weather.

Interestingly, I have had a report of small solar balloons flying perfectly in very hot Florida summer weather. I'm not sure why they'll fly in Florida heat but not Tennessee heat; however, I can say after reading a lot of reports from around the world that solar balloons will fly differently not only in different seasons, but also in different climates.

## Lifting payloads

A solar balloon will not generate as much lift as a fire-heated balloon of the same volume. This is simply because the heat from the plastic doesn't amount to the heat generated by a flame. A solar balloon that will carry a human and some ballast is roughly the same size as a propane burner-heated hot air balloon that can hold three people plus fuel.



In the area where I live (about 700 feet above sea level), I get a little less than a pound of lift from a 10-foot tetrahedral solar balloon (tetroon). I use balloons of this size, as well as a large drawstring tube-shaped balloon (Giant EZ Tube), to



carry a digital camera for aerial photography and videos. Smaller balloons can be used for the more compact, lightweight digital cameras. I was able to get my 6-ounce camera off the ground with a 7.5-foot tetroon in the late autumn. However, I wouldn't recommend using a balloon that has a

maximum lifting capacity of about the same as the weight of your camera, as was the case with the 7.5-footer and my 6-ounce camera.

### Summing it Up

Now that I've covered the basics, I'll put together a few rules of thumb to remember before we move on to the building instructions.

- **Winter** is usually better for flying solar balloons.
- Solar balloons should have an **opening** (mouth) at the bottom.
- Different **climates**, **weather**, and **season** all affect how solar balloons fly.
- Solar balloons must be **black** or contain a significant amount of black surface to be heated by the sun.
- Solar balloons will fly in **very cold** weather, but usually won't perform well in **very hot** weather.
- Last but not least, **the sun must be full** – no cloud cover or shade.  
(*Sometimes solar balloons will fly under clouds, depending on conditions.*)

## **Building Your Own – Getting Started**

Think of sitting down in your living room with some trash bags, scissors, and a roll of tape. Within about half an hour, you put some of the trash bags together to create a 5-foot tall solar balloon. You write some information on a piece of paper, and attach it to your balloon. Then, you take the balloon out in the morning sun, fill it up with air, and watch it fly away. Some time later, you are contacted by someone who has found your balloon in some town that's several hundred miles' driving distance away from your house.

Or you could build a larger balloon, and harness your camera below the balloon to take high-resolution shots of your neighborhood, town, etc.

You could also build an "EZ Tube" solar balloon and take it anywhere to entertain kids at the park, grab attention for an event, or use it for anything else for which you might want an easily-inflated, easily-flown solar balloon.

In this section, I will cover everything necessary to build a solar balloon, and will show you how to make many different models, including my personal fleet of tetrons, EZ tubes, traditional hot-air-balloon-shaped balloons, and even a UFO-shaped balloon. These balloons can serve a variety of purposes, some of which I mentioned above.

You have already learned a bit about successfully flying solar balloons; now, you will learn how to build all of these balloons. However, we first must look at acquiring the necessary materials that determine whether or not the balloons will be truly good fliers.

## Material 1: The Most Important – Trash Bags

Let me first say that most black trash bags you see in the stores are not ideal for building solar balloons. Some will work OK for larger balloons, but most are *too heavy*. These bags may look and feel lightweight enough, but the smallest differences in bag thicknesses can mean the difference between a 5-foot tetraon flying a hundred miles and a 5-foot tetraon dragging across the ground, barely making it into the air.

Larger balloons can be made with thicker bags. For example, if the thinnest bags you can find are still thicker than what I am about to recommend, you can still make a 10-foot tetraon that will fly well enough. You may not get the best lifting capacity, but flyable balloons can be made with thicker bags if the balloon is large enough.

Trash bags of the ideal thickness for solar balloons can be hard to find in stores. This thickness is usually measured in **mils** (0.001 inch). Below I will put the number in large letters for easy reference.

Ideal plastic bag thickness for solar balloons: **0.5 mil.**

I have heard of successful flights from thicker balloons; in fact, I have flown a few myself. One person was able to successfully fly a 5-foot tetraon that was made from 0.6 mil trash bags. I once made a flyable pillow-shaped balloon that measured 10 feet long by 5 feet wide using 0.7 mil high-density trash bags.

Once again, climate and time of year may affect how your balloons fly. If you can't find the right bags, the best thing to do is to experiment. See what you can come up with that works best for you. A rule of thumb is that you should always use the thinnest bags you can find. Check any store that carries trash bags, and look through all the black trash bags and check the thickness of each one.

### How do I find out how thick the bags are?

All trash bags should have the dimensions and thickness printed on the package. Look around the packaging for small print that will tell you the height, width and thickness of the bags. Thickness is usually displayed in both **mils** and **microns** ( $\mu\text{m}$ ). Check the thickness printed on each different package of black bags – for example, a common bag thickness is “0.85 MIL (21.6  $\mu\text{m}$ )”. You are looking for bags that are 0.50 mil (13  $\mu\text{m}$ ) or thinner. See the scanned image below for an example of ideal trash bags.



## Plastic Density

Not all trash bags are made with the same kind of plastic. All the bags that I know of are made of some type of **polyethylene**, but the grades of plastic are different among brands.

Many thicker bags and kitchen trash bags are made from **low density polyethylene** (LDPE). This plastic is characterized by tear resistance to some extent, but not much puncture resistance. It is fairly easy to stretch or poke holes in LDPE bags, but if you try to tear them, the torn edge will be ruffled, stretched-out, and uneven. LDPE bags are a lighter yet less durable type of plastic bags. You might be able to more easily get away with using thicker bags if they are made from LDPE.

Typically, the thinner bags and bags that are often, but not always, advertised as extra-strong (*not* Force Flex bags) are made from **high density polyethylene** (HDPE). This plastic has a more rigid structure than the lower-density grades of polyethylene and the best example of this type of plastic is your ordinary plastic shopping bag. The plastic is more crinkly than LDPE, and is not as easy to stretch or poke holes in. However, HDPE tears more easily, and the edges of a tear are cleaner—less stretched and less ruffled—than those of LDPE. Because of this, small holes in HDPE solar balloons can become large tears in gusty conditions.

Some bags may be made of a blend of plastics, or medium-density polyethylene (MDPE). An easy way to get an idea of the density of your trash bags is to open a bag, crumple it up, and then tear it into two pieces.

High density polyethylene will be more crinkly and not very shiny, while low density polyethylene will be more soft, shiny and easier to stretch.

You can choose a higher or lower density depending on the available bags you can find, the available thickness of bags you can find, or how durable you want your balloon to be. Overall, density is not a very important factor when choosing the right kind of bags. The most important factor is that the bags should be as lightweight as possible.

### **Online sources**

If you really want the thinnest bags possible, and can't find them thin enough in your area, there are online sources that sell very thin trash bags. You can find these via a simple [Google](#) search or two.

### **Bag dimensions and tie type**

Two last things to mention about trash bags are the dimensions and tie type. The bags to be used for my solar balloon designs should be advertised for 30 gallon trash cans. This is the size that I use for all my designs and is what you should use when building your own balloons from the instructions in this eBook. Dimensions, as shown in small print, should be around 2 feet, 6 inches by 3 feet. When the bag is cut open, it should be a flat sheet that measures 5 by 3 feet (or very similar). The dimensions are only important if you want your balloons to match my designs and be of the correct shape and size.

By *tie type*, I mean *how the bags are tied shut*. Bags should be labeled as twist-tie trash bags, not flap-tie or drawstring bags. Flap-tie and drawstring bags would take a lot more time and effort to prepare, as you would need to cut off the tops to make an even edge.

Twist tie bags have flat top edges and a bottom seam that can be easily cut off.

## **Material 2: Second Most Important – Tape**

You need a solid yet lightweight method of sealing the edges of trash bags. Tape holds the bags together, shouldn't add too much weight, and helps the balloon carry the load of a tether or payload by distributing the weight across the surface of the balloon.

My tape of choice is **cheap masking tape**. I prefer the Duck (Manco) brand, as it is very sticky, lightweight and inexpensive. When this is stuck to a trash bag, it doesn't easily come off. Once you press the tape down, it sticks permanently and will hold your balloon together for a long time. Get this tape at hardware stores, Walmart, or any place that sells paint products.

Other tapes that will work are Scotch tape and packaging tape. Keep in mind that you want a lightweight tape. Heavy tapes like duct tape may be too heavy for small balloons such as the 5-foot tetraon.

## Tools and Workspace

All you need now is a good pair of scissors and a table or open floor space on which to work. The scissors should be new or recently sharpened without any rough spots or kinks on the blade edges. It can be surprisingly difficult to cut trash bags with bad scissors.

If you are working at a table, there should be some open space on the side opposite that at which you are sitting. This way, the balloon can spill over the other end of the table as you work on it.

If you prefer to work on the floor, make sure there is enough room for the balloon to spread out a bit. It's OK for the balloon to bunch up a little, but too much bunching will make it difficult to tape accurate seams. Also consider the type of floor you are working on. Carpet can make it more difficult to press down the seams smoothly; a hard, flat surface is the best one to work on.



## Preparation & Seaming

Before you build your first balloon, you should know a couple things about preparing the trash bags and taping them together. First, you must know how to cut the bags open so they become a flat, rectangular sheet with straight edges. You also must use an overlap when taping the bags together, to avoid sticky spots which could ruin your balloon.

### Cutting bags open

Your trash bags should come on a roll that is less than a foot (12in) wide. The bags are folded several times to make a narrower roll of bags. As you pull off each folded bag from the roll, you will see a **seam** and **perforations** where you tear the bag off of the roll. The first step when making your balloons is to **cut the seams off of the bags**.

Start by gathering all the bags you need for the particular balloon you are making, and cut all the seams off as evenly as possible, with sharp scissors:



When the seams are cut off, feel the long edges of the (still folded) trash bag. Find the edge where the bag is folded several times. Usually there will be 4 folds on one edge, and only one on the other. **Slip the scissors into one of these folds** (the topmost being ideal) **and cut along the edge for the length of the entire bag.**

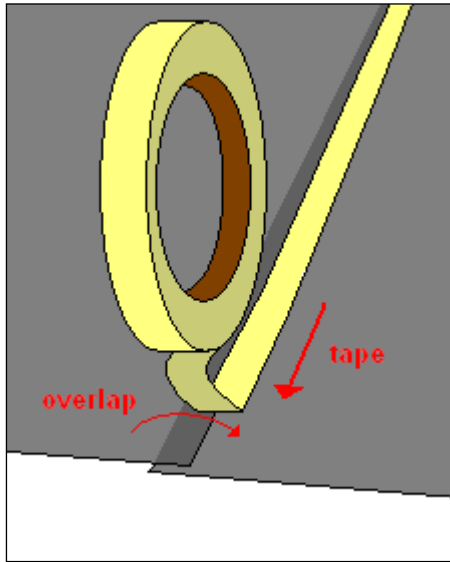


When you have cut off the seam and an edge of the trash bag, you should be able to open the bag by carefully pulling the cut-open fold apart. When the bag is completely open and fully spread out, you should have a rectangular sheet that looks like this:



This is what you will use to make your balloons. When using 30 gallon trash bags as recommended, the open sheet should measure around 3x5 feet.

## Seams



There's one more thing to mention before we get into the actual building instructions: taping the bags together. When you tape together the edges of two sheets, these edges should overlap a little to avoid exposing the sticky side of the tape on the other side of the plastic. Sticky spots can catch onto any other part of the balloon, and may easily tear holes in the balloon if you attempt to detach them. Overlapping by at least  $\frac{1}{2}$  inch should

ensure clean, stick-free seams that will hold in the air and keep the balloon together for a long time.

Now that we've covered the basics of preparation and seaming...

### ***You're ready to build!***

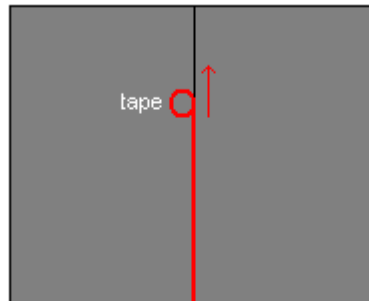
It's time to start putting these trash bags together and make some balloons. Don't rush it – take your time when you build your first few solar balloons. As you get used to the techniques, you'll find the easiest way to assemble your balloons, whether it be on the floor, at a large table, or wherever works best for you.

## BUILDING INSTRUCTIONS

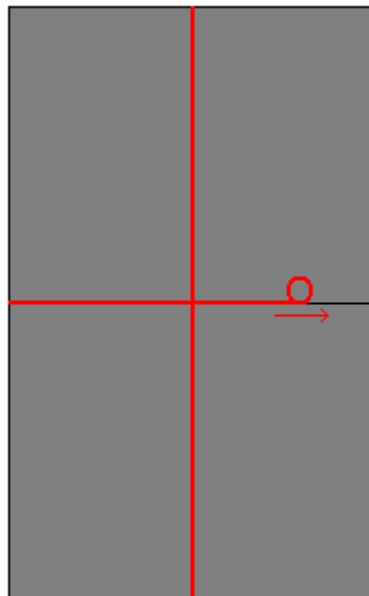
### 5-foot Tetron

You will need 4 30-gallon trash bags and a roll of tape for this balloon.

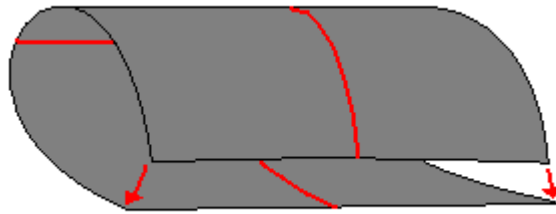
1. Cut open the trash bags so you have four 3x5-foot sheets of plastic.
2. Lay two of the bags out, and tape them together along the 5-foot edges.



3. Repeat step 2 for the other two bags, and join the two taped sheets together so you have a 4-bag sheet.



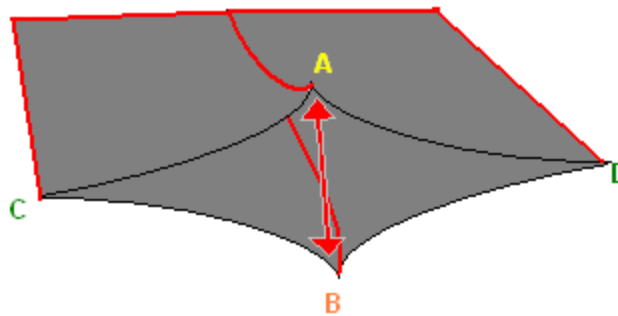
4. Fold the big sheet in half as shown.



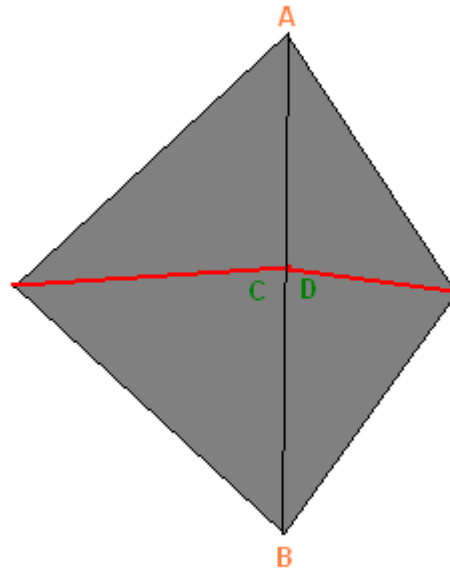
5. Tape the 5-foot sides together, leaving you with a 6-foot wide opening.



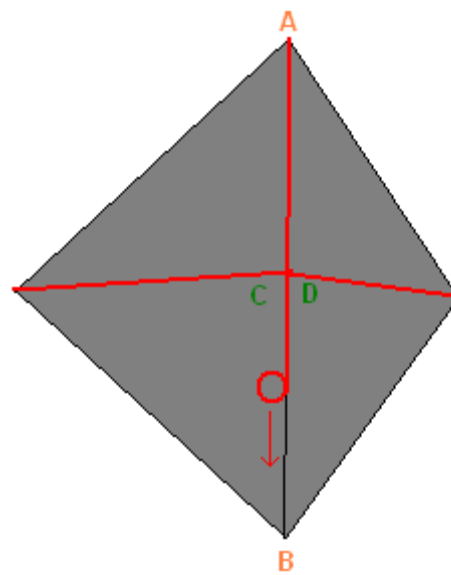
6. Grab the two seams in the center of the opening (A and B), and pull them apart.



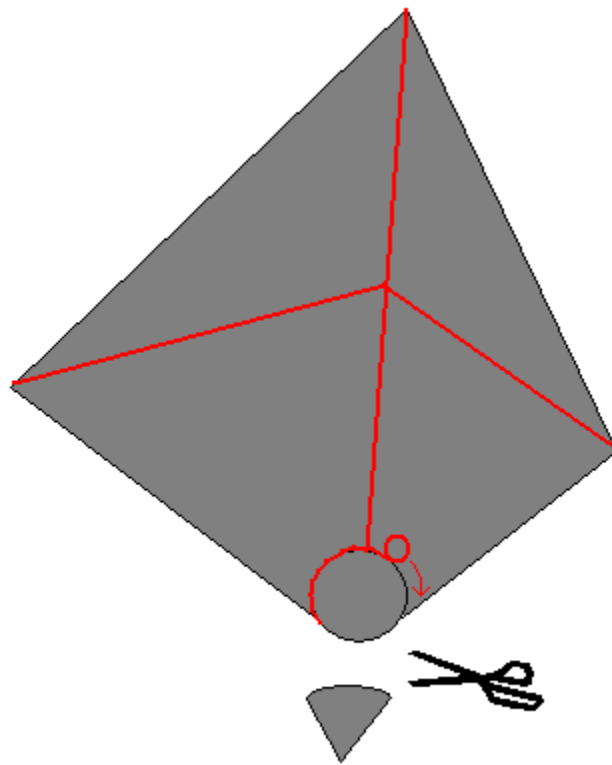
7. Pull A and B apart until C and D come together.



8. Tape the opening together with C and D touching. A and B should become two corners of the balloon.



- Cut about 5 inches off one of the corners, and reinforce the opening with tape to prevent accidental tearing.



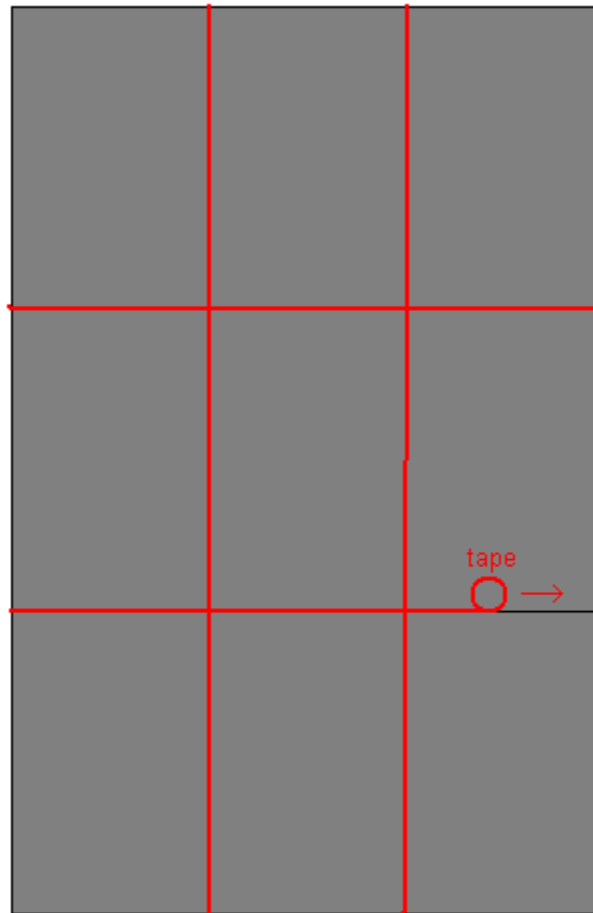
- Your balloon is ready to fly!



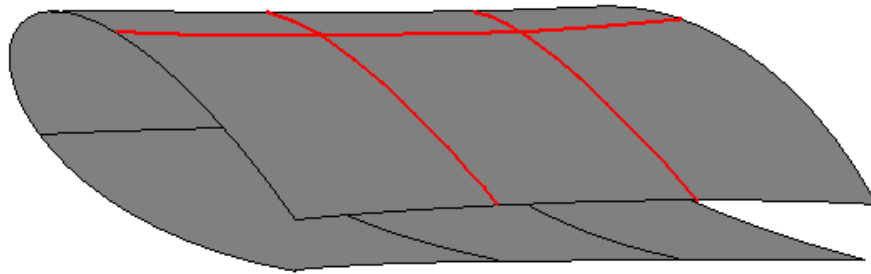
## 7-foot Tetroom

Actually closer to 8 feet tall, this balloon is the next step up in size from the 5-foot tetroom, and it's just as easy to fly. This one uses 9 30-gallon trash bags.

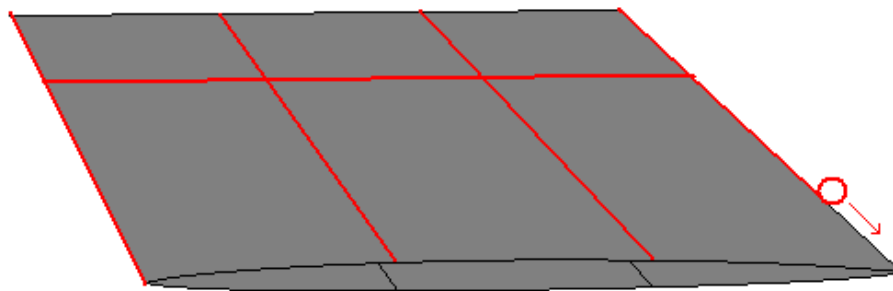
1. Cut open 9 bags so you have 9 3x5-foot sheets. Tape 3 together along their 5-foot edges; repeat with the next three, and then the last three. Then, tape them together so you have a sheet that measures 3 bags by 3 bags, or 9x15 feet.



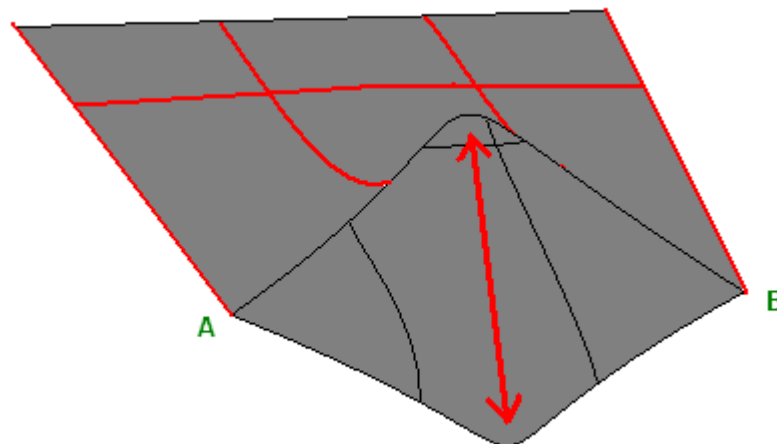
2. Fold the large sheet in half.



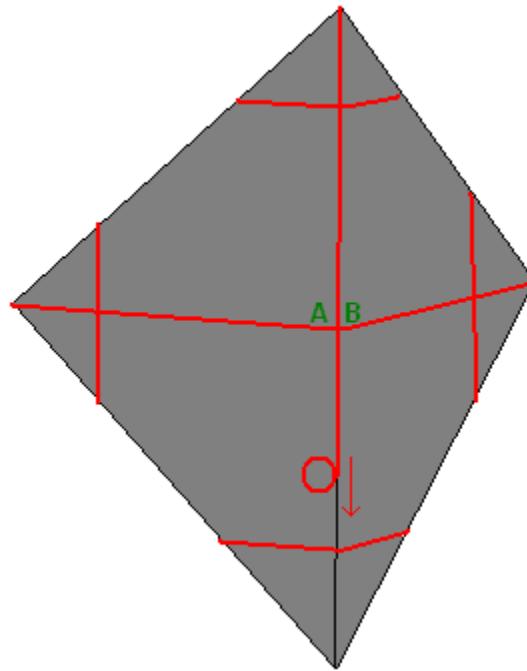
3. Tape the sides together so you have one 9-foot-wide opening.



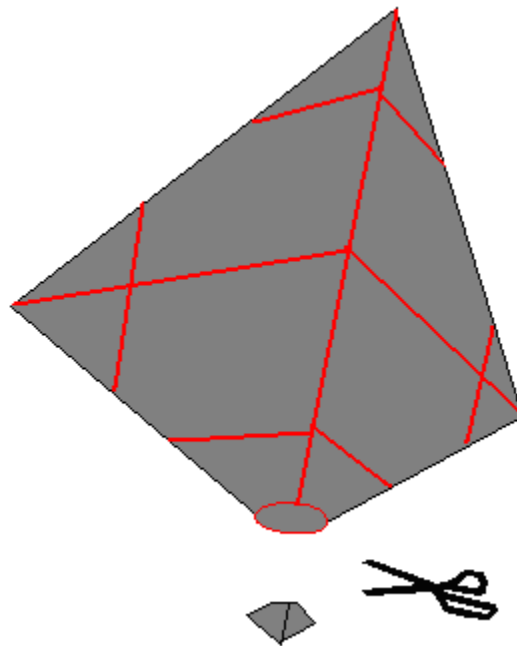
4. Pull the center of the opening apart by grabbing the edge of each side straight in the middle. Pull apart till the corners A and B meet.



5. Tape shut the opening, making sure A and B are still touching.



6. Cut a few inches off one of the corners, and reinforce the opening with tape.



7. Your balloon is ready to fly!



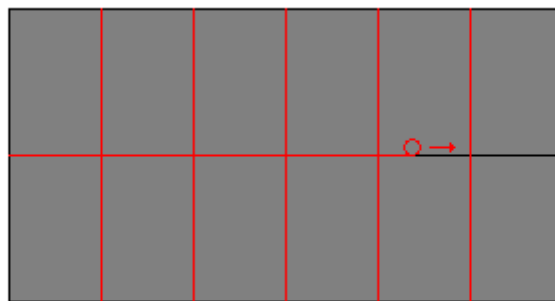
## 9-foot Tetroom

This will carry most compact digital cameras (not SLRs). The 9-foot tetroom uses 12 trash bags.

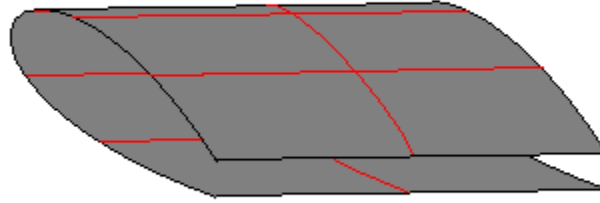
1. Cut open 12 trash bags.
2. Tape 6 of the bags together by their 5-foot edges; this should give you an 18 x 5 foot sheet.



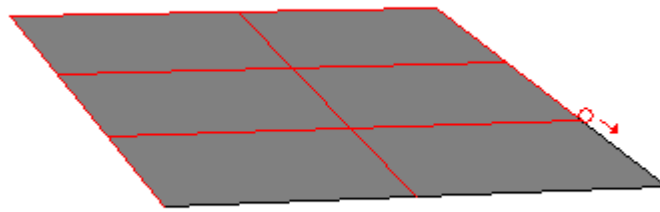
3. Repeat step 2 for the other 6 bags.
4. Tape the two long sheets together by their 18-foot edges.



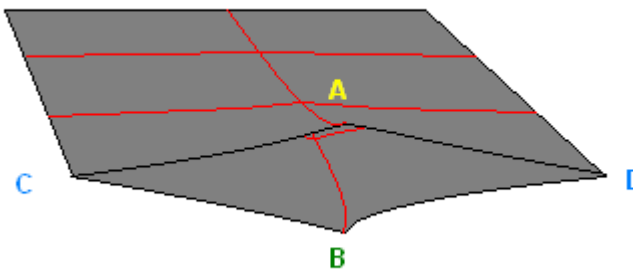
5. Fold the large sheet in half as shown.



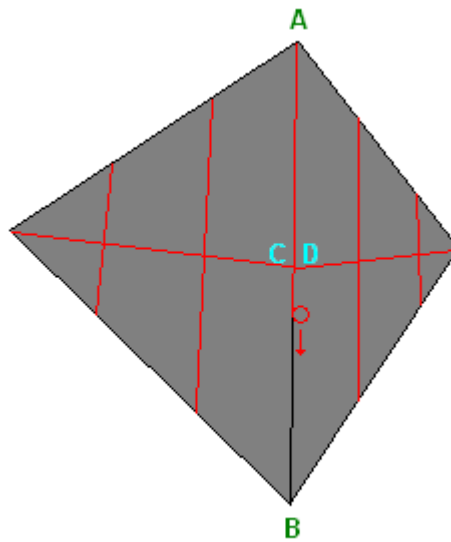
6. Tape up the two sides, leaving a 10-foot wide opening.



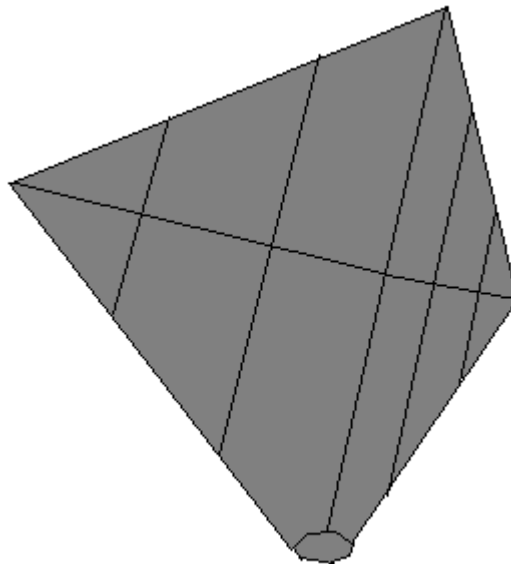
7. Pull the centers A and B of the opening apart, until corners B and C are touching.



8. Tape the opening shut, making sure C and D remain touching.



9. Cut a corner off of the balloon, and reinforce the opening with tape.



10. Your balloon is finished!

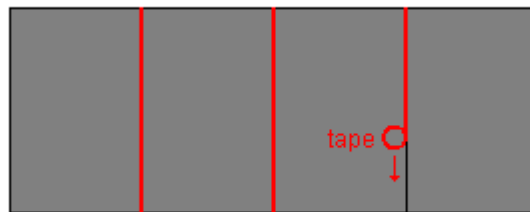


## 10-foot Tetron

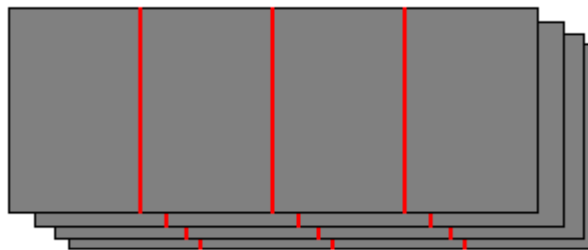
This balloon may take a couple hours to build, but it's worth the time and can lift up to a pound in the right conditions.

1. Cut open 16 trash bags.
2. Tape 4 bags together by their 5-foot edges.

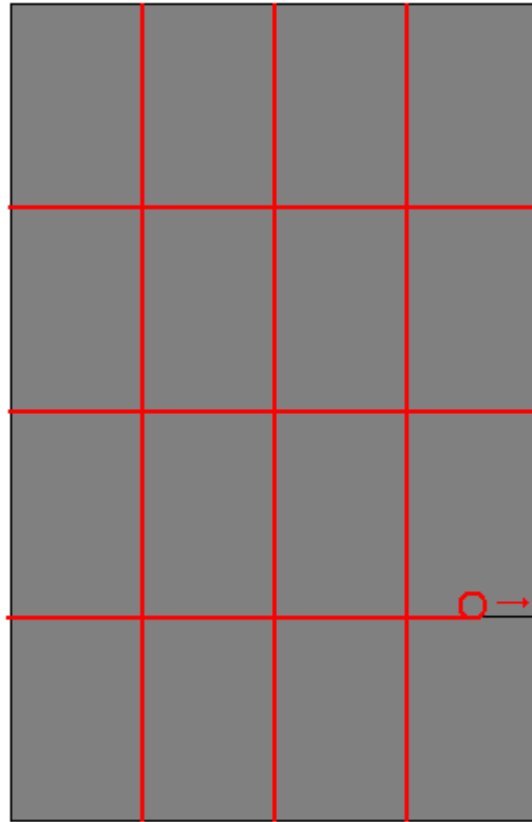
The result should be a 5 x 12 foot sheet.



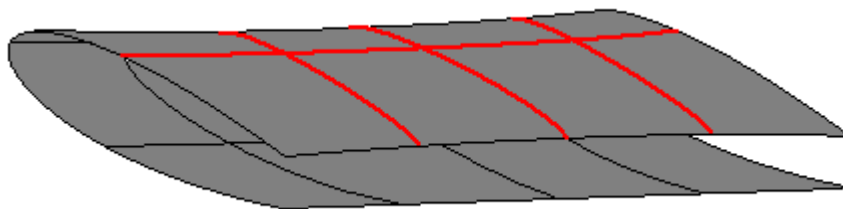
3. Repeat with the other 12 bags, so you have 4 sheets of 4 bags each.



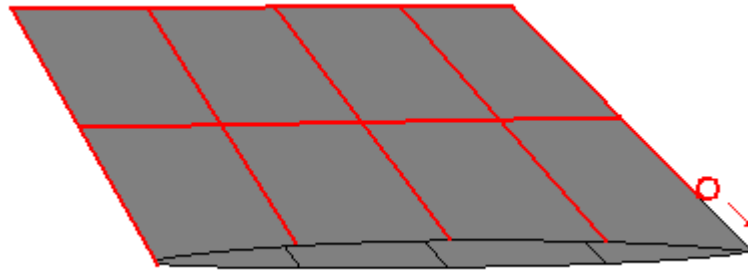
4. Tape the 4 long sheets together by their 12-foot sides to get one large sheet.



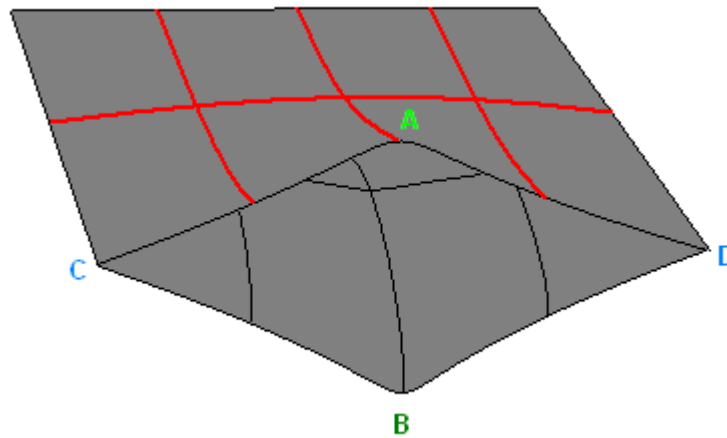
5. Fold the large sheet in half.



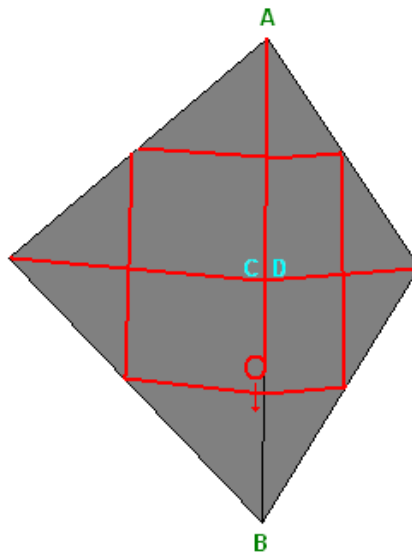
6. Tape the 10-foot edges, leaving a 12-foot opening.



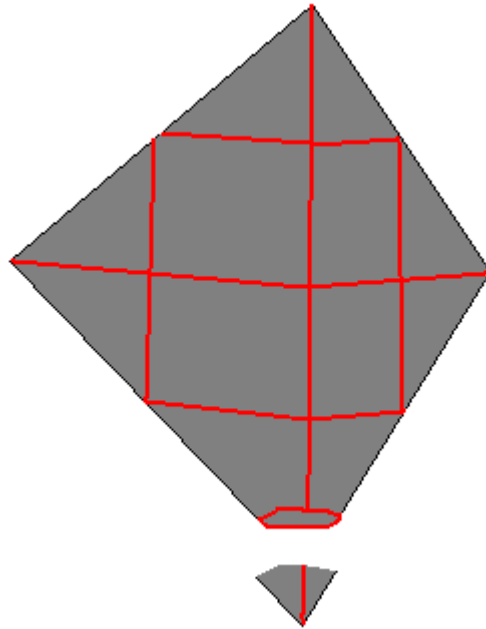
7. Pull the centers (A and B) of the opening apart until corners C and D meet.



8. Tape the opening shut, with C and D touching.



9. Cut a few inches off of a corner;  
reinforce the opening with tape.



10. Your balloon is finished!



## Larger Tetroons

If you haven't noticed, most of the tetroons I have shown use the same pattern of bags. The 5-, 7-, 10- and 13-foot tetroons are all made from a large sheet with an aspect ratio of 5 to 3. Notice that this is also the aspect ratio of a single bag. The large 5:3 sheet is folded in half, and made into a tetrahedral shape by the process you should now be familiar with.

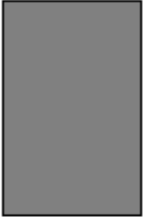
If a single bag has an aspect ratio of 5:3, and all the larger sheets have the same aspect ratio, then the larger sheets must measure the same number of bags in width as they do in height. With this rule, you can build a tetroon of any size; for example, a 13-foot tetroon or even a 16-foot tetroon.

To make a 13-foot tetroon, you will need 25 bags to make a large sheet that measures 5 bags wide by 5 bags long, or 15 feet by 25 feet.

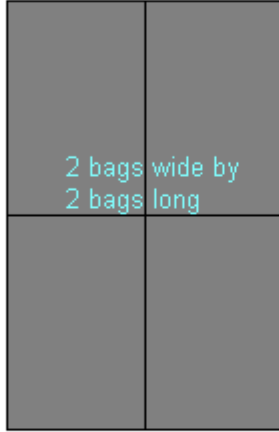
A 16-foot tetroon will use a 6-bag by 6-bag sheet of 36 bags. Keep adding bags to increase the size of your balloon to whatever size you desire.

To calculate the *approximate* height of the balloon, figure out the length of the **long** side of the 5:3 sheet; then divide this length by 2. For example, a sheet that measures **20** feet by 12 feet will make a balloon that is around 10 feet tall.

For some examples of different tetroon sizes, see the illustrations below of different sheets that are used to make different-sized tetroons. Notice that they all share the same aspect ratio of 5:3 and all measure the same number of bags long as they do wide.



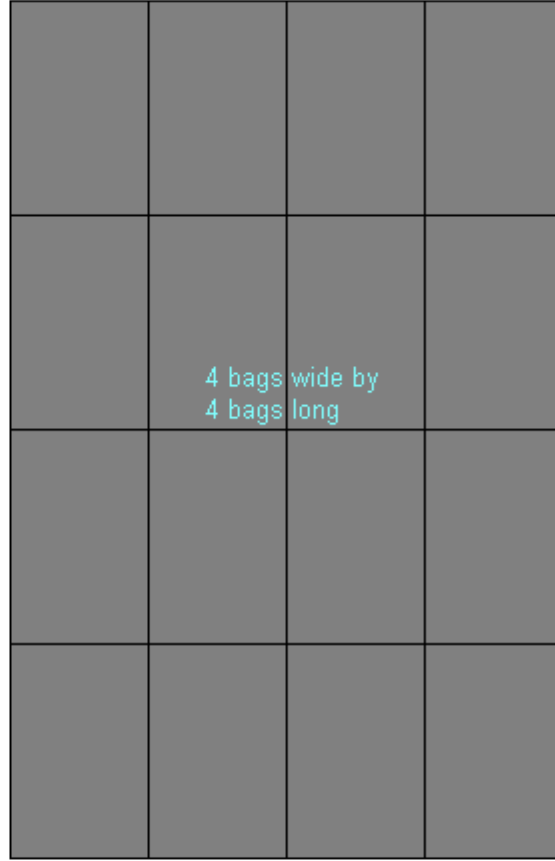
**Single Bag**  
aspect ratio = 5:3



2 bags wide by  
2 bags long  
**5-foot tetroon**  
aspect ratio = 10:6 = 5:3



3 bags wide  
by  
3 bags long  
**7-foot tetroon**  
aspect ratio = 15:9 = 5:3



4 bags wide by  
4 bags long  
**10-foot tetroon**  
aspect ratio = 20:12 = 5:3

These different sheets are folded in half and made into "tetroons." They all share the same aspect ratio, and are all the same number of bags wide as they are long.

You now should hopefully have an understanding of my tetroon design. Just remember this rule – same number of bags across as wide; a 5:3 aspect ratio for the big sheet. This does not make a perfectly regular tetrahedron, but it comes very close; close enough not to be noticeable.

Now we'll move on to some more solar balloon designs...

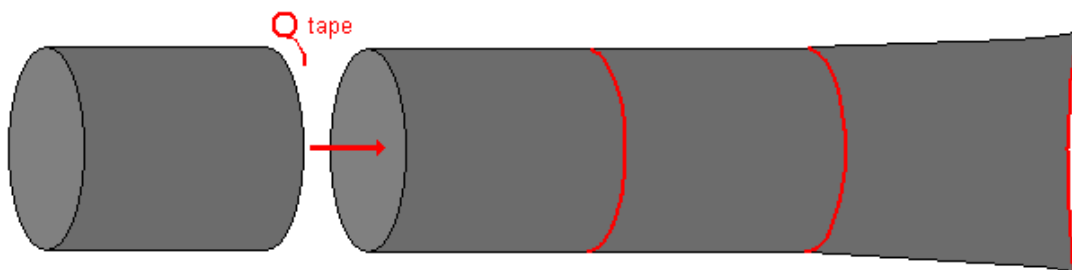
## Tube Balloon

This is a very simple balloon design, and probably the one that creates the least amount of lift. I have had about a 50-50 success-failure rate flying this balloon. It doesn't seem to fly in warmer weather or wind. This is because of its long, narrow profile, which means more surface area, less air capacity, and faster cooling when the wind blows.

This balloon is good for kids as an educational project. It can be made easily and inflated without a fan. I recommend it for winter use only. Give this one a try – the great thing about the tube is that you can add on more bags *any time* to make your balloon longer.

### A very simple process

Instead of completely cutting the trash bags open, *only cut the seams off*. Tape the open ends together to make a long tube. Tape one end completely shut, and leave the other end open for inflation. Inflate the balloon by holding the mouth open and running into the wind to fill the balloon. Close the mouth and keep it shut with a twist tie during flight.

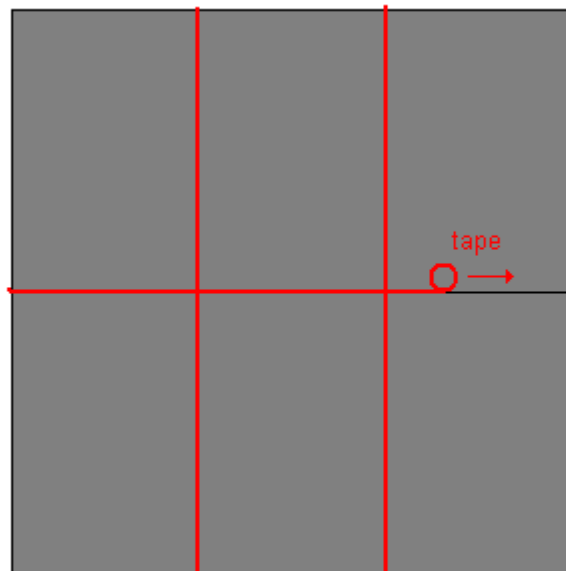


## EZ Tube

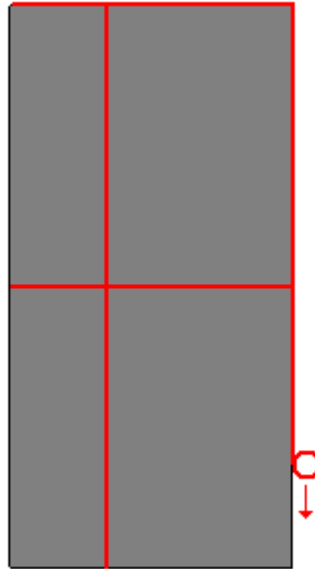
The EZ tube is preferable over the regular tube balloon, mainly because it has a wider profile and can be opened and closed very easily. The only drawback is that the EZ tube is a bit more difficult to build. However, I'll show you the basic steps to creating a small EZ tube; then, you can apply the concept to larger sizes and make EZ tubes of any size.

### Building instructions

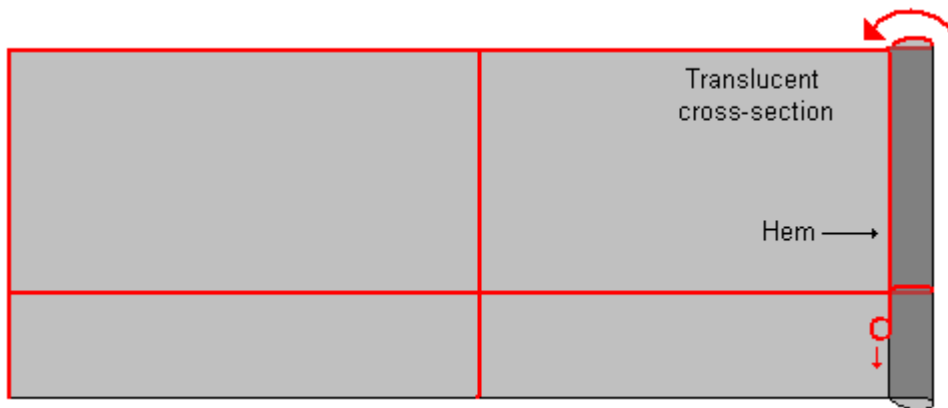
To build an EZ tube that measures 10 feet long by approximately 3 feet wide, start by cutting open 6 trash bags. Tape them together as shown below to make a 9x10-foot sheet.



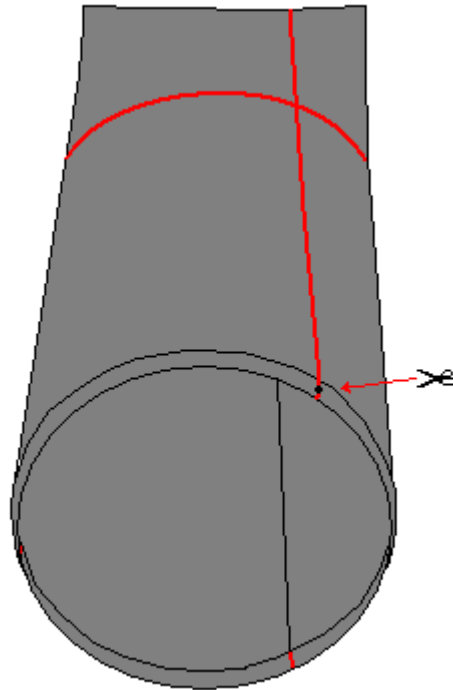
Fold this sheet in half and tape the long side and one of the narrow sides.



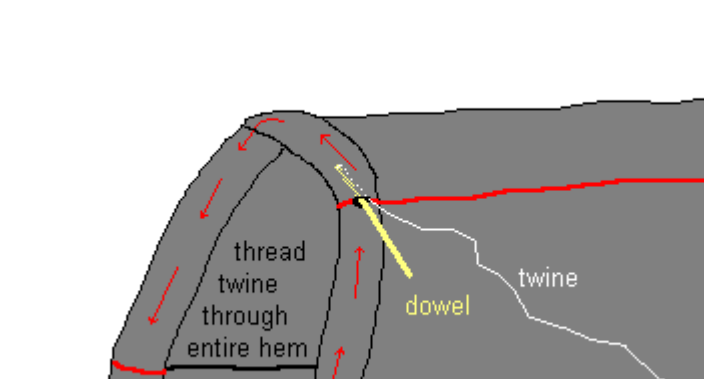
Bend back about 1 ½ inches of the open edge and tape the edge down to make a hem through which you will thread a string. Tape the edge back to make a hem around the entire circumference of the opening.



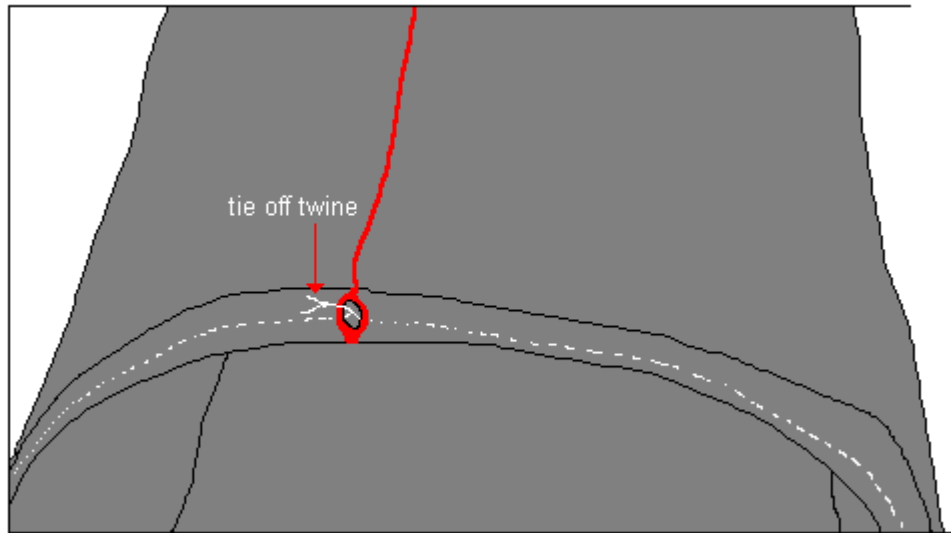
When the hem is completed, cut a hole in the hem large enough to take a dowel rod or a ruler. Reinforce the edges of the hole with sturdy tape.



Cut a piece of string (kite twine works well) about one foot longer than the circumference of the opening (for this particular design, the string should be 10 feet long). Secure one end of the string to a dowel rod or a ruler, and use this device to push the string through the entire hem.



Cut the string off of the dowel or ruler, and tie the two ends together.



**Your balloon is finished!**

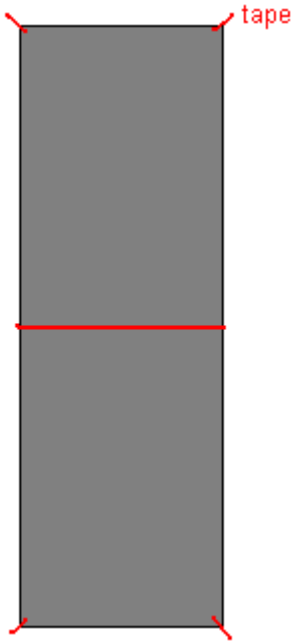
To inflate the EZ tube, hold the drawstring end open and run into the wind. When the balloon is full of air, quickly pull on the drawstring to close the balloon and trap the air inside. It will heat up after a couple minutes.



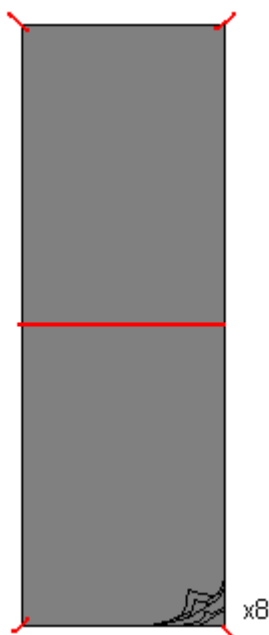
## Traditional Hot Air Balloon Shape

Use this design to build an 8-foot tall solar balloon in the shape of a regular hot air balloon. This balloon uses 16 trash bags and should be built on an open floor space.

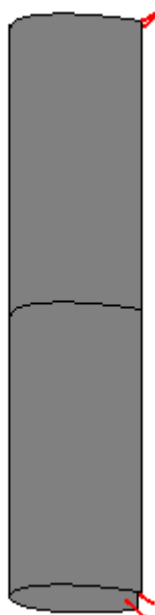
Start by cutting open all 16 bags. Tape 2 of them together by their 3-foot edges so you have a sheet that measures 3 x 10 feet. Tape the corners down onto the floor to keep the sheets spread out.



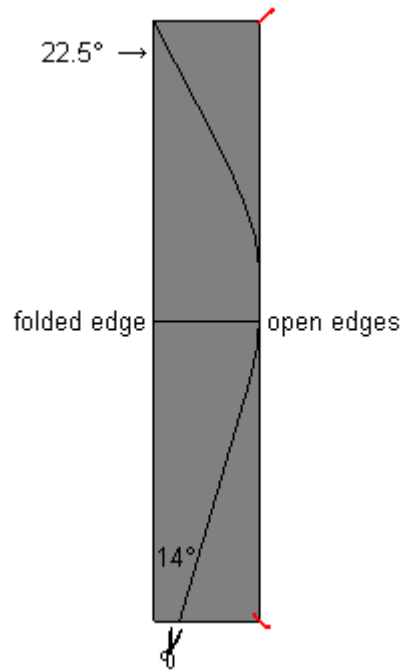
Make 7 more of these 10x3 sheets and stack them all on top of each other so you have a total of 8 sheets.



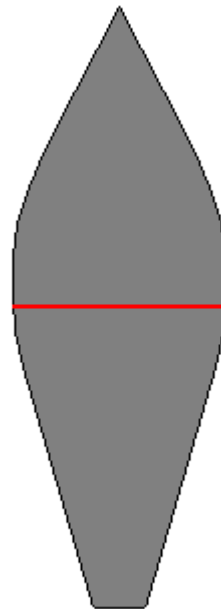
Carefully remove the tape from floor on the corners of one side of the sheets. Fold the stack in half lengthwise as shown.



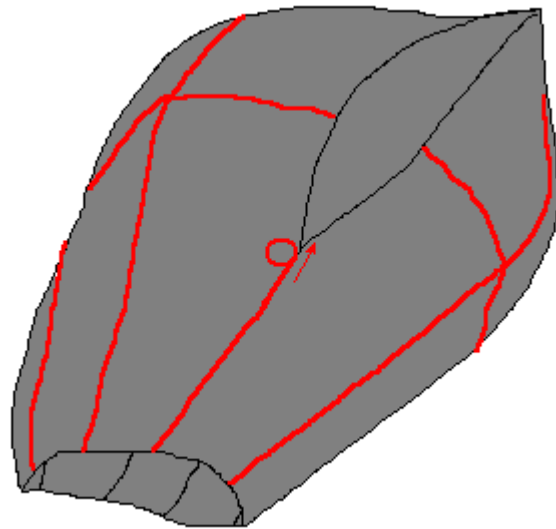
Cut the shape as shown. Make sure the top angle is  $22.5^\circ$  and the bottom is between  $13^\circ$  and  $15^\circ$ .



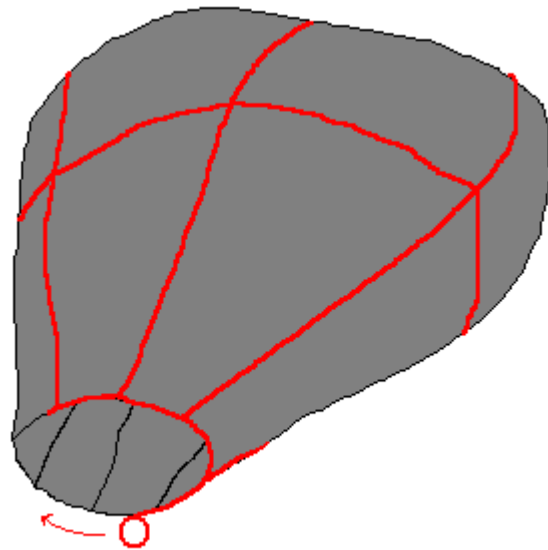
Unfold the stack so you have 8 leaf-shaped "gores" like this:



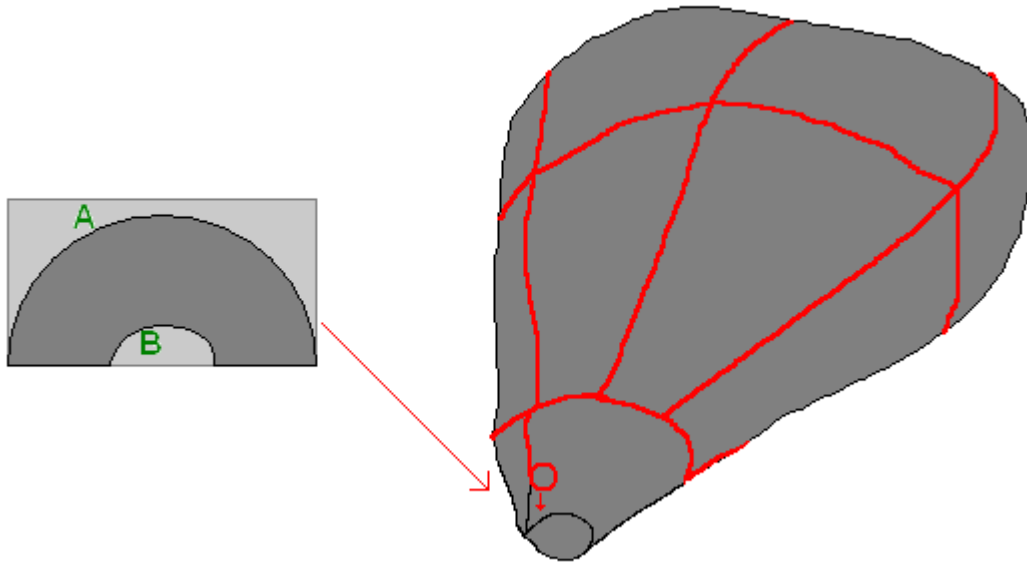
Tape the gores together along the edges from bottom to top.



Make sure there are no holes in the top of the balloon; then reinforce the bottom (mouth) with tape to prevent tears.



If the mouth is larger than you want, you can make a “skirt” for the balloon by cutting a semicircle from another trash bag. Use the illustration below as a guide to cutting and attaching a skirt. The long, curved end of the skirt (A) is fastened around the mouth of the balloon, while the short, curved end (B) becomes the new, smaller mouth.



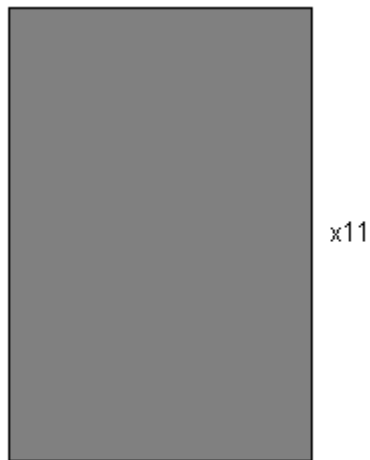
**Your balloon is ready to fly!**



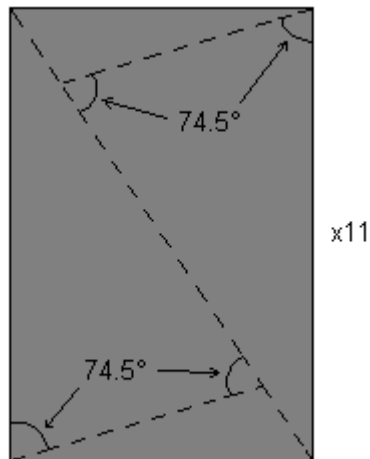
## Solar UFO

This balloon is about 10 feet wide and looks like a black flying saucer when seen in the air from a distance. The UFO uses only 11 bags.

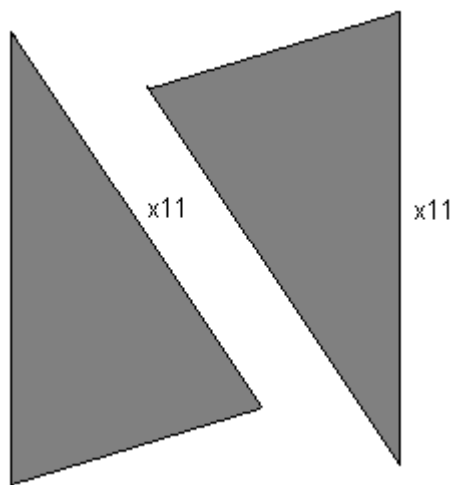
Start by cutting open the bags. Stack them all on top of each other, making sure they are spread out (don't use tape to keep them spread).



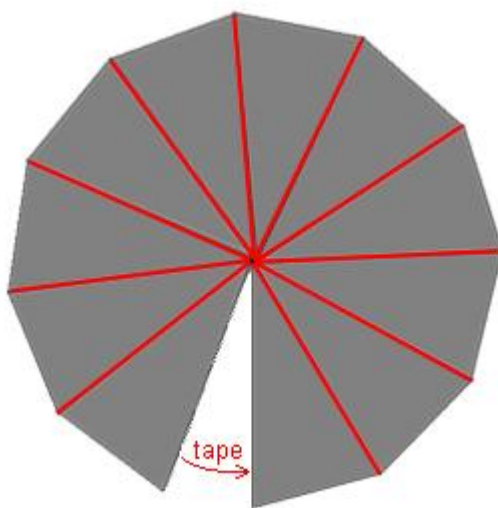
Cut the stack as shown by the dotted lines.



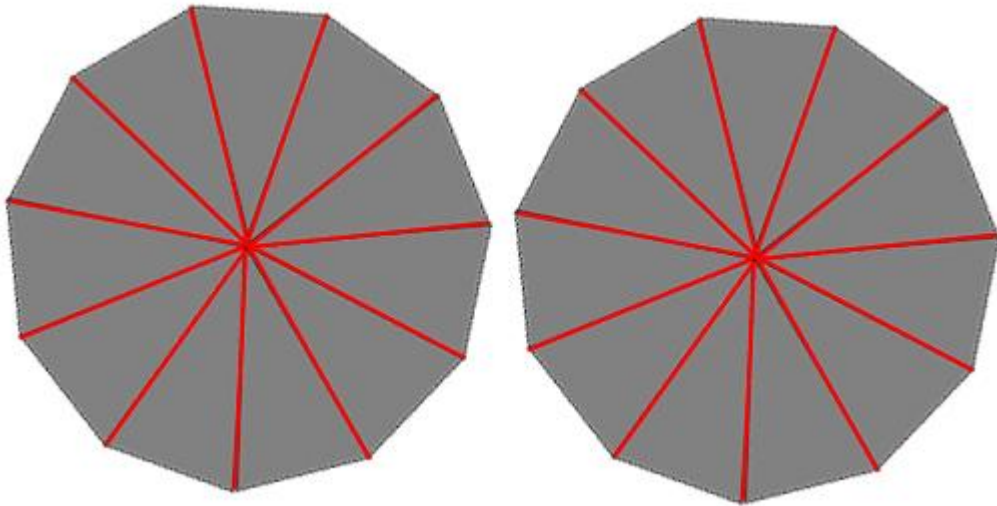
Discard the small triangular scraps. You should have two stacks of 11 triangular sheets.



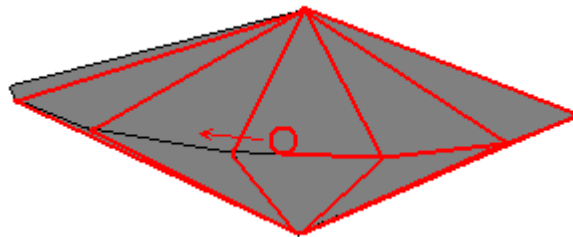
Tape the first 11 together as shown.



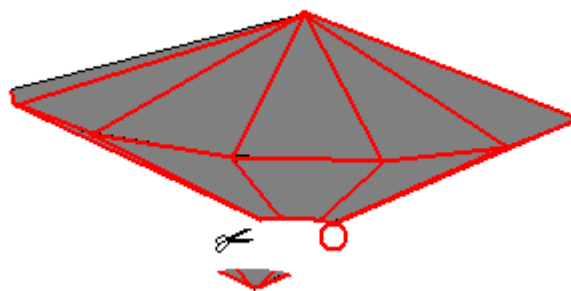
Tape the second 11 together just like before, so you have two identical pieces.



Tape these pieces together as shown.

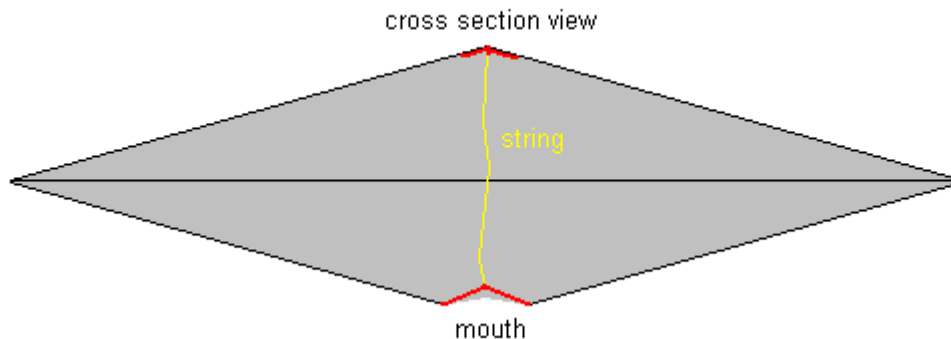


Cut a hole in the center of one end of the balloon. This will be the bottom where you will inflate the balloon.



If you don't want the seams to be visible from a distance, turn the balloon inside out.

Cut a piece of string about 3 ½ feet long. Secure one end to the center of the top on the *inside* of the balloon. Use multiple, stacked pieces of tape in a crisscross pattern to prevent the string from tearing away from the plastic. Secure the other end of the string to the mouth.



The string will hold the balloon in a saucer shape; without the string, the balloon would become more rounded and wouldn't have the appearance of a flying saucer.

### **Your balloon is finished!**

**IMPORTANT:** Attach some weight (2-5 ounces) to the mouth of the balloon; without bottom weight, it will flip upside-down as soon as you release it.

Inflate your balloon and let it go! Tethering the UFO may cause the shape of the balloon to become significantly distorted. This balloon works best in free flight.

## Tethering Solar Balloons

Tethering a solar balloon keeps it anchored to an object on the ground. If you are not planning to release a balloon with an “If Found” tag, then you should tether your balloon to avoid losing it.

Use string to tether your balloon. The string must be strong yet lightweight, and it must be attached securely to the balloon to avoid accidental breakage. Gusting wind on a solar balloon can pull the tether surprisingly hard, as the balloon acts like a sail and catches large amounts of wind.

Before getting into the specifics on tethering, let me tell you quickly how I discovered solar balloons. This happened to involve an incident where I lost a balloon due to a broken tether.

I had been experimenting with model hot air balloons, and had discovered that black balloons stayed hot a lot longer in the sun than white balloons. I figured this was due to the fact that dark colors absorbed heat, but I hadn't done any kind of research on the subject.

One sunny day, I had a balloon tethered to a chair using cheap curling ribbon. The ribbon was apparently not strong enough to withstand the tugs coming from the balloon. After a few minutes of thrashing, the tether snapped and the balloon was free.

I watched the balloon as it continued to gain both distance and altitude. It never

stopped rising, and eventually the black speck in the sky was gone.

This was the first incident in which one of my experimental balloons proved that it was solar-heated. After some internet research, I discovered the concept of solar balloons, and began building more balloons using black plastic instead of white plastic. I also learned to use a stronger tether.

Now, back to the topic of tethering – I'll show you my favorite tether; it's what I use for all of my balloons and has never failed me.

### Monofilament Fishing Line



This nylon line is thin and lightweight, yet very strong and can withstand the tension of a large solar balloon blown by the wind.

If you're a fisherman, you know that fishing line comes in many different strengths. The strength of fishing line is indicated by **x-pound test**. X indicates the number of pounds of strain at which the line will break. For example, 10-pound test fishing line will withstand up to 10 pounds of tension before it breaks.

When I fly larger solar balloons that carry expensive equipment such as a digital camera, I usually use 30- to 50-pound fishing line for extra security. 15-pound line should work fine for a 10- or 13-foot tetraon, but I use a much higher strength in case of nicks or other abrasions in the line - which brings up another subject.

Check your fishing line before each flight to ensure that it doesn't have severe nicks where it could break easily. Run the line between your fingers to feel for rough spots. If you think your line looks or feels too beat-up, replace it with some fresh line to avoid accidentally losing a balloon.



13-foot tetraon maiden flight with 50-pound fishing line

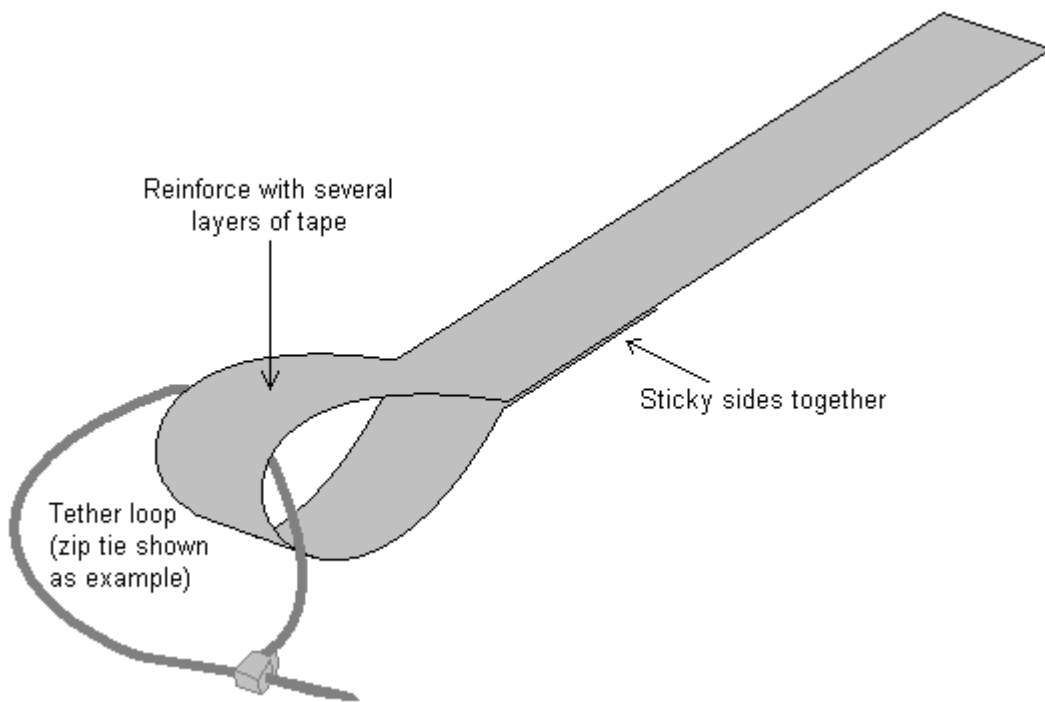
### **Attaching the Tether**

You will need to attach your tether to the balloon securely, so it does not tear away from the balloon during gusts or hard pulls.

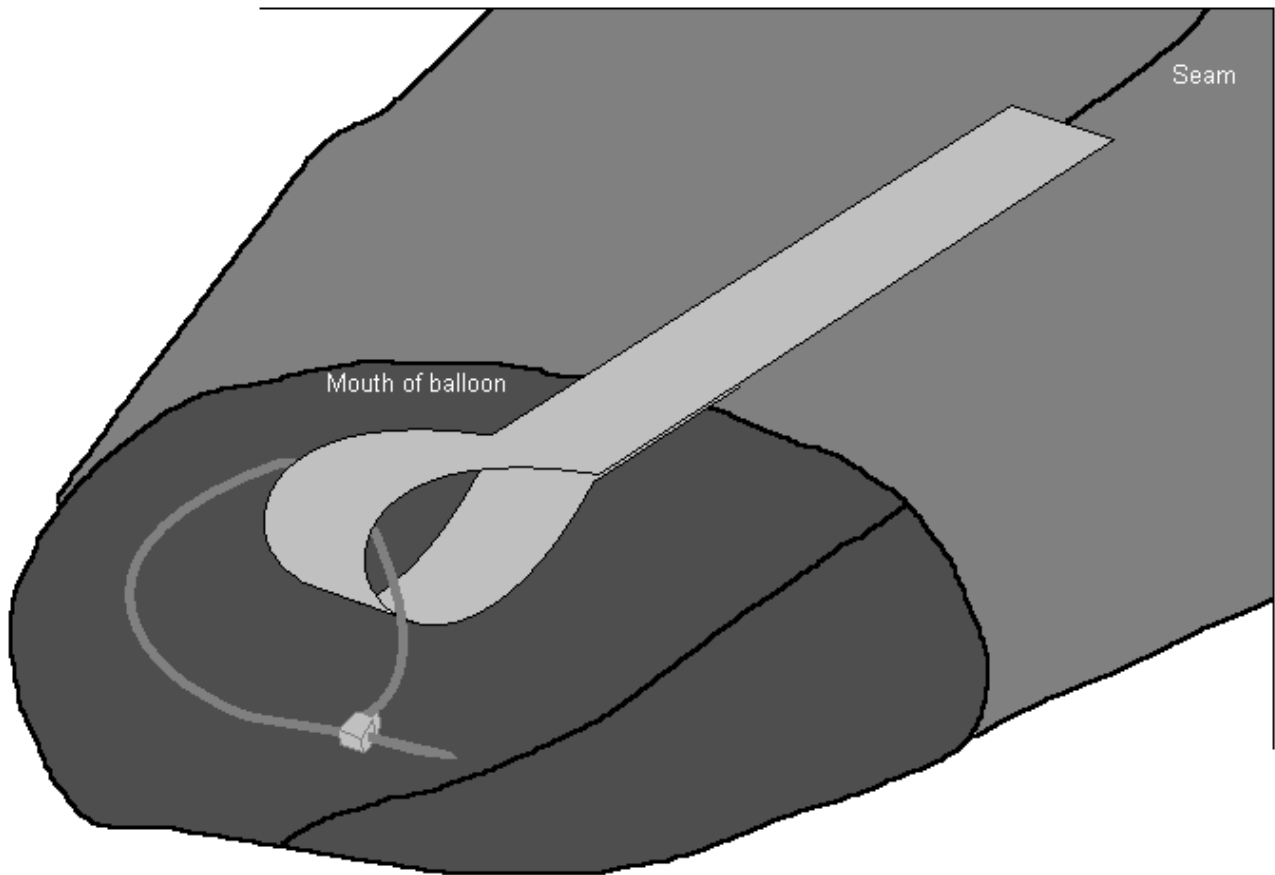
A rule of thumb for good, secure tether attachments is to distribute the tension a short distance up the length of the balloon to avoid focusing all the strain on one point.

Start by making a loop to which you will tie the end of the tether. I usually make this loop with a thick stack of several strips of tape, but you can also use wire, zip ties, fishing line, or other sturdy materials to make a loop.

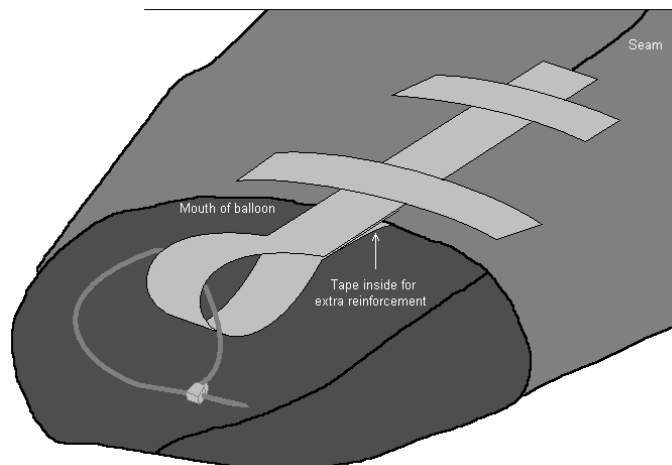
Secure the loop to a 1- to 2-foot long piece of sturdy packaging or duct tape. This strip of packaging or duct tape will serve as a load tape, which will help distribute the tension across the lower part of the balloon. Use the illustration below as a guide to attaching the loop to the load tape.



When your loop is securely attached to the load tape, stick the tape directly on a seam, as shown below. The seam is a strong point on the balloon; it's important to attach your tether to a strong point. This keeps the tether from tearing away a portion of the mouth if the balloon is pulled excessively hard.



Reinforce the tape to ensure its security and to prevent it from tearing off.



When you feel confident that your tether attachment loop is secure, tie on the tether using several knots to keep it secured to the loop.

**Your balloon is now ready for secure tethered flight!**



## Releasing Solar Balloons

Solar balloons show their true flying potential when they are released. Whether the tracking system is a simple 'If Found' note or a complex radio transmission system with a GPS hooked up to Google Earth, you can release your own solar balloons and discover how far they can fly.

I will get into detail here with the simple 'If Found' note method. Basically, a note containing contact information is attached to a solar balloon, which is then released on a sunny day. Depending on where the balloon is released and where it lands, it may or may not be found. Of the balloons I've released, some were found less than 100 miles away, while others were found 500 or more miles from their launch site!

### 'If Found' Note

Print or write out a note on a sheet of paper containing the following info:

- Your contact information (email, phone, etc)
- Identification of the balloon (so you know for sure that it's your balloon)
- Instructions for contacting you (such as *"please include the flight ID, location found, and date found."*)

I use what I call a "Flight ID" – usually a sequence of numbers and letters that I use to identify balloons that are released. When a balloon is found, its finder will type the flight ID into the form when he/she submits the report to me. That way, I know which balloon has been found.



## Where and When to Release

Consider your location before you release a balloon. Which way does the wind usually blow? Could the balloon end up in a remote area or in the ocean? Will it likely land in a populated place or will it fly straight towards an extensive forest or desert? Also, are there any local laws that prohibit the release of balloons? Check your local laws, and also study your local weather patterns and the jet stream to determine the direction in which your balloons are most likely to fly.

In middle Tennessee, from where I release most of my balloons, there's a possibility of a released solar balloon reaching the Atlantic ocean. If I release a balloon early enough in the morning of a west-wind day, it will blow eastwards

and likely will end up in the ocean. If the wind is forecasted to blow north or northeast, I can release a balloon much earlier in the morning without worry of the balloon landing in the ocean.

The time your balloon is in the air and the wind speed will determine how far your balloon goes. My personal record 700-mile flight took place during what was probably the windiest release I've done. It took at least 15 minutes before I could get the balloon up in the air without the wind blowing it towards the houses or trees. But when it did finally take to the air and clear the treetops, it sped north-northeast at a faster rate than any of my other released balloons.

If I had released a balloon on an equally windy day, at the same time of day, but with a wind directly from the west, the balloon would have surely gone out into the ocean. But if I had released a balloon at the same time during a near-windless day, it would have probably stayed over land.

So consider your conditions before releasing your balloon. Check your weather forecast to determine where the wind might take your balloon. Look for mountains, plains, forests, or other unpopulated areas that might be likely landing areas. If you live in a place that seems bad for releasing balloons, then it's best to wait until you're in a better location before you release any solar balloons.

## The Release

When you're ready and you've got the balloon all set up, remember these extra notes:

- Make sure the mouth is properly weighted; the balloon must stay upright but not be weighted down too much. A few stone pebbles should work.
- Use a smaller balloon, such as a 5-foot tetron to start with.
- Keep the mouth of the balloon **open**. If the balloon flies into choppy wind conditions, air could be knocked out of the balloon, and it will need to re-inflate itself. With a closed mouth, the balloon will slowly lose air through small holes in the seams and won't be able to refill with air.

...And that's about all there is to know about releasing your own solar balloons.

## Biodegradable Alternatives

Building your balloons with materials that can decompose quickly is by far the best choice for balloons that you intend to release. It's likely that many balloons you release may not be found, which means that they are probably caught somewhere in the wilderness and won't decompose for hundreds of years.

Unfortunately, biodegradable bags are still in their early days and not many options are available. It can be difficult to find bags that are thin or lightweight enough to use for solar balloons. However, performing some Google searches can turn up possibilities worth trying. Remember, the bags must be black and as thin as possible. If you can't find thin enough bags, building a larger balloon is still worth a try and may be your only option.

I recommend biodegradable materials *only* for balloons that are to be released. Many biodegradable bags don't have a good shelf life and/or they will deteriorate after a while in direct sunlight. For balloons that are intended to be tethered and re-used, use regular HDPE plastic for long-lasting solar balloons.

To get you started, here are links to a couple of online sources for biodegradable bags. Sites like these can be found easily using a Google search.

[Green Office Store](#)

[OnlyGreen](#)

If you do some sleuthing on the internet, you will find that most biodegradable bags are either too thick, the wrong size, not black, or all of the above. If you do find a good source of biodegradable bags, keep in mind that they are most likely thicker than what I recommend and that they are also likely more dense, which makes them even heavier. Build a larger balloon such as a 9- or 10-foot tetraon if a smaller one won't fly.



## **Taking Solar Balloons a Step Further**

Now that we've covered everything you need to know about building and flying solar balloons, it's time for you to start creating. Build some balloons, take aerial photos, make a 100+ mile flight, or entertain kids at the park. Take what you've learned here as a guide, and use the knowledge to create even more designs or uses for solar balloons.

If you're an RC nerd or if you know of one, why not try a remote-controlled solar blimp? Or, if you want to really get fancy, look into the radio/GPS rigs that people are putting on weather balloons to record long flights. If you'd rather keep it simple, there's always fun in just flying a plain old solar balloon.

On days when it's sunny but not windy enough for kite flyers to take their kites to the park, bring out a solar balloon. It will attract attention. I've had countless people ask me about my solar balloons when I flew them at the park.

However you fly your balloons, be sure to spread the word. Solar balloons are still a little-known hobby. Make flyers and hand them out to people who are interested. Give away a couple balloons to kids at the park. Do what you can to get the word out about this unique, cheap, and fun hobby. I think this hobby has some great potential, so why not share it with others?

Now go out and build some balloons! And tell me your results. I'd love to hear about experiences, long flights, experiments, or anything else you do with your solar balloons.

E-mail me your photos, stories, comments, suggestions, and ideas to:

[solarballoons@gmail.com](mailto:solarballoons@gmail.com)

And if you like my Web site or this eBook, don't forget to tell your friends.

Happy flying!

Jonathan Boehme

Webmaster

[www.solar-balloons.com](http://www.solar-balloons.com)



