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# The Flux of Stem Cells to the Area of the Retina

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## Abstract

Stem cell transplantation for the blind is a promising area of research, but it is still in the early stages of development. Our aim in this article is to think about geometric-mathematical tools so that by the flux of stem cells into open and curved spaces in the retina of recently blind people and macular degeneration patients, (AMD) patients, we will enable the growth of visual cells in their retinas.

## Keywords

Stem Cells, Vector Flux, Vector Aria Element, Curved Coordinates

## 1. Introduction

In article [1], we presented cylindrical and spherical coordinates, and in articles [2] [3] and [4], we presented a mirror eye lens and telescopic eye lens consisting of 3 lenses with a variable point radius eye lens for the aid of age macula degeneration (AMD) but we did not present the structure of the lens.

Article [5] shows experiments in which pluripotent stem cells can produce complex tissue organoids that are useful for *in vitro* disease modeling studies and for the development of regenerative therapies. It also describes a method for generating retinal organoids in a hybrid culture system.

In this article, we hope that by geometric-mathematical tools and the flux of stem cells into open and curved spaces in the retina of recently blind people and (AMD) patients, we will enable the growth of visual cells in their retinas.

In this article, we present only a proposal for the mathematical use of the flux of sperm cells without medical laboratory results.

## 2. The Flux of a Vector Field through a Vector Area Element of the Surface

The flux of a vector $\boldsymbol{F}$ through a vector area element of the vector surface $\mathrm{d}\boldsymbol{S}$ is shown in **Figure 1**, and a vector surface of a curved surface is shown in **Figure 2**.

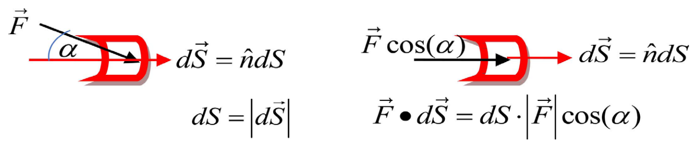


**Figure 1.** The flux of a vector field through a vector area element of the surface.

The flux of the vector field all over the surface: $\phi = \iint_S \boldsymbol{F} \cdot \mathrm{d}\boldsymbol{S}$ .

Is equal to the number of stem cells that are needed for the patient, where:

$$\boldsymbol{F} = P(x,y,z)i + Q(x,y,z)j + R(x,y,z)k$$

A vector area element of an eye surface according to **Figure 2** and to the next Mathematical developments depending on **Figure 2**:

$$\boldsymbol{r}(x,y,z) = xi + yj + zk \Rightarrow \mathrm{d}\boldsymbol{r} = \boldsymbol{r}'_x\mathrm{d}x + \boldsymbol{r}'_y\mathrm{d}y + \boldsymbol{r}'_z\mathrm{d}z = \mathrm{d}xi + \mathrm{d}yj + \mathrm{d}zk$$

$$z = z(x,y) \Rightarrow \boldsymbol{r} = xi + yj + z(x,y)k = \boldsymbol{r}(x,y) \Rightarrow \mathrm{d}\boldsymbol{r} = \boldsymbol{r}'_x\mathrm{d}x + \boldsymbol{r}'_y\mathrm{d}y \Rightarrow \mathrm{d}\boldsymbol{S} = \boldsymbol{r}'_x\mathrm{d}x \times \boldsymbol{r}'_y\mathrm{d}y$$

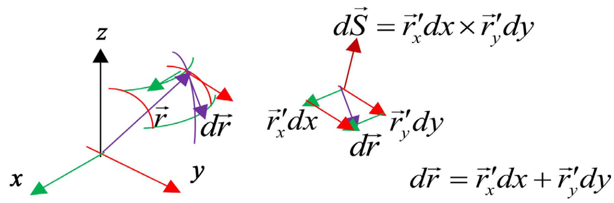


**Figure 2.** A vector area element of an eye surface.

## 3. Mathematical Developments of Vector Flux according to Figure 2

If we define a symmetric vector flux:

$$\boldsymbol{r}(x,y,z) = xi + yj + zk \Rightarrow \mathrm{d}\boldsymbol{r} = \boldsymbol{r}'_x\mathrm{d}x + \boldsymbol{r}'_y\mathrm{d}y + \boldsymbol{r}'_z\mathrm{d}z = \mathrm{d}xi + \mathrm{d}yj + \mathrm{d}zk$$

$$z = z(x,y) \Rightarrow \boldsymbol{r} = xi + yj + z(x,y)k = \boldsymbol{r}(x,y) \Rightarrow \mathrm{d}\boldsymbol{r} = \boldsymbol{r}'_x\mathrm{d}x + \boldsymbol{r}'_y\mathrm{d}y \Rightarrow \mathrm{d}\boldsymbol{S} = \boldsymbol{r}'_x\mathrm{d}x \times \boldsymbol{r}'_y\mathrm{d}y$$

$$\mathrm{d}z = z'_x\mathrm{d}x + z'_y\mathrm{d}y \Rightarrow \mathrm{d}\boldsymbol{r} = \mathrm{d}xi + \mathrm{d}yj + (z'_x\mathrm{d}x + z'_y\mathrm{d}y)k = (i + z'_xk)\mathrm{d}x + (j + z'_yk)\mathrm{d}y$$

$$\mathrm{d}\boldsymbol{S} = \boldsymbol{r}'_x\mathrm{d}x \times \boldsymbol{r}'_y\mathrm{d}y = ((i + z'_xk)\mathrm{d}x) \times ((j + z'_yk)\mathrm{d}y) = (i + z'_xk) \times (j + z'_yk)\mathrm{d}x\mathrm{d}y$$

$$\phi = \iint_S \boldsymbol{F} \cdot \mathrm{d}\boldsymbol{S} = \iint_S \boldsymbol{F} \cdot ((i + z'_xk) \times (j + z'_yk))\mathrm{d}x\mathrm{d}y = \iint_S \begin{vmatrix} P & Q & R \\ 1 & 0 & z'_x \\ 0 & 1 & z'_y \end{vmatrix} \cdot \mathrm{d}x\mathrm{d}y \tag{1}$$

If we define the area of the retina as part of a sphere and the vector field that forms a conical surface with a constant density of stem cells, then we get the following **Figure 3**:

If $m$ is a constant density of stem cells along each vector of the vector field $\boldsymbol{F} = m(xi + yj + zk)$, then according to **Figure 3** and Equation (1).

In directory coordinates through circular coordinates in **Figure 4**, we get:

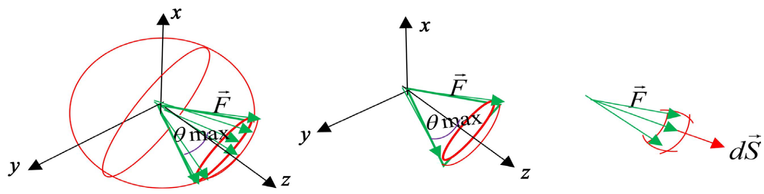


**Figure 3.** The flux of a vector field through an area of an eye surface.

$$
\begin{aligned}
& x^2+y^2+z^2=R^2 \Rightarrow z=\sqrt{R^2-x^2-y^2} \Rightarrow z'_x=-\frac{x}{z},\ z'_y=-\frac{y}{z} \\
& \phi=\iint_S \boldsymbol{F}\cdot \mathrm{d}\boldsymbol{S}=m\iint_S \begin{vmatrix} x & y & z \\ 1 & 0 & -\frac{x}{z} \\ 0 & 1 & -\frac{y}{z} \end{vmatrix}\cdot \mathrm{dxdy}=m\iint_S\left(\frac{x^2}{z}+\frac{y^2}{z}+z\right)\cdot \mathrm{dxdy} \\
& =mR^2\iint_S \frac{1}{z}\rho\cdot \mathrm{d}\varphi\cdot \mathrm{d}\rho=mR^2\iint_S \frac{1}{z}\rho\cdot \mathrm{d}\varphi\cdot \mathrm{d}\rho \\
& =mR^2\iint_S \frac{1}{R\cos(\theta)}R\sin(\theta)\cdot \mathrm{d}\varphi\cdot \mathrm{d}\left(R\sin(\theta)\right) \\
& =mR^3\iint_S \frac{1}{\cos(\theta)}\sin(\theta)\cdot \mathrm{d}\varphi\cdot \cos(\theta)\cdot \mathrm{d}\theta \\
& =mR^3\iint_S \sin(\theta)\cdot \mathrm{d}\varphi \mathrm{d}\theta=mR\iint_S R^2\sin(\theta)\cdot \mathrm{d}\varphi \mathrm{d}\theta \\
& =mR\iint_S \mathrm{d}S=mR^3\int_0^{2\pi}\mathrm{d}\varphi\int_0^{\theta_{\max}}\sin(\theta)\cdot \mathrm{d}\theta \\
& =2\pi mR^3\cdot\left[-\cos(\theta)\right]_0^{\theta\max}=2\pi mR^3\cdot\left(1-\cos\left(\theta_{\max}\right)\right)
\end{aligned}
\tag{2}
$$

where: $R, m, \theta_{\max}$ are given according to the eye Doctor's decision.

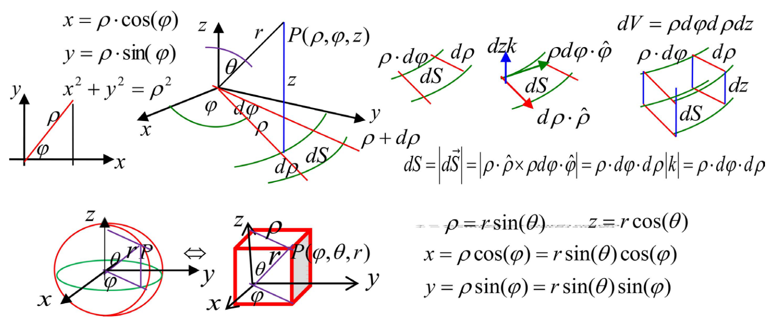


**Figure 4.** In directory coordinates through circular coordinates.

## 4. Conclusions

We hope that by geometric-mathematical tools and the flux of stem cells into open curved spaces in the retina of recently blind people and macular degeneration patients, we will help enable the growth of visual cells in their retinas.

In this article, we present only a proposal for the mathematical use of the flux of sperm cells without medical laboratory results.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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