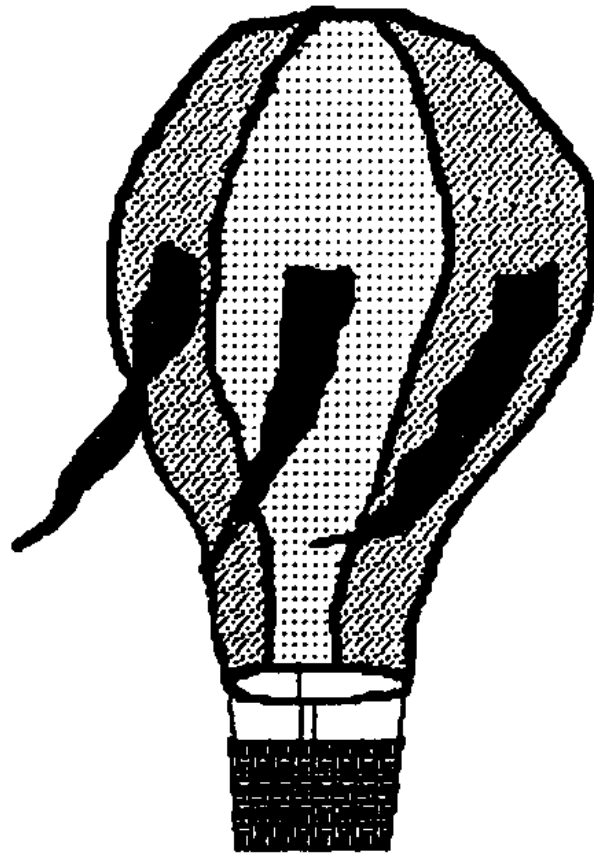


# Science Alliance

April 17, 1996

**Tissue Paper Hot Air Balloons**

**Enthusiasm Soars High With Hot Air Balloons!**



Presented by  
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## \*A Special Note of Thanks\*

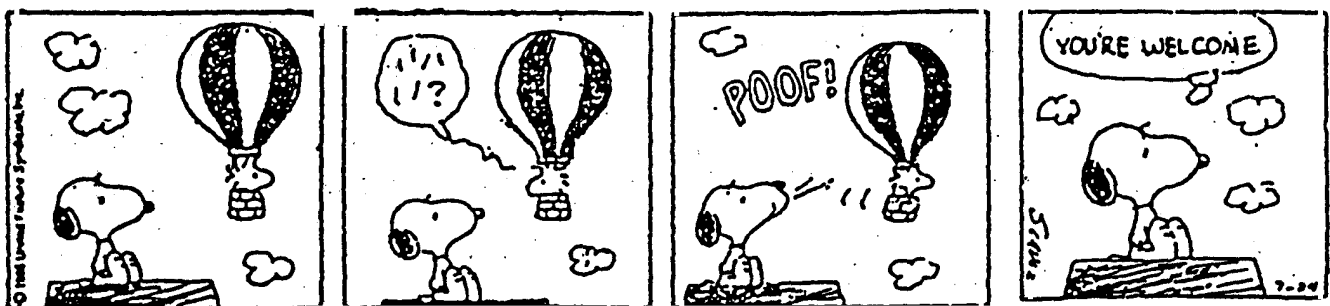
This material is used with the kind permission of Darrel Zimmerman. Darrel is a middle school teacher from DeSoto, Kansas who has excited students for years with this marvelous teaching tool. He compiled the information in this handout for a 1993 Convention of the National Science Teachers Association.

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The hpt air balloon is a real winner! You will find that students will be willing to spend a lot of their own time constructing one. It is a good starter for more conventional work on buoyancy, convection, expansion of gasses, Charles' Law, transport, history of inventions, etc. Tissue paper balloons in the classroom can serve many other purposes as well. For weather classes the balloons can demonstrate wind currents, wind shear, etc. They have been used as rewards for achievements and to celebrate the "launching" of a new science curriculum.

## PEANUTS by Charles Schultz



# History of Hot Air Balloons

Some 200 years ago, one of our oldest dreams came true... we soared into the skies. The Montgolfier brothers pointed the way with their first balloons, making all else possible. From that time forward we have been able to travel the heavens, along with the birds and the clouds. It is difficult to imagine the enthusiasm of those who hailed the sight of that first miraculous flight, but the result was many inventors/scientists/hobbyists perfecting ballooning rapidly. In those great times, France took an early lead. French were the first to fly and typically the French charlatans provoked the greatest excesses on the part of the public. England, North America, and Italy did not lag far behind, and ideas spread quickly. Thanks to these early pioneers, ballooning ceased to be quite so dangerous, such a matter of chance. Experience showed how risks could be foreseen and reduced to a minimum.

Still, however, the aeronauts were frustrated in their attempt to control the course of their balloons. They all dreamed of the day when their airy machines would change into practical methods of travel from one point to another. When the airplane and the controllable airship arrived, the balloon was freed from its utilitarian aspirations, the balloon was replaced by the noisy, heavier than air monsters. Thus the free balloon seemed to have finished its career. In changing circumstances, balloons had been the decoration of the skies, attracting thousands of viewers at times of national rejoicing. Ballooning probably reached its finest hour as the link between besieged Paris and unoccupied Paris.

Becoming purposeless did not cause the hot air balloon to disappear. Heedless of the noisy machines which replaced it, it continued to ride on the winds. People continued to enjoy the unique sensations brought of silence and calm. Borne up in his wicker basket, man shed his burden of gravity, and while the flight lasted, was transformed from a terrestrial creature into a poet who surveyed all creation from the heavens.

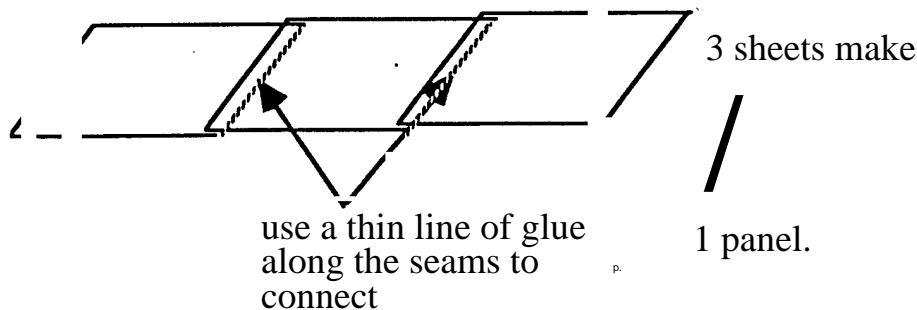
# Creating a Tissue Paper Balloon

## Materials:

2 or 3 people per balloon  
tissue paper in 20 by 30 inch sheets. (amount is dependent on the balloon pattern used)  
white glue  
a balloon pattern (see pages 11,12, & 13)  
about 20 straight pins  
scissors  
1 foot of kite string  
a set of pliers or wire cutters  
4 feet of 18 gauge wire or a 2 by 48 inch piece of poster board  
1 paper clip  
cellophane tape

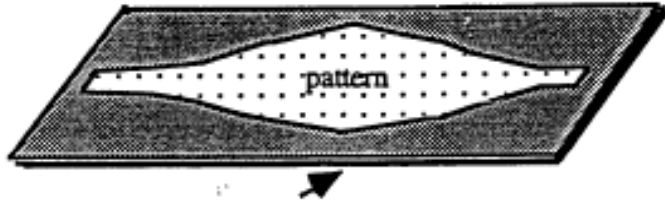
## Procedure:

1. Decide on a balloon pattern.
2. Choose the color scheme for your balloon. Do you want a solid colored balloon, a checkered pattern, or maybe vertical stripes? Be creative!
3. Using white glue, connect three sheets of tissue paper together. This will make one long panel. Overlap the edges about one inch or less. Continue to make panels until you have enough for your whole balloon. The balloon pattern determines how many panels you need to make.



4. Stack all of the panels on top of each other. Order the panels so that you achieve the desired color scheme (for example: if my balloon was to be alternating vertical stripes of purple and white, I would stack the panels now so that the panel colors alternate between purple and white). Attempt to make them straight, even and wrinkle free. Make sure the panels do not stick to each other!
5. Place a pattern on top of the stacked panels. Use straight pins to connect the pattern to all of the panels

Place straight pins 12 to 18 inches apart, or as needed.

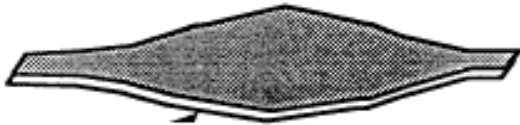


stack of  
panels

6. Using the pattern as your guide, cut all the panels to size. The scrap tissue paper can be saved and used later to make streamers or pictures for the balloon. These additions should be made when the balloon is finished.

7. Unpin the pattern, and save it to use again for another balloon. Leave all the panels in their stack.

8. Remove the top two panels from the stack. Offset them so that the bottom panel extends out 1/2 inch along one side. Fold the bottom edge up and make a good crease. Apply a thin but continuous line of glue 1/4 inch from the edge of the top panel. Fold the bottom panel up and over to cover the glue. The two panels should be connected along one side now.

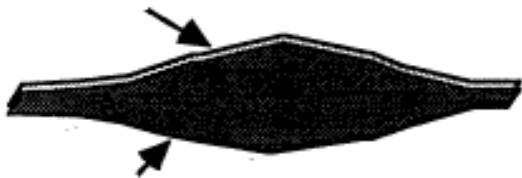


Bottom  
panel  
extends out 1/2  
inch



The  
bottom panel  
is folded over the  
top panel

9. Take the next panel off of the stack and place it on top of the two attached panels. Again, offset the bottom panels (the attached ones) out 1/2 inch along the opposite side that was offset in step #8. Again, apply a thin line of glue and fold the bottom edge over the top panel.



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inch  
The bottom panel  
is folded over the  
top panel

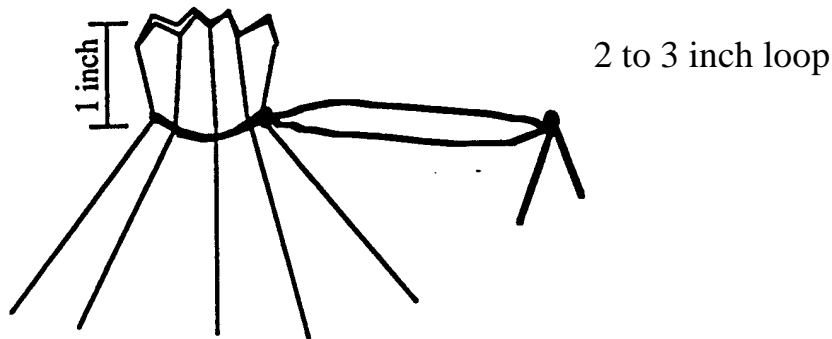
Place straight pins 12 to 18 inches apart, or as needed.

10. Continue to attach the panels to each other along alternating sides. Remember to apply only a very thin line of glue. If you use too much glue the glue will soak through the tissue paper and adhere additional panels together. It is a good idea to periodically check that this is not occurring.

Place straight pins 12 to 18 inches apart, or as needed.

11. After you have attached the final panel, you need to fasten it to the bottom panel. To join the ends: a) flip the attached panels over all at once, b) gently fold the inside panels up, not allowing them to get a crease, but allowing the two unattached edges to meet, c) glue the two edges together.

12. With the balloon still flat, gently unfold the inner panels, at the top and gather them together. Use the 1 foot of kite string to tie the top shut with a knot. Leave about an inch of tissue paper on the top. With the loose ends of the string make a two to three inch loop by tying another knot. This loop is to hang the balloon with.



13. With the balloon still flat, gently unfold and open the bottom of the balloon. Make a hoop out of wire\* or posterboard and insert this hoop into the mouth of the balloon. Carefully expand the hoop until it just fits the diameter of the balloon one inch from the bottom. Remove the hoop from the balloon permanently set the diameter of the loop (i.e.: twist the wire or staple the posterboard at its correct size), and reinsert the hoop in the mouth of the balloon. If using a wire hoop, fasten the custom fitted wire in the balloon by folding the inch of tissue paper over the wire and gluing the tissue paper to itself. To fasten a posterboard hoop in, simply run staples around the hoop, stapling through both the posterboard and the balloon, and then gluing the very bottom inch of tissue paper to the cardboard by overlapping the tissue paper onto the hoop.

14. Attach a paper clip to the string loop on the top of the balloon and hang the balloon from the ceiling or a light fixture. Let the glue on the balloon dry by delicately opening up the entire balloon.

15. While the balloon is hanging check all the seams to make certain none of the glue is fusing unwanted parts together, use cellophane tape to patch any tears in the tissue paper, and glue tissue paper streamers or cut-out designs to the outside of the balloon.

16. The balloon is now ready to fly! See page 7 to learn how to launch the balloon.

Place straight pins 12 to 18 inches apart, or as needed.

## Launching a Tissue Paper Balloon

Launching tissue paper balloons can be very dangerous and every precaution needs to be taken to ensure a safe liftoff. There are many experienced balloon launchers and students who will confirm the fact that tissue paper is flammable. Do not attempt to launch balloons with a class of children if you, yourself, have never launched balloons before.

There are two basic methods of launching balloons. One method uses a newspaper fueled flame under a stove pipe to generate the hot air. The second method uses a propane burner to heat the air.

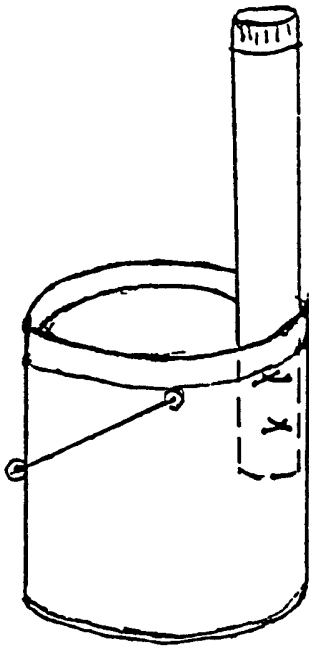
### Stove Pipe Balloon Launcher

#### Materials:

- a five gallon metal bucket
- 4 feet of stove pipe or galvanized heat duct (4 to 6 inches in diameter)
- 2 pieces of 12 inch wire
- crumpled newspaper for fuel

#### Building Procedure:

Punch two holes into the side of the bucket with a nail or drill (see figure). Use the wire to wrap around the pipe and to hold it into place. The pipe should extend about half way down into the bucket.



#### Launching Procedure:

1. Light newspaper wads in the bucket (sterno cooking fuel can be used as a pilot light in the bottom of the bucket).



Place straight pins 12 to 18 inches apart, or as needed.

2. Place the balloon loop on the nail of your launching stick\*. Hold the balloon up using the stick.

a launching stick can be made from the two larger diameter sections of a jointed cane fishing pole. Wrap the shank of a nail with masking tape until it fits snugly in the top ferrel.

3. When flames no longer extend above the top of the stove pipe, move the balloon over to the pipe. Have someone guide the opening of the balloon and lower the balloon down over the pipe. The top of the pipe should be in the upper center of the inside of the balloon. Someone needs to gently pull the sides of the balloon outwards (grab at a seam). This helps the balloon inflate and prevents the tissue paper from being swept over the flame and catching fire.

4. When and if enough hot air is in the balloon, the balloon will rise and unhook itself from the launching stick.

5. The balloon floats away!!!

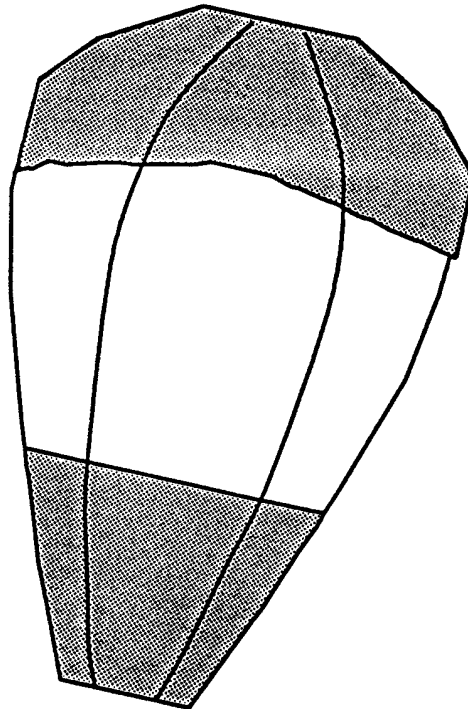
6. When the balloon comes down again, assuming you are there, grab it by the top. This way the balloon can be deflated, rolled up, and protectively carried.

7. The flying process can be repeated as long as the balloon holds out. Fix any tears with cellophane tape.

8. Garbage bags make excellent storage containers for tissue balloons. They must be labeled if there are a lot. Garbage bags all look alike from the outside.

#### Launching Tips:

- Take care that the balloon does not catch fire. Remember there must be some element of fire risk so take all precautions.
- Only fly the balloon when there is a <3 mile per hour wind.
- It is strongly recommended that the balloons be inflated using a static heater and that they are not sent up carrying any form of lighted material.



Place straight pins 12 to 18 inches apart, or as needed.

8

7

Place straight pins 12 to 18 inches apart, or as needed.

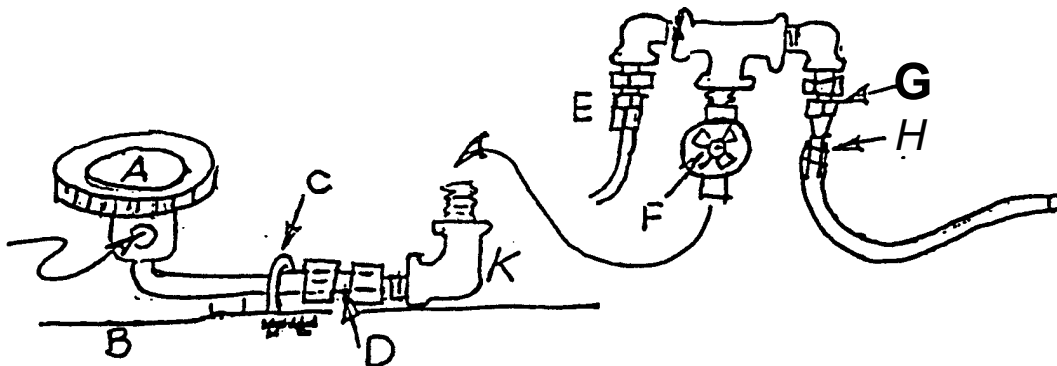
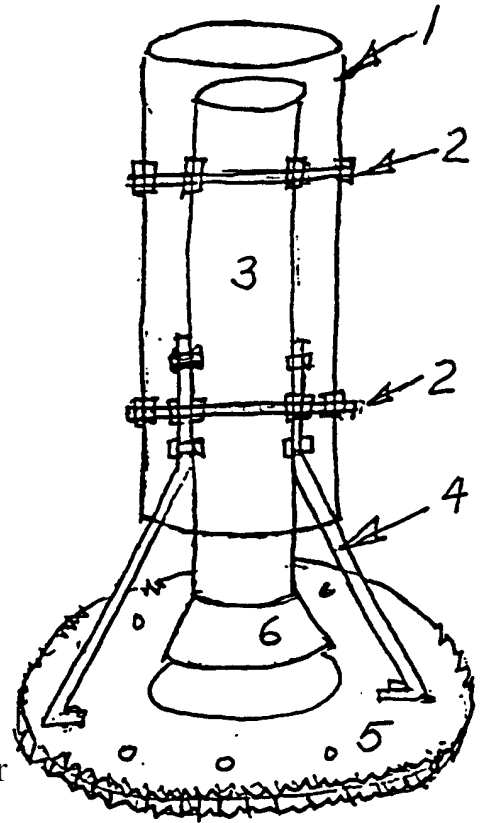
## Propane Fired Balloon Launcher

The propane burner has worked out quite successfully, having several advantages over other sources of heat. It heats very quickly, makes no smoke, and the heat can be regulated. Balloons have even been launched indoors using this type of launcher. The big disadvantages are cost and weight. If you decide to make a propane fired balloon launcher it would be wise to investigate the possibility of getting some salvaged parts.

Precautions that must be mentioned are that with the set-up described below, gas will escape from the pilot anytime the tank valve is open. Propane is heavier than air and if it escapes unburned, it could collect in low areas. It is, in a sense, an open fire and remember that tissue paper burns so be cautious! Balloons have been inflated inside of buildings, but doing so is not recommended.

### Materials:

1. 8 inch diameter by 2 inch round heat duct
2. 1/4 inch diameter all-thread bolt with 8 nuts and washers
3. 4 inch diameter by 2 inch round heat duct
4. 3 evenly spaced strap iron legs
5. Heavy metal base auto flywheel or something similar
6. Sheet metal hood to cover burner and transfer to 4 inch pipe
- A. Burner form a gas hot water heater (a small orifice is needed for propane)
- B. Base
- C. U-bolt to holder burner to base
- D. Compression fitting to 1/2 inch pipe
- E. Compression fitting from 1/2 inch pipe to pilot light
- F. In line water shut off valve
- G. Flare fitting to connect 1/2 inch pipe to 1/2 inch outside diameter copper pipe (rubber O-ring in flare to make a gas tight seal)
- H. Hose clamp over ends of 6-8 inch of 1/2 inch inside diameter plastic or rubber hose
- I. Camper size propane tank with a pressure regulator



Place straight pins 12 to 18 inches apart, or as needed.

Launching Procedure:

1. Set up outside Use a proper fitting wrench, not pliers, to tighten connections on the gas supply.
2. Close main heater valve.
3. Open propane bottle valve all the way
4. Open main heater valve for 5 seconds to purge the gas line
5. After closing heater valve, check location of pilot light.
6. Gas will feed to pilot anytime propane valve is open. With your face away from pilot, ignite the pilot with a match
7. Do not look down the pipe when the main burner is on
8. With the balloon suspended over the pipe with a launching stick, have helpers pulling the sides of the balloon out.
9. Open valve. The pilot will ignite the main burner.
10. When the air in the balloon is sufficiently heated, the person in charge gives a signal for everyone else to step back from the balloon and the launcher.
11. The person in charge turns off the burner and releases the bottom of the balloon.
12. Shut off the propane valve when it is left unattended.

Tips:

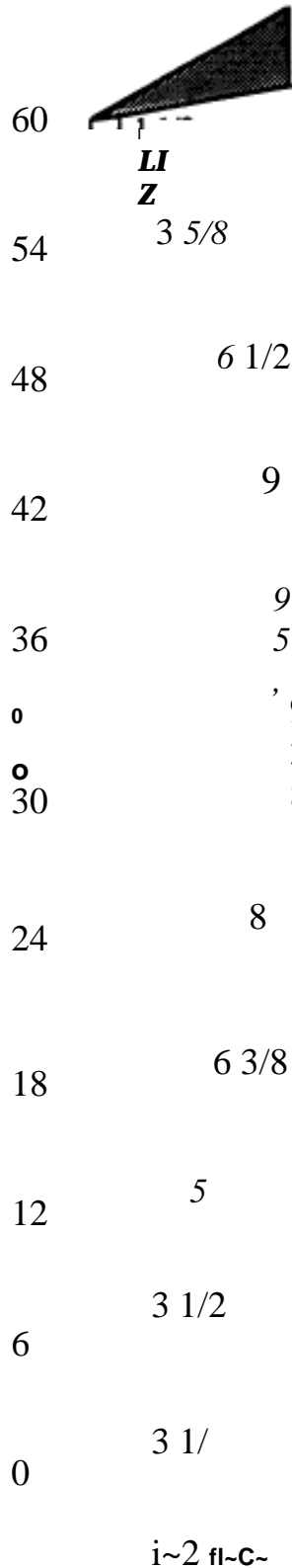
- Practice procedures and use with adults before involving children.
- Fire regulations may prohibit storage of propane in buildings.
- If a balloon should catch on fire allow it to burn out on its own. Just cross your fingers and pray. The balloon will be consumed in a few seconds and the kids will love it.

Place straight pins 12 to 18 inches apart, or as needed.

10

Place straight pins 12 to 18 inches apart, or as needed.

## Tissue Paper Balloon Pattern Z-3



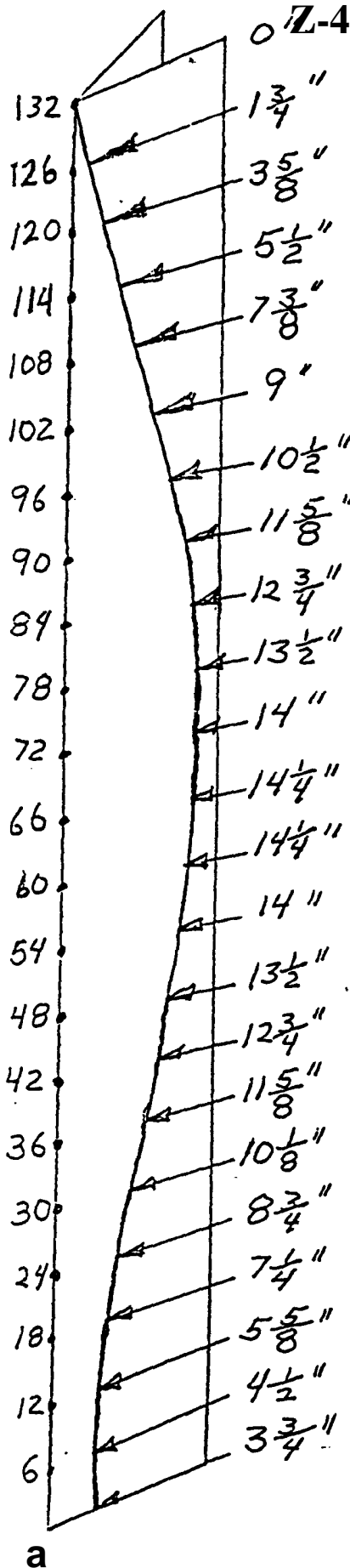
This balloon requires 12 sheets of 20 inch by 30 inch tissue paper to be formed into 6 panels of 2 sheets each..

The pattern uses a 2 foot by 5 foot piece of butcher paper.

- 1) fold the butcher paper length wise ~
- 2) make a pencil mark every 6 inches along the folded edge
- 3) lay out measurements
- 4) connect the points to make a uniform curved line
- 5) cut the pattern out with scissors and label as

Place straight pins 12 to 18 inches apart, or as needed.

## Tissue Paper Balloon Pattern



0 Z-4

This balloon requires 60 sheets of 20 inch by 30 inch tissue paper to be formed into 10 panels of 6 sheets each.

Pattern: The pattern uses a 36 inch by 132 inch piece of butcher paper.

Panels: Standard 20 by 30 pieces of tissue paper are used, but they are arranged like the drawing below.

Bottom hoop: Using approximately 30 feet of 18 gauge wire, double, and twist to form a four strand cable.

Top piece: Since this pattern makes a balloon that is not gathered at the top, special arrangement must be made to attach the string.

- a) cut an 8 inch circle from mimeo or ditto paper
- b) fold in half then fold on fourths
- c) cut a "V" in the top to make a 10 pointed star with a 3 inch diameter center
- d) cut out a 2 by 3 inch rectangle of paper and shape into a tight roll 2 inches long
- e) Tie in the center with a 1 foot piece of string, placing the other end of the string through the center of the star
- f) glue a 2 inch circle of paper on the bottom to hold the paper roll inside
- g) after the panels of the balloon have all been connected, arrange the balloon in a pile with the top in the center
- h) put a thin bead of glue around the edge of the star and press onto the top center of the balloon