

Independent Study
Telescope Making

THE ANDROMEDA TELESCOPE

Arrowhead High School
Hartland, WI

1999 - 2000

Instructor: Mrs. Kaiser

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Sunday, August 22, 1999

1:45 – Started “Finder Scope”

- filed threads if male PVC (inside part)
- cut PVC pipe
 - *lens tube
 - *lens holder (1/4 inch pieces)
- painted inside of PVC pipe - black
 - <to prevent light reflection>

NOTE #1: Having trouble finding a way to make an accurate focuser since threads on the outside of the male PVC connector become smaller, and will not completely fit into the female part of the PVC connector.

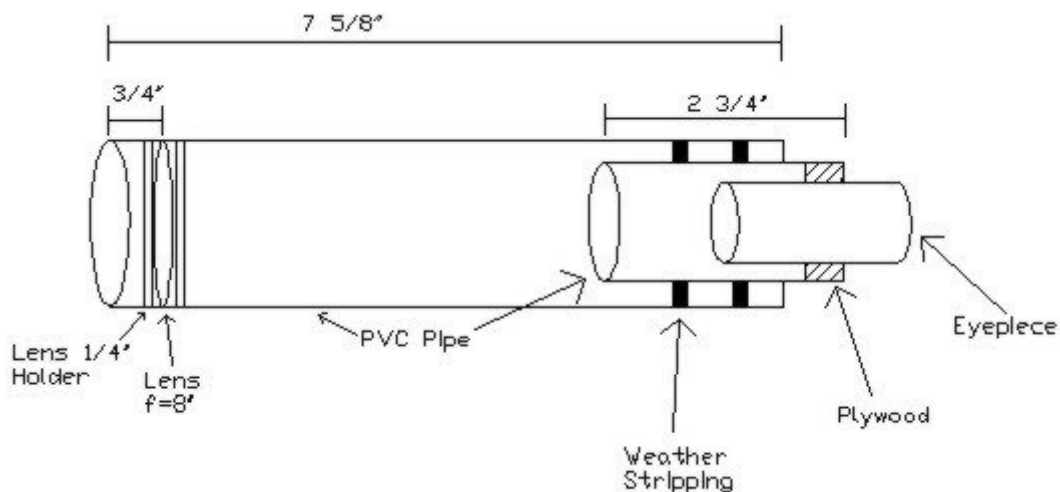
SOLUTION #1: Screw PVC connectors

3:15 – Went to the hardware store

- Bought > weather stripping
- coupling nut for the spider
- hole saw

4:15 – Continue working on “Finder Scope”

- thought of new technique that uses friction rather than tracking
 - *diagram below



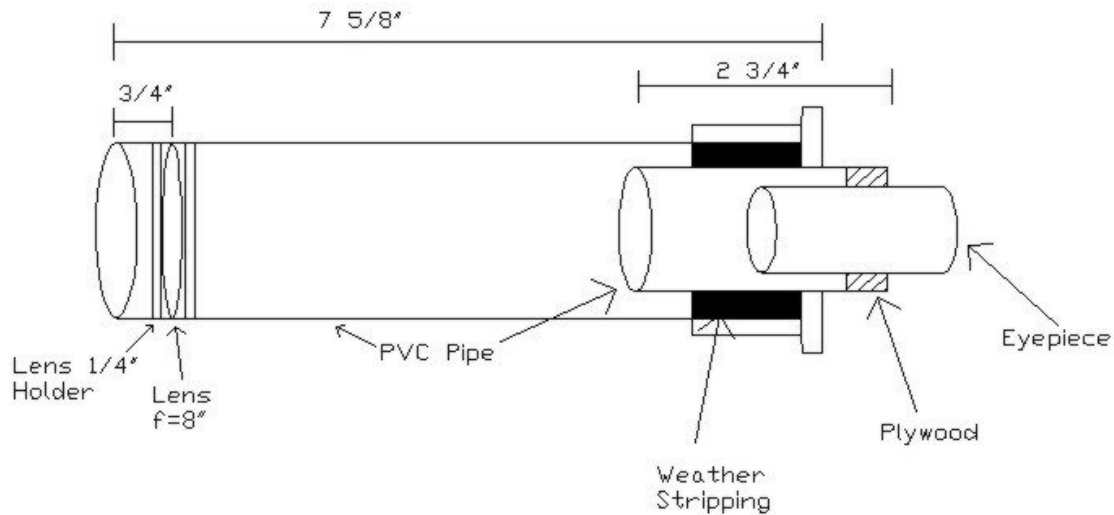
- cut PVC pipe and plywood
- glued plywood into smaller PVC pipe
 - *weather stripping will be added inside the plywood, and will hold the eyepiece

-glued first lens holder into longer PVC pipe

8:15 – Done – must wait for the glue to dry

Monday, August 23, 1999

UPDATED DIAGRAM



2:00 – Continued working on “Finder Scope”

-cut strips in pipe

*for weather stripping which creates friction

-cut the female PVC connector in half

*this will hold the focuser which holds the eyepiece

-painted the inside of the pipe – black

-painted the outside of the pipe – blue

Saturday, August 28, 1999

4:15 – Completed “Finder Scope”

-cut small strips from PVC pipe

*this filled the holes that were cut on 8-23-99 half way

-glued weather stripping into the holes of female PVC connector

-glued lens into PVC pipe

-lens became dirty on the inside part of the Finder Scope because excess glue was found on the lens

*attempted to clean it – did not work, lens came out

*started over, used less glue

NOTE #2: The focuser tends to jump when moved because weather stripping makes too much friction. No solution yet, but think that the weather stripping might loosen as the focuser moves back and forth in time.

8:00 – Done – “Finder Scope” completed (see photo on next page)



Completed finder scope—The eyepiece, on the right, fit's into the focuser, in the middle, and stays in place. The focuser then is placed in the tube, left, which holds a lens in the opposite end. The focuser is then able to move in and out slightly to adjust focus.

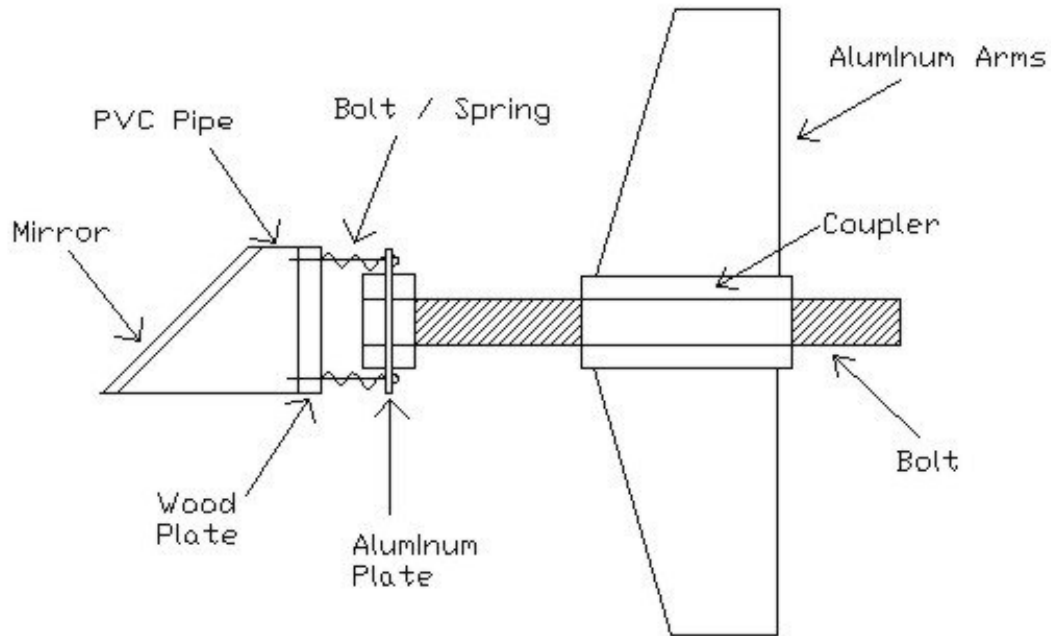
Saturday, September 25, 1999

6:00 – Started the “Spider”

-drilled and tapped the coupler

*coupler is the part that the arms are connected to

See Diagram below



7:30 – Done

Sunday, September 26, 1999

10:30 – Worked on the “Spider”

-cut the aluminum for the arms

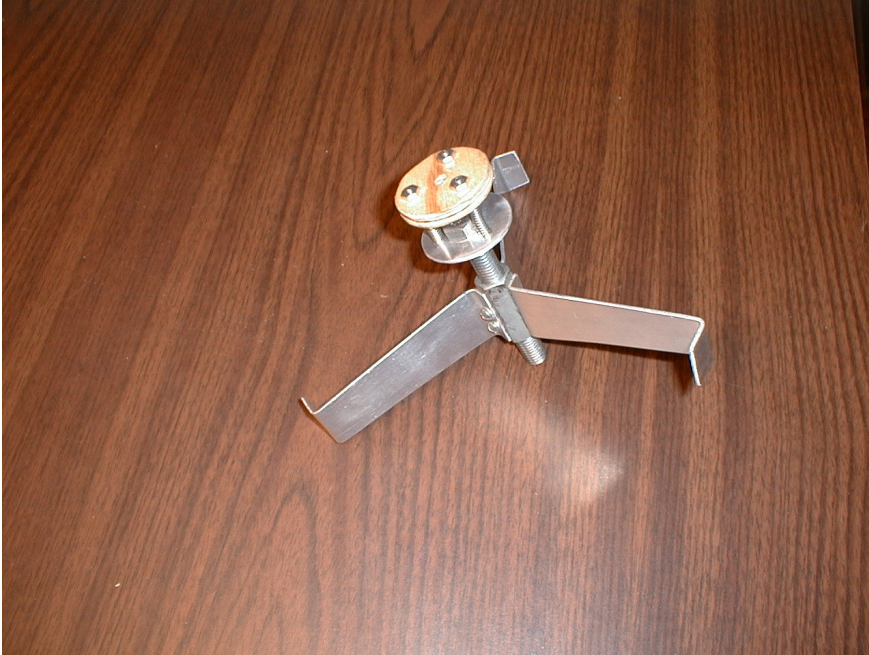
-bent aluminum arms (to connect with the coupler)

-attached the arms to the coupler

-cut aluminum and plywood circles

-assembled the plywood and aluminum circles to the main bolt

4:30 – Done – See following page for pictures



Incomplete Spider—The wood piece will be inside of a tube that will hold the secondary mirror. The aluminum arms will be attached to the inside of the main optical tube. The arms are attached to a coupler that is on the main bolt. This assembly allows the entire bolt/tube/mirror piece to rotate and be adjusted front to back.



Incomplete Spider—Another angle of the spider

Sunday, October 31, 1999

3:00 – Worked on the “Spider”

- cut PVC pipe that holds the mirror
- put blocks inside of pipe to hold the mirror
- painted the assembly black
- glued the mirror into place
- assembled the spider

6:30 – Done – See following page for pictures of the completed “Spider”



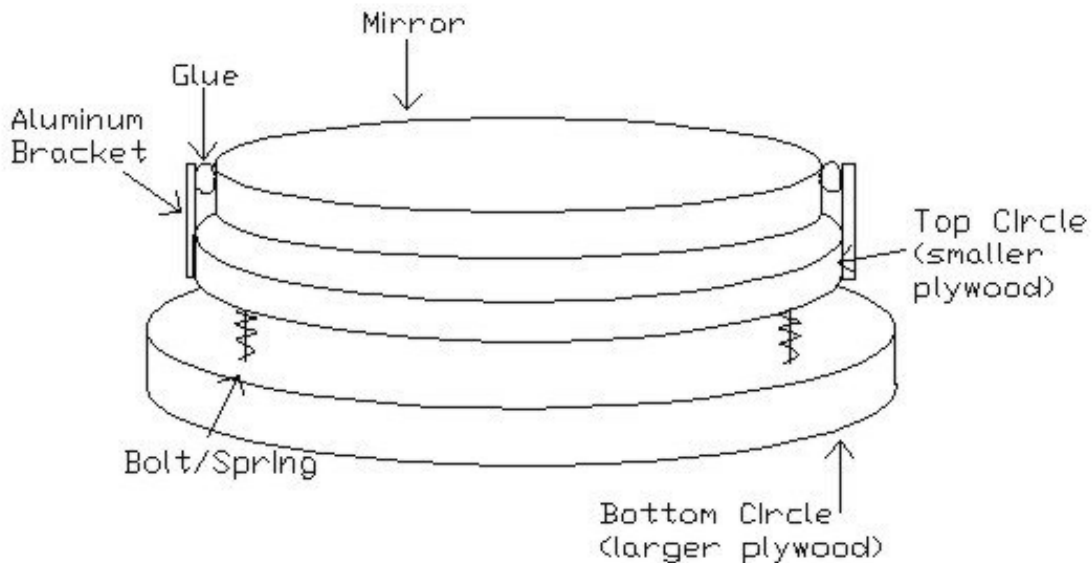
--Completed "Spider"

Saturday, November 13, 1999

9:30 – 11:30 – Cut circles for mirror cell at Rob's house

12:00 – Worked on mirror cell

- Drill side holes in large circle to attach it to the tube
- Drill holes in circles to attach to each other
- Insert tee-nuts into small circle
- Counter sink the three springs on the large circle
- “Test-Assemble” mirror cell
- See Diagram



2:00 – Clean up

Sunday, November 21, 1999

3:00 – Cut Aluminum strips that are glued to the mirror

- Drilled pilot holes in aluminum brackets
- Attached aluminum brackets to small circle
- Counter-sunk tee-nut holes
- Drilled “semi-holes” in small circle to bond to glue
- Painted the large and small circles

6:30 – Clean up – See following page for pictures



Incomplete mirror cell – The mirror will sit on the top circle and be glued to the wood and aluminum brackets that are screwed to the circle. The top circle is attached to the bottom, larger circle by three “bolt / spring” assemblies.



Incomplete mirror cell – Another angle of the mirror cell

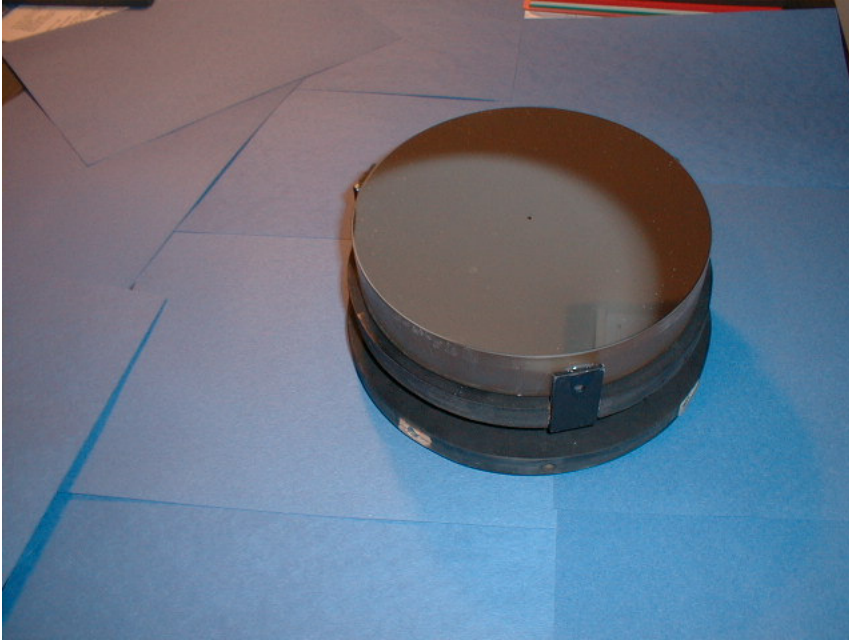
Tuesday, November 23, 1999

7:30 – Glued primary mirror onto mirror cell

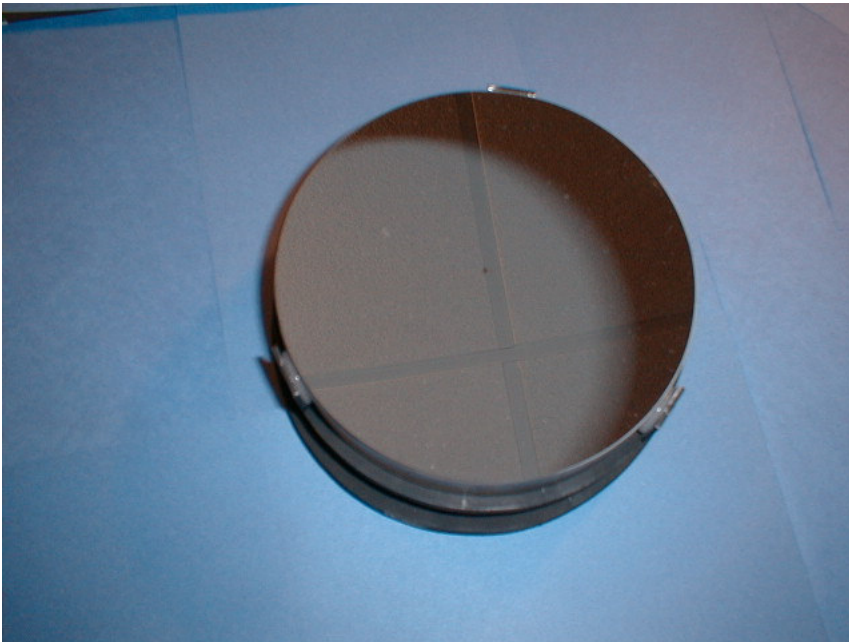
8:00 – Done – Must wait for glue to dry

*At least 24 hours curing time

See following page for pictures



Completed Mirror Cell with mirror glued in place



Completed Mirror Cell – second view

Monday, December 27, 1999

- 2:00 – Drilled hole in tube for focuser and primary mirror cell
 - Fit primary mirror cell, focuser, and spider in main tube
 - Aligned mirrors to see if it worked (it did)
- 5:15 – Done

Tuesday, December 28, 1999

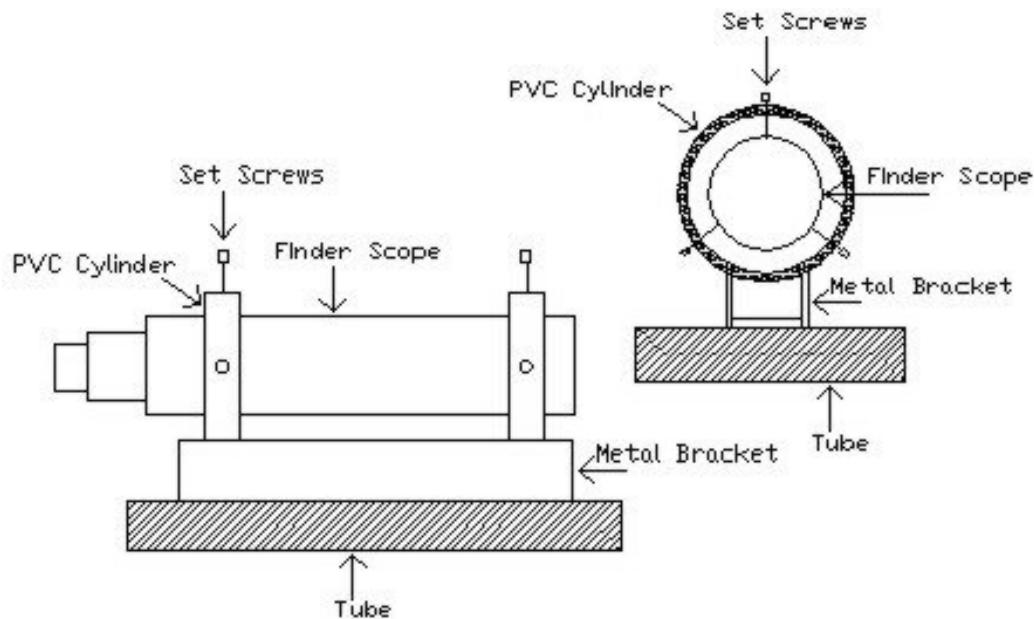
- 4:00 –Went to Rob's house to cut 6" PVC Caps so they will fit snugly on the tube
 - The PVC Cap is a cylinder without a top on it about 4" tall and the topless side had to be cut so a 9.5" diameter circle parallel with the sides of the cylinder could pass through the cap in a direction perpendicular to the top.
- 6:00 – Done

Wednesday, December 29, 1999

- 2:00 – Sanded PVC caps to better fit tube and to be even
- 4:00 – Done

Sunday, January 16, 2000

- 9:00 – Made Finder Scope holder
 - *See diagram below



- cut PVC pipe into 2 - $\frac{3}{4}$ inch cylinders, sanded
- drilled holes for set screws and base attachment
- cut the edges off the T-nuts
- connected the PVC cylinders to the metal bracket
- attached the bracket to the base

12:00 – Found the center of mass

- put both the primary and secondary mirrors in the tube
- attached the Finder Scope and holder and Focuser
- found the center of mass
- remove everything from the tube

1:30 – Tried to attached PVC caps to the tube

- measured where holes should go
- drilled holes in PVC caps
 - *two smaller holes → for bolts to attach to the tube
 - *one larger hole → to connect the SkyWizard Computer and tension strings

-3:00 → had to go to the Hardware Store – did not have any useable bolts to attach

-3:30 → Home – still not the correct size

-4:00 → Returned to the Hardware Store – CLOSED

*now frustrated – will wait until tomorrow

4:15 – Done

Monday, January 17, 2000

11:00 – Attached PVC caps to the tube

- went to the Hardware Store – got correct size bolts

- attached one PVC cap to the tube

- using a T-square, found where the cap was perpendicular to the table

- lined up the second PVC cap to be perpendicular to the table and attached it to the tube

1:00 – Put everything back in tube and attached the Finder Scope and Focuser

2:30 – Made Temporary Base (for lunar eclipse)

5:30 – Clean-up

See following page for pictures of up-to-date telescope and temporary base



Up-to-date telescope with a good view of the temporary base.



Another angle of the telescope and temporary base.



Completed Finder Scope and Holder → Two $\frac{3}{4}$ inch cylinders of PVC pipe are attached to a metal bracket which is attached to the tube. Three screws are placed into three holes that were drilled to hold the Finder Scope center.

Tuesday, February 8, 2000

- 3:30 – Cut 9½” ring out of ¼” plywood to cover the back of the tube
 - went to hardware store to buy plastic plugs for extra mirror holes
- 5:00 – Cut 3 small rectangles out of aluminum to hold the plywood ring onto the back of the tube
 - cut 3 small rectangles of plywood
 - drilled holes in aluminum and plywood rectangles
- 6:15 – Cut approximatly 1” off the back of the tube
- 7:00 – Assembled telescope
- 7:40 – Allign mirrors on telescope
- 8:30 – Done

Sunday, February 20, 2000

- 12:00 – Cut wood for the base of the telescope
 - still need to use Rob’s tools to make final cuts on the circles
- 12:50 – Done

Saturday, February 26, 2000

- 7:00 – Went to PDC to use their nifty tools
- 7:15 – Cut and sanded circlces for base
- 7:40 – Cut semi-circlces out of side panels
- 7:45 – Laminated base circle with formica
- 8:15 – Laminated PVC Caps
- 8:45 – Squared the wood panels for the base
- 9:15 – Went home

- 9:30 – Cut Teflon for side panel bearings
- 9:45 – Sanded semi-circlces so PVC caps would fit
- 11:30 – Screwed Teflon onto side panels

Sunday, March 05, 2000

12:30 – Applied $\frac{3}{4}$ " wood venier to cut side of circles

1:30 – Sanded off excess venier – still requires finish sanding

2:30 – Done

Friday, March 17, 2000

4:00 – Applied wood venier to the cut sides of the other pieces of the base

5:45 – Removed excess venier and sanded

7:00 – Doweled the sides of the base together

8:45 – Done

Saturday, March 18, 2000

9:00 – Made Eyepiece holder and attached it to the side of the base

10:30 – Doweled the 3 sides of the base to the top base circle

11:20 – Nailed Teflon pads to the too of the bottom circle

11:45 – Started to paint the base pieces with a primer

12:30 – Made a tee nut for a $\frac{1}{2}$ " bolt for use on the base of the telescope

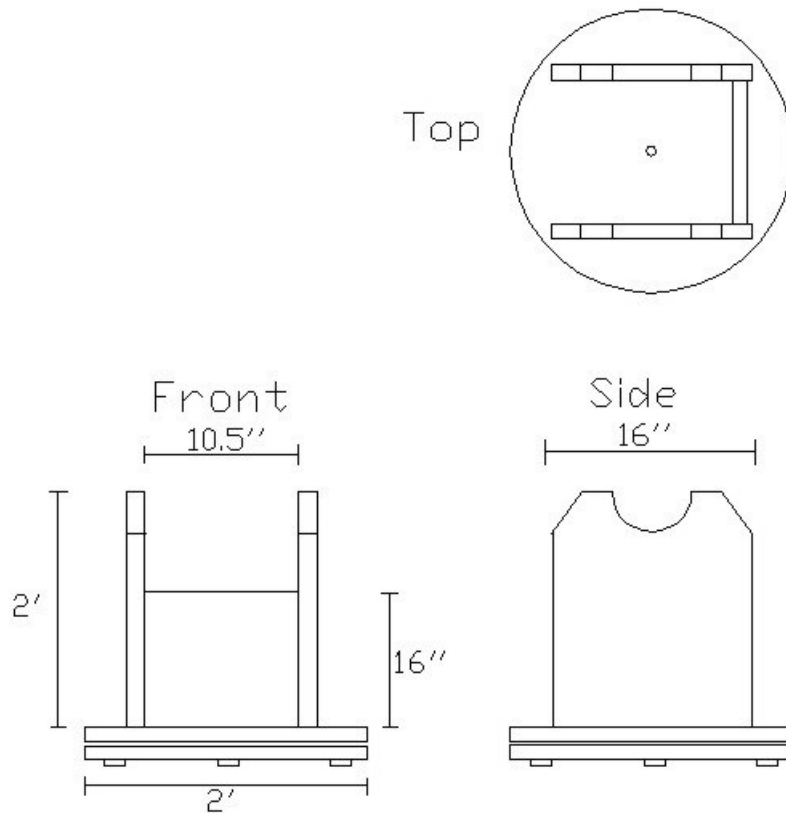
--Note this was after going to 6 different hardware stores and
not being ablet o find one

1:30 – Used a die to put more threads on the bolt that hold the circles
together

2:00 – Attached homemade tee nut to the bottom circle of the base

2:30 – Done

*See diagram of base below



Sunday, March 19, 2000

12:00 – Painted the PVC caps satin black

12:45 – Painted the bottom circle of the base

--Note the primer is still drying on the rest of the base

1:30 – Painted the bolts that go in the PVC caps

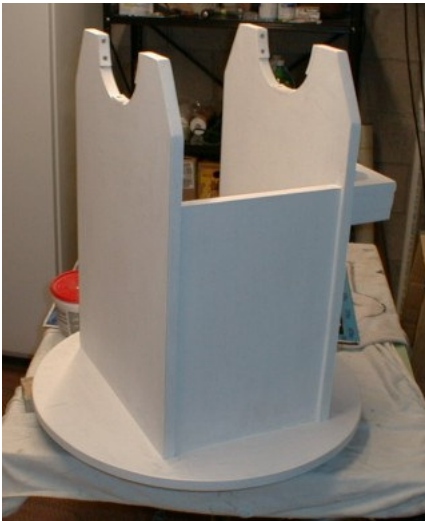
2:00 – Put laminate in a ring around the back of the tube

2:45 – Painted laminate ring black

See following page for pictures of the PVC caps and the base assembly



Painted and laminated PVC caps—The holes are for the center bolt and the bolts that hold it to the base.



Assembled base—These pictures are of the base after it was primed. The eyepiece holder and bottom circle are visible in the second picture.

Friday, March 24, 2000

- 1:30 – Made new circle to cover back of tube
- 2:30 – Drilled holes in the back piece of plywood in the mirror cell to attach the new circle to
- 3:00 – Painted the base satin black
- 5:30 – Painted the tube Midnight Blue
- 7:30 – Done

Saturday, March 26, 2000

- 10:00 – Made small feet for the bottom of the base
- 10:25 – Attached PVC caps to tube
- 11:00 – Made and attached Teflon strips to the side of the PVC caps
- 12:00 – Put small rubber stopper on the top of the front panel of plywood to prevent the tube from being damaged
- 12:15 – Done

Sunday, March 26, 2000

- 12:00 – Painted stars in constellations from the story of Andromeda on the tube
- 3:30 – Painted planets on the base
- 4:45 – Put the mirrors in the tube
- 5:15 – Done

Sunday, April 2, 2000

- 1:00 – Attached sensor on the bottom base of the telescope for the SkyWizard
 - Cut small block to attach to side of base where the sensor is attached
 - Attached the sensor on the side of the base
- 2:00 – Plugged SkyWizard into sensors
- 2:15 – Done

Sunday, April 9, 2000

- 11:00 – Drilled one hole in each side of the base under the PVC caps
- Put a tee nut in the holes drilled
 - Fastened a bolt in each hole with a nut
 - Strapped a small bungi cord around the axis of rotation on the PVC Cap and attached it to the bolt
- 12:30 – Done

