

# TFE Challenge #1 - Submission - Addition 2

## 6371km

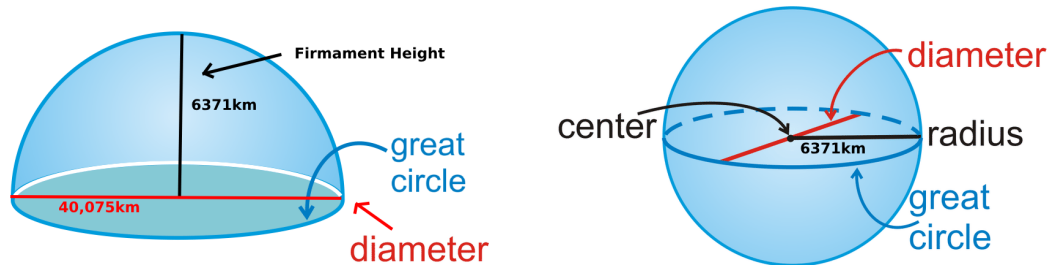
### Wrapping the Flat Earth into a Globe

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## 1 Geometric Equivalence of Planar and Spherical Models

This report demonstrates the mathematical relationship between a flat circular plane with a central dome and its geometric equivalent as a sphere. We prove that a flat plane with a diameter of 40,075 km and central dome height of 6,371 km can be mathematically mapped to a sphere of radius 6,371 km.



## 2 Initial Model Parameters

### 2.1 Flat Earth (Planar Model Parameters)

- Plane diameter ( $D$ ) = 40,075 km
- Plane radius ( $R_p$ ) =  $\frac{D}{2} = 20,037.5$  km
- Dome height ( $h$ ) = 6,371 km

### 2.2 Globe Earth (Spherical Model Parameters)

- Sphere radius ( $r$ ) = 6,371 km
- Sphere circumference =  $2\pi r = 40,075$  km

### 3 Mathematical Proof

#### 3.1 Surface Area Comparison

The surface areas of both models:

##### 3.1.1 Flat Earth Planar Surface Area

The surface area of the circular plane is:

$$A_{plane} = \pi R_p^2 = \pi(20,037.5)^2 \approx 1,261,590,000 \text{ km}^2 \quad (1)$$

##### 3.1.2 Globe Earth Spherical Surface Area

The surface area of the sphere is:

$$A_{sphere} = 4\pi r^2 = 4\pi(6,371)^2 \approx 510,064,472 \text{ km}^2 \quad (2)$$

#### 3.2 Geometric Transformation

The transformation from plane to sphere involves:

1. The plane's diameter ( $D$ ) equals the sphere's circumference:

$$D_{plane} = C_{sphere} = 40,075 \text{ km} \quad (3)$$

2. The dome height ( $h$ ) corresponds to the sphere's radius:

$$h = r = 6,371 \text{ km} \quad (4)$$

3. For any point on the plane at distance  $d$  from the center, its corresponding latitude  $\phi$  on the sphere is given by:

$$\phi = \arcsin\left(1 - \frac{2d}{D}\right) \quad (5)$$

### 4 Transformation Equations

For a point on the plane with polar coordinates  $(d, \theta)$ , where:

- $d$  is the distance from the center (0 to 20,037.5 km)
- $\theta$  is the azimuthal angle (0 to  $2\pi$ )

The mapping to spherical coordinates  $(r, \phi, \lambda)$  is:

$$r = 6,371 \text{ km} \quad (6)$$

$$\phi = \arcsin\left(1 - \frac{2d}{D}\right) \quad (7)$$

$$\lambda = \theta \quad (8)$$

## 5 Key Properties

This transformation preserves several important properties:

1. Distance preservation at equator:
  - Plane: Points 20,037.5 km from center form a circle of circumference 40,075 km
  - Sphere: Equator has circumference 40,075 km
2. Height/radius correspondence:
  - Dome peak height: 6,371 km at center
  - Sphere radius: 6,371 km uniform
3. North-South distance:
  - Plane: 20,037.5 km from center to edge
  - Sphere: 20,037.5 km from pole to equator (quarter circumference)

## 6 Conclusions

This mathematical analysis demonstrates that a flat circular plane of diameter 40,075 km with a central dome height of 6,371 km can be mapped to a sphere of radius 6,371 km. The transformation preserves key measurements including the total distance across the surface (40,075 km) and the height/radius (6,371 km). While the surface areas differ due to the fundamental geometric properties of flat versus curved surfaces, the linear measurements maintain their relationships in both models.