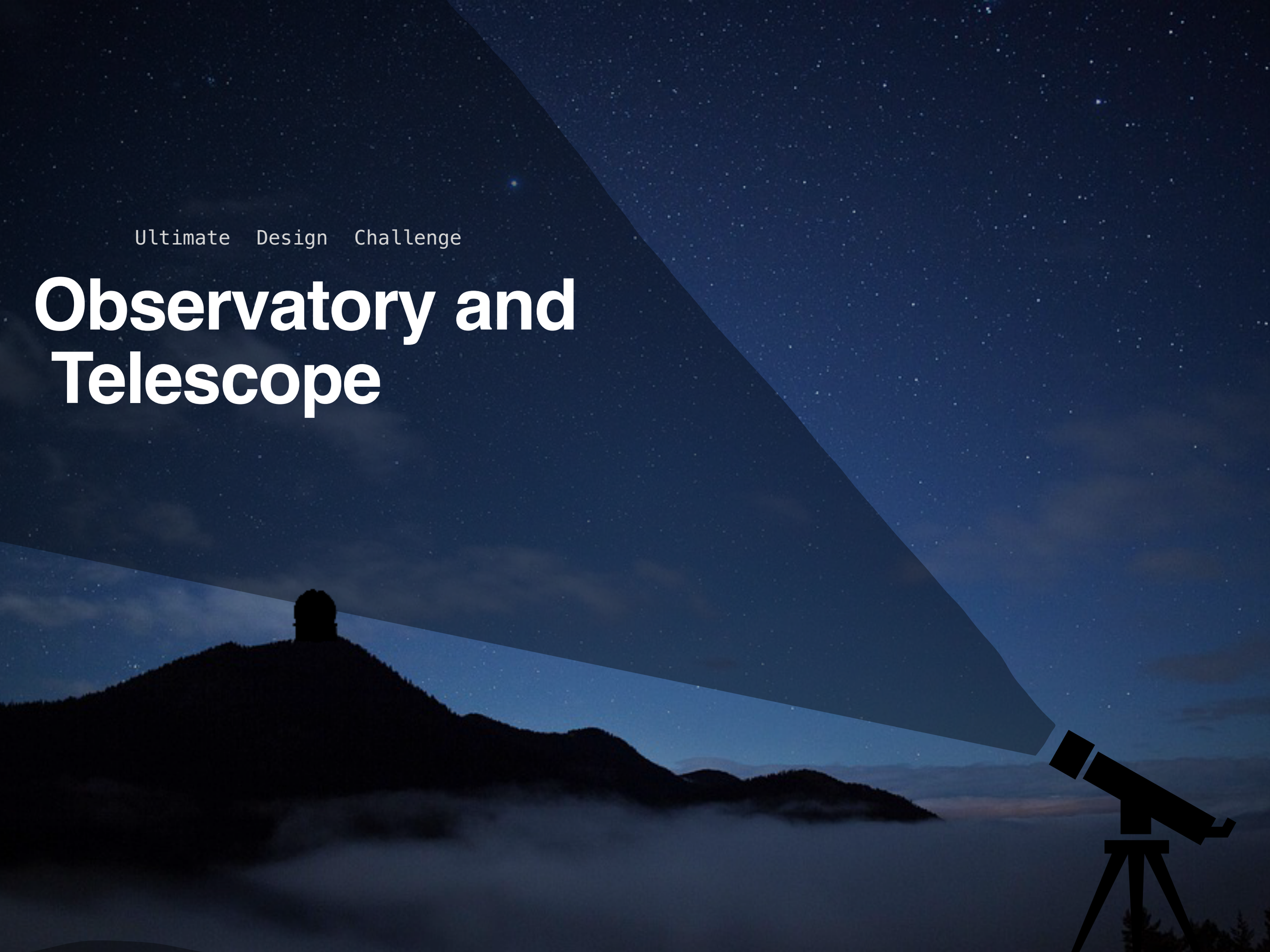
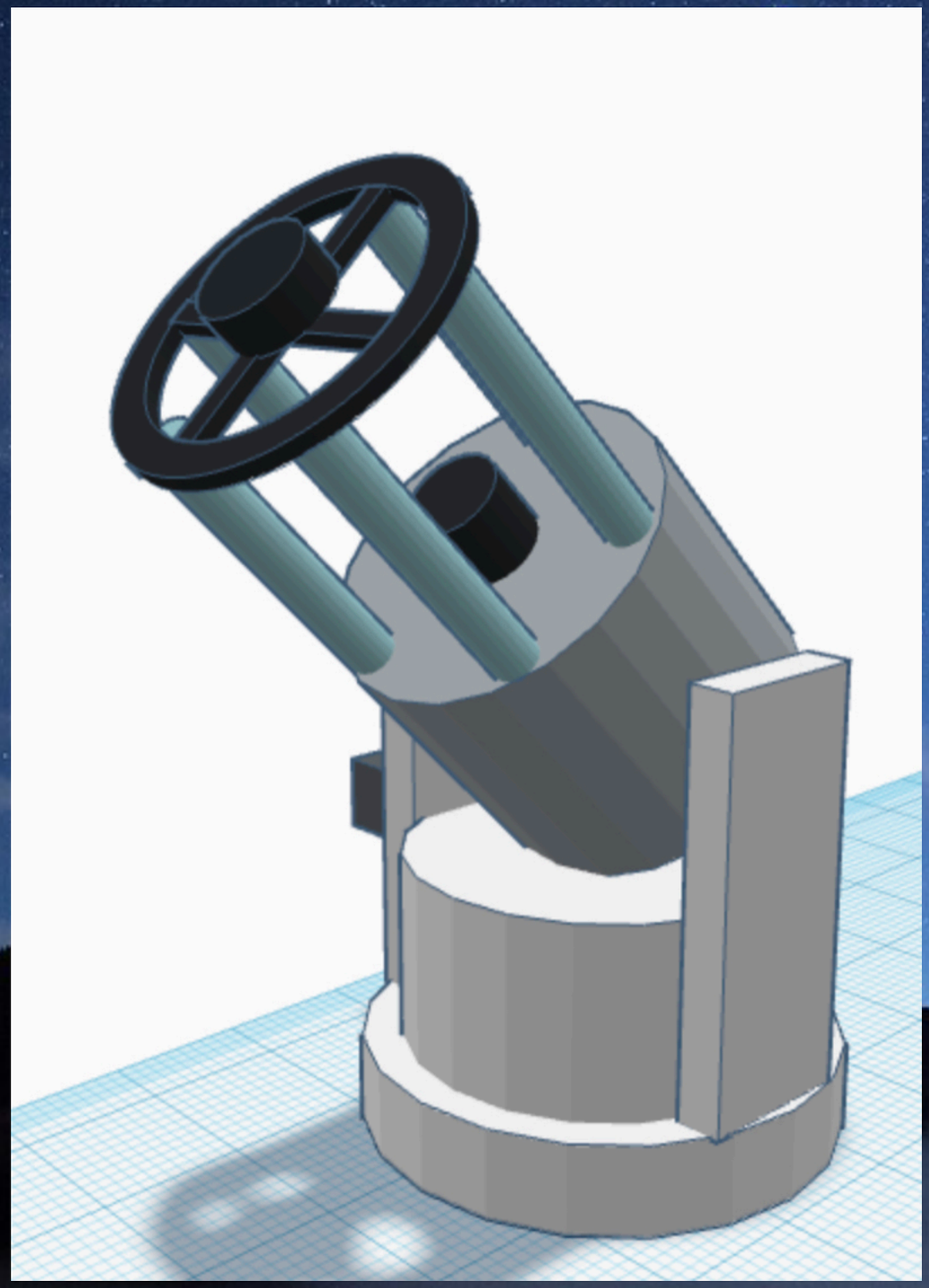
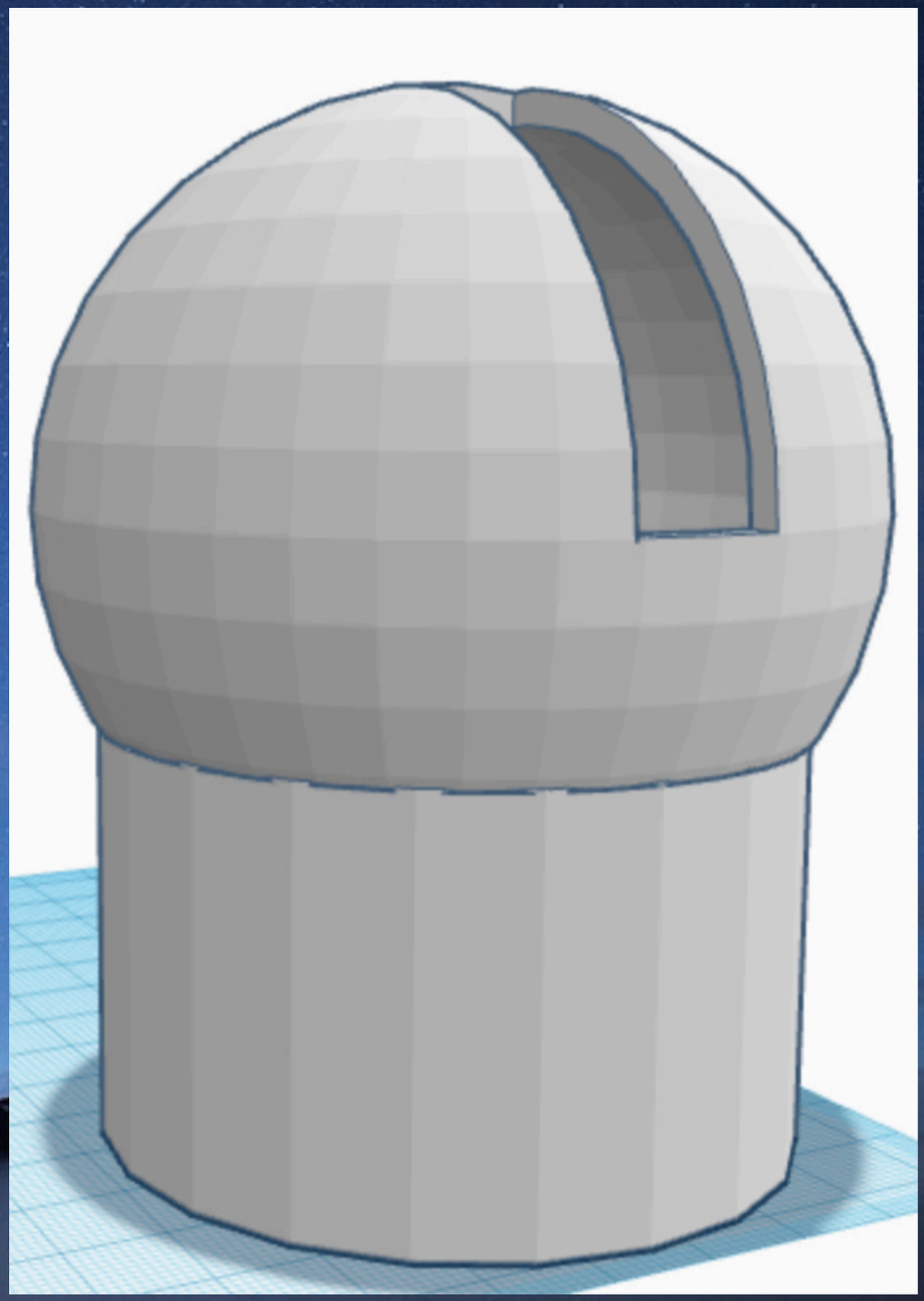
Ultimate Design Challenge

# Observatory and Telescope



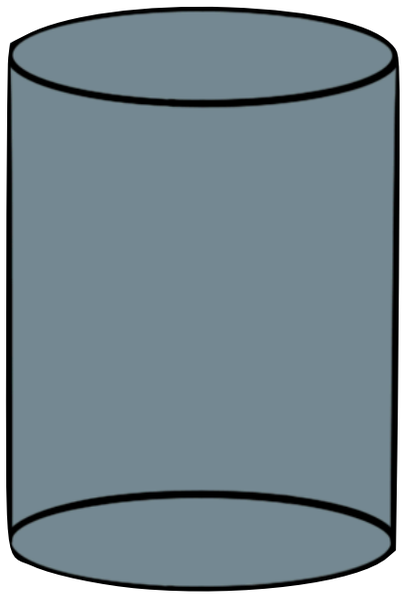
# Maximized For Volume$^3$

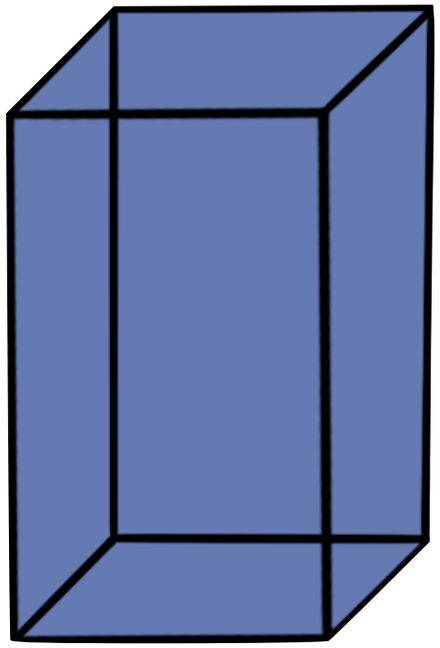


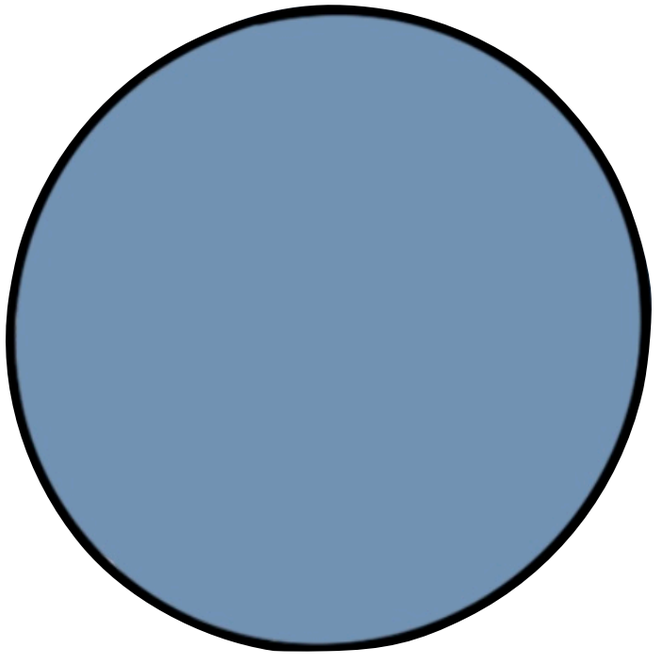


# Shapes

## yay!



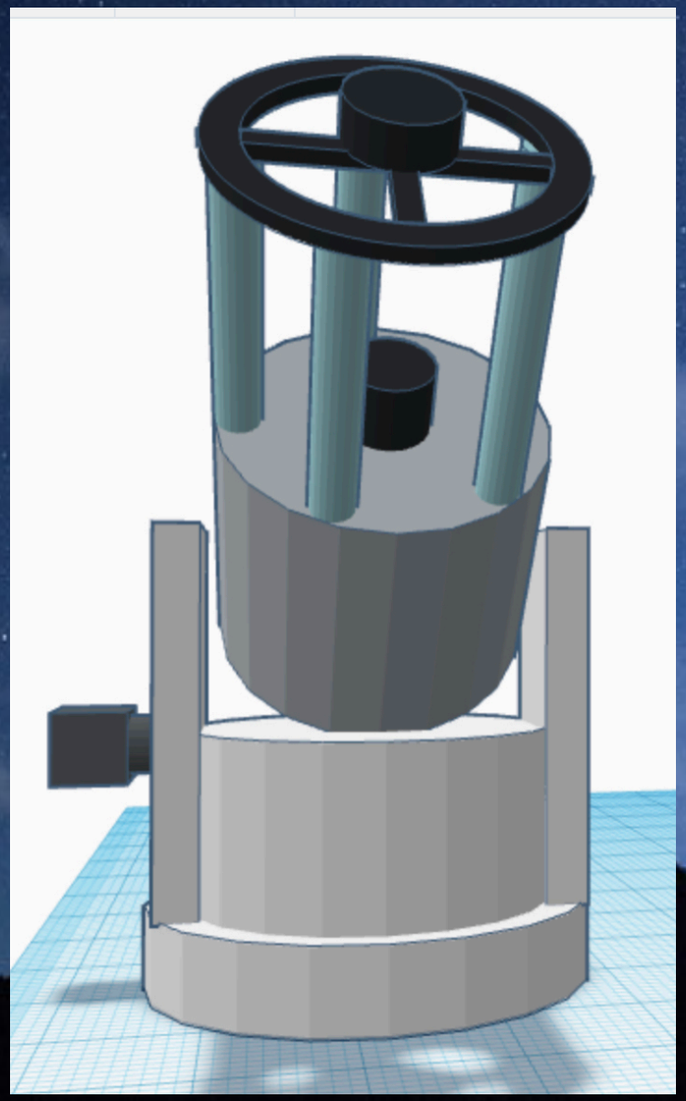




- Cylinder -
  $V = \pi r^2 h$
  $SA = 2\pi r^2 + 2\pi rh$
- Rectangular Prism -
  $V = l \times w \times h$
  $SA = 2(l \times w) + 2(l \times h) + 2(h \times w)$
- Sphere -
  $V = 4/3\pi r^2 \times 0.75$
  $SA = 4\pi r^2 \times 0.75$

# Surface Area & Volume

## Telescope



Total $SA = 8{,}569.04mm^2$

Total $V = 22{,}540.78mm^3$

cylinders 1–5

* Both circle are not "showing"

d = 3mm

h = 20mm

SA = 2πr² + 2πrh

= 2(3.14)(1.5²) + 2(3.14)(1.5)(20)

= 2(7.06) + 2(94.2)

= 14.12 + 188.40

= 202.60 mm²

18.48 × 5 = 92.4 mm²

× 5

− SA = 18.48 mm²

* only face showing

Total SA = 92.4mm²

V = πr²h

= (3.14)(1.5²)(20)

= 141.37 mm³

cylinder 6

* 1 circle face is not showing

d = 6mm

h = 5 mm

SA = 2πr² + 2πrh

= 2(3.14)(3²) + 2(3.14)(3)(5)

= 2(28.27) + 2(94.20)

= 56.54 + 188.40

= 244.94 mm²

V = πr²h

= (3.14)(3²)(5)

= 141.37 mm³

cylinder 7

d = 23mm

h = 20 mm

SA = 2πr² + 2πrh

= 2(3.14)(11.5²) + 2(3.14)(11.5)(20)

= 2(415.47) + 2(722.56)

= 830.94 + 1,445.12

= 2,276.06 mm²

V = πr²h

= (3.14)(11.5²)(20)

= 8,309.51 mm³

Math for collision:

2,276.06 mm²

− 7.06 × 5

− 28.27

= 2,212.49 mm²

cylinder 8

* one circle face showing

d = 27

h = 13

SA = 2πr² + 2πrh

= 2(3.14)(13.5²) + 2(3.14)(13.5)(13)

= 2(572.55) + 2(551.34)

= 1,145.1 + 1102.68

= 2,247.78 mm²

V = πr²h

= (3.14)(13.5²)(13)

= 7,443.21 mm³

cylinder 9

33mm

h = 6mm

SA = 2πr² + 2πrh

= 2(3.14)(16.5²) + 2(3.14)(16.5)(6)

= 2(855.29) + 2(311.01)

= 1,710.58 + 622.02

= 2,332.60

V = πr²h

= (3.14)(16.5²)(6)

= 5,131.79 mm³

Math for collision

2,332.60

− 572.55

− 33

− 33

2,332.60 − 572.55 − 66 =

total SA = 1,694.05 mm²

cylinder 10

7mm

3mm

SA = 2(3.14)(3.5²) + 2(3.14)(3.5)(8)

2(38.48) + 2(32.98)

76.96 + 65.96

142.92 mm²

V = (3.14)(3.5²)(3)

= 115.45 mm³

Math 4 collision

142.92 mm²

− 7 × 1.5 × 2

142.92 − 21 = ?

total SA = 121.92mm²

cylinder 11

d = 4mm

h = 2mm

V = (3.14)(2²)(2)

= 25.13 mm³

SA = 2(3.14)(2²) + 2(3.14)(2)(2)

2(12.56) + 2(12.56)

25.12 + 25.12

50.24 mm²

Math 4 collision

* 1 circle face is not showing

12.56 + 25.12 = 37.68mm²

cylinder 12

outer cylinder

SA OC = 2(3.14)(11.5²) + 2(3.14)(11.5)(1)

= 830.95 + 72.25 = 903.2 mm²

− circles = −2(3.14)(9.5²) = 569.05

+ cylinder wall = + 2(3.14)(9.5)(1) = 59.69

SA = 393.84

V OC = (3.14)(11.5²)(1) = 415.47

V IC = (3.14)(9.5²)(1) = 283.52

= 415.47 − 283.52

total V = 131.95 mm³

23mm

19mm

1mm

Math 4 collision:

393.84

− 1.5 × 1 × 4

393.84 − 6 =

total SA = ?

387.84 mm²

RP 13+14

28mm

11mm

5mm

SA = 2(lxh) + 2(wxh) + 2(lxw)

= 2(11x28) + 2(3x28) + 2(11x3)

= 616 + 168 + 66 = 850 mm²

V = lxwxh

= 11x3x28 = 924 mm³

Math 4 collision

28 x 11 = 308

− 11 × 13 = 143

308 − 143 = 165

850 − 165 = 685 mm²

total SA = 685 mm²

× 2

= 1,370 mm²

RP 15-16

× 2

18 mm

1.5 mm

1mm

SA = 2(lxw) + 2(wxh) + 2(nxl)

= 2(1.5x1) + 2(1x18) + 2(18x1.5)

= 3 + 36 + 54 = 93mm²

V = lxwxh

= 1.5x1x18 = 27mm³

Collision Math

93mm²

− 1.5x1x4

− 7 × 1.5 × 2

66 x 2 = ?

total SA = 132mm²

93 − 6 − 21 = 66

RP 17

SA = 2(lxw) + 2(lxh) + 2(wxh)

= 2(6x5) + 2(6x5) + 2(5x5)

= 60 + 60 + 50 = 170 mm²

5mm

6mm

5mm

V = lxwxh

= 6x5x5 = 150 mm³

Math for collision

170

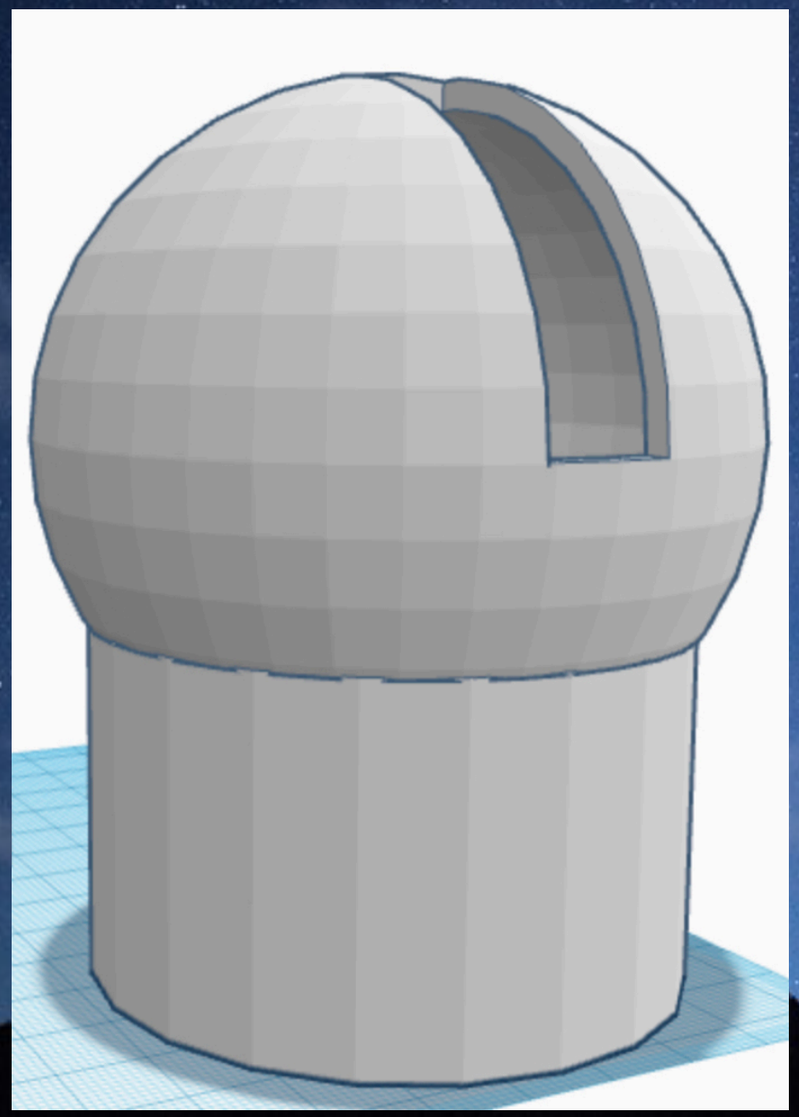
− 12.56

170 − 12.56 =

Total SA = 157.44mm²

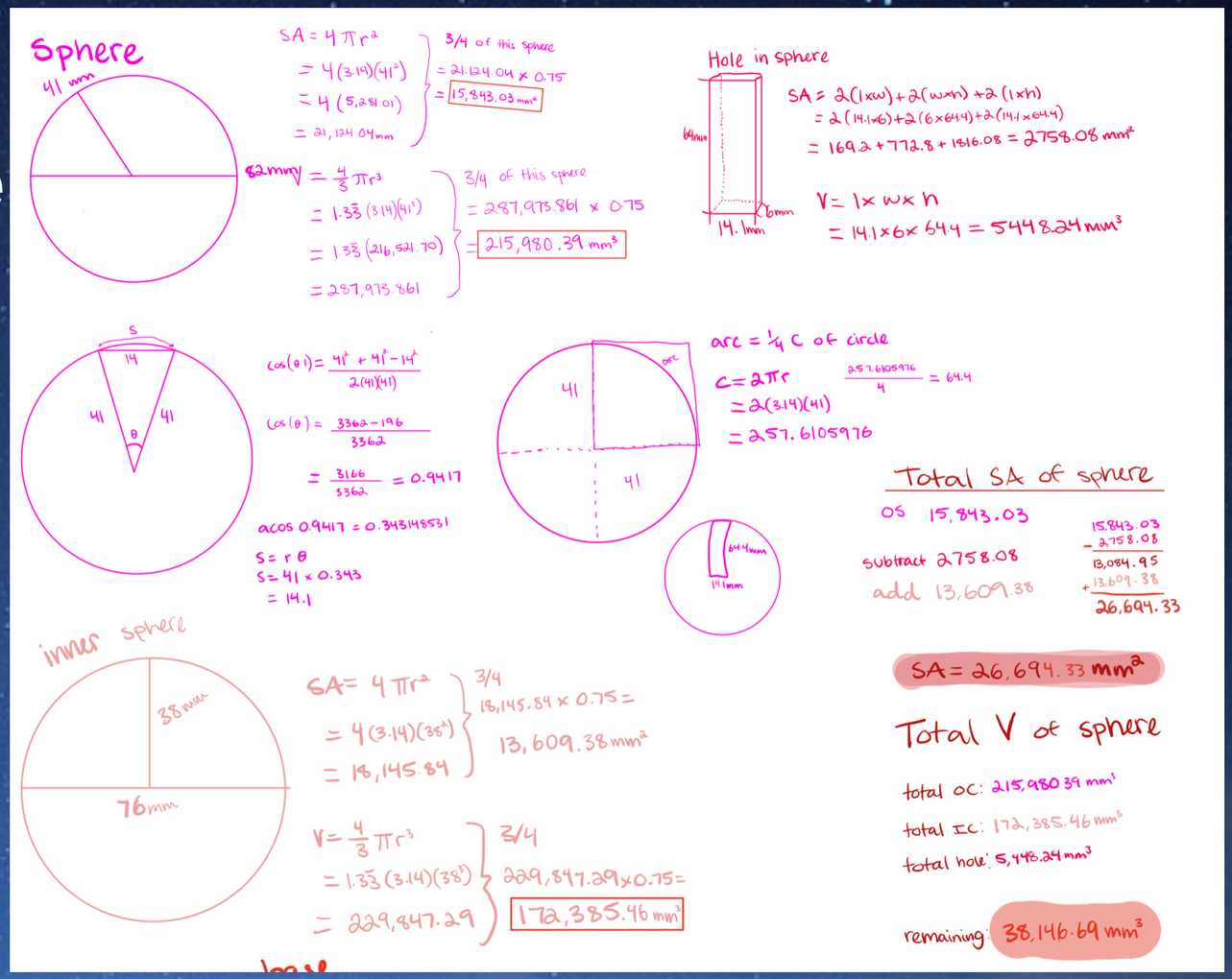
# Surface Area & Volume

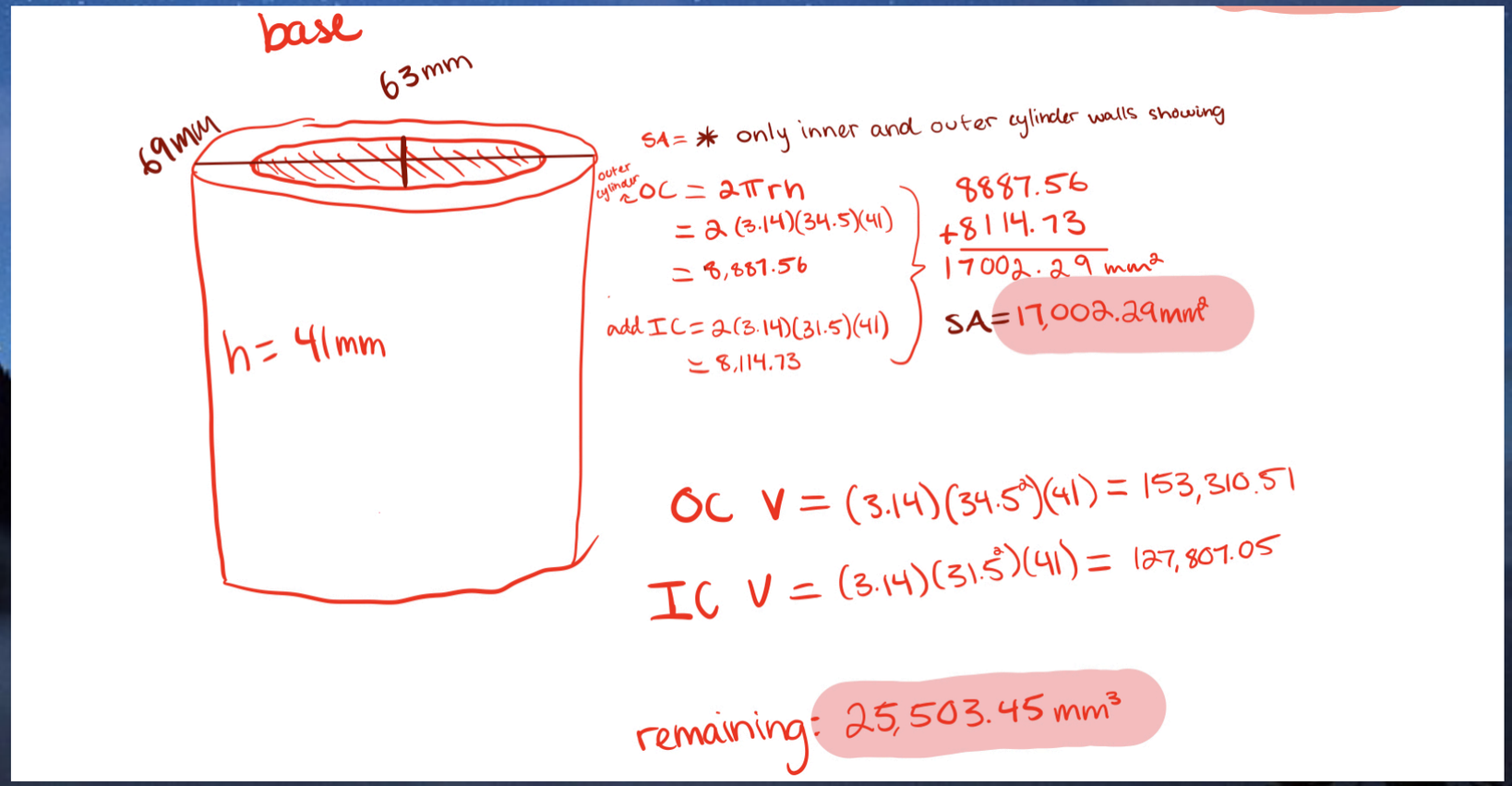
## Observatory



Total $SA = 43{,}696.62 mm^2$

Total $V = 63{,}650.14 mm^3$



# Ratios

## Volume:Surface Area

### Observatory Ratio V:SA

SA = 26,694.33
+ 17,002.29
43,696.62 mm²

V = 38,146.69
+ 25,503.45
63,650.14 mm³

Ratio V:SA

63,650.14 : 43,696.62

= 63,650.14 / 43,696.24 = ↘

1.45 : 1

↓ ↓

1.45mm³ : 1mm²

### Telescope Ratio V:SA

SA =
92.40
687.99
2212.49
1675.23
1694.05
121.92
37.68
387.84
1370.00
132.00
+ 157.44
8,569.04 mm²

V =
141.37
141.37
8309.51
7443.21
5131.79
115.45
25.13
131.95
924.00
27.00
+ 150.00
22,540.78 mm³

Ratio V:SA

22,540.78mm³ : 8,569.04mm²

= 22,540.78 / 8,569.04 = ↘

2.63 : 1

↓ ↓

2.63mm³ : 1mm²

### Total Ratio V:SA

V = 63,650.14
+ 22,540.78
86,190.92 mm³

SA = 43,696.62
+ 8,569.04
52,265.66 mm²

86,190.92mm³ : 52,265.66

= 86,190.92 / 52,265.66 = ⟶ 1.64 : 1 = 1.64mm³ : 1mm²

# Thanks!