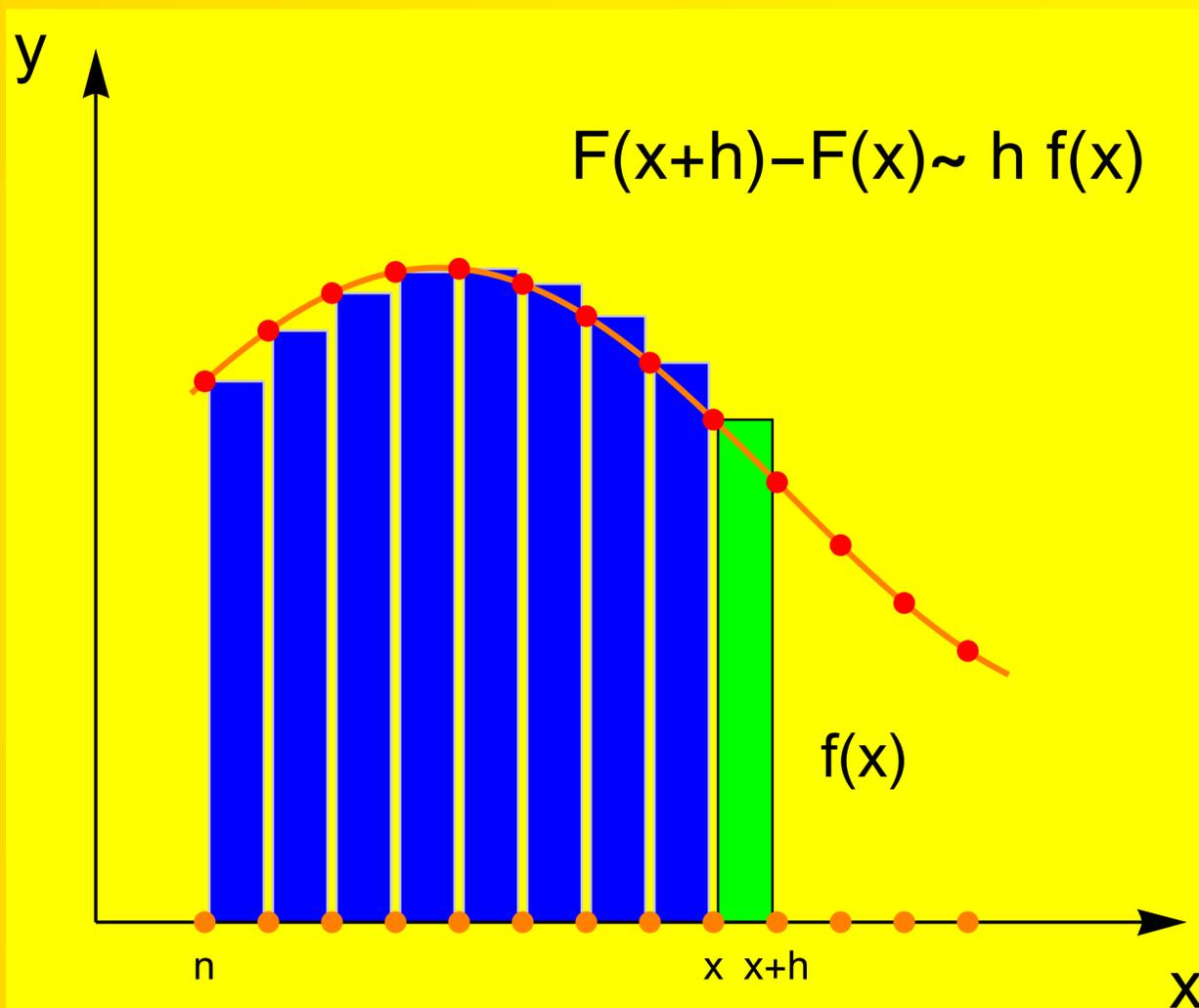
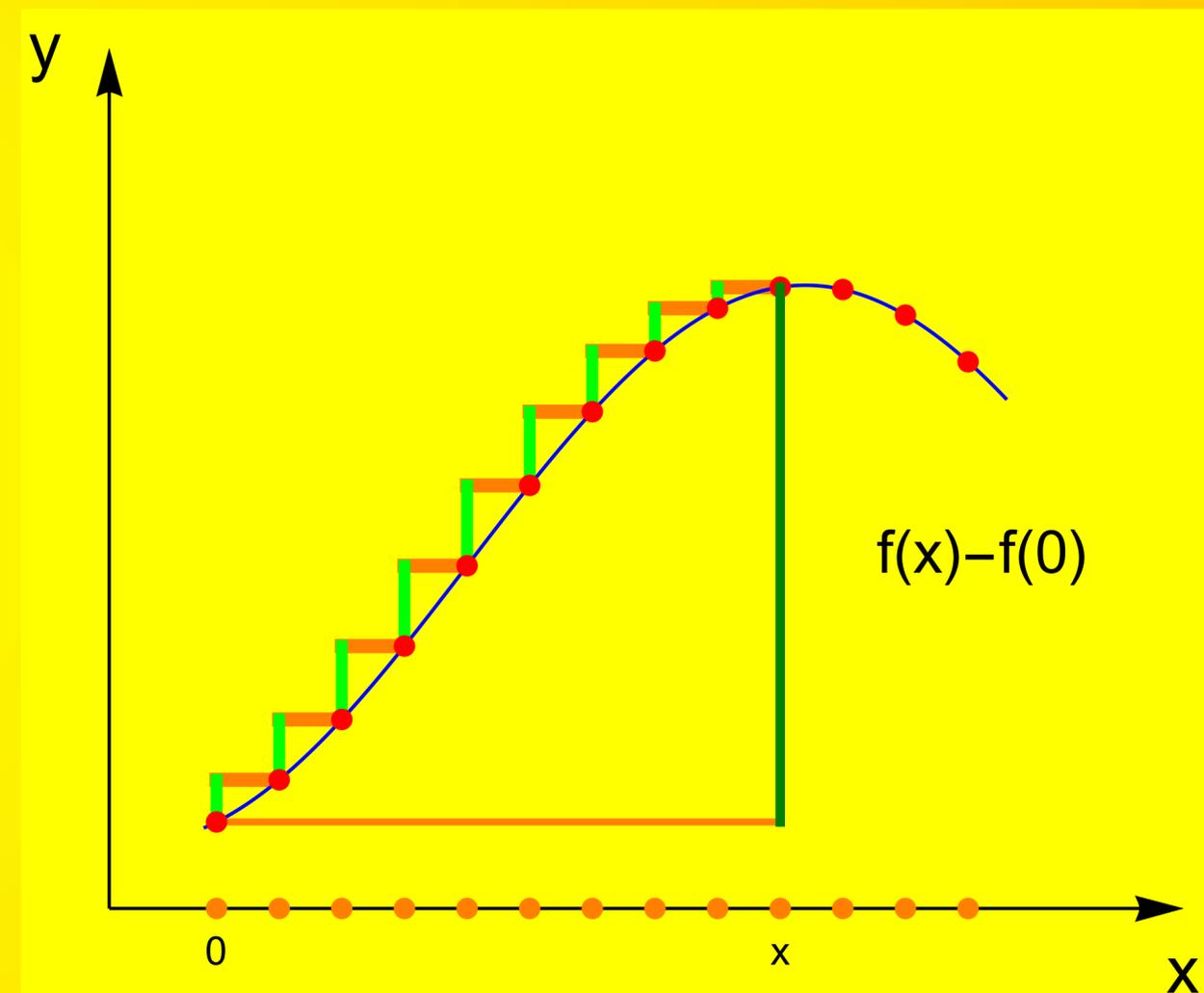


18

Fundamental Theorem



$$\left(\int_0^x f(x) dx \right)' = f(x)$$



$$\int_0^x f'(x) dx = f(x) - f(0)$$

PLAN

1. Poll

2. The theorem

3. Anti derivatives

5. Jam

POLL

Which
of the three
formulas
is the false one

A $\frac{d}{dx} \int_0^x f(t) dt = f(x)$

B $\int_0^x f'(t) dt = f(x)$

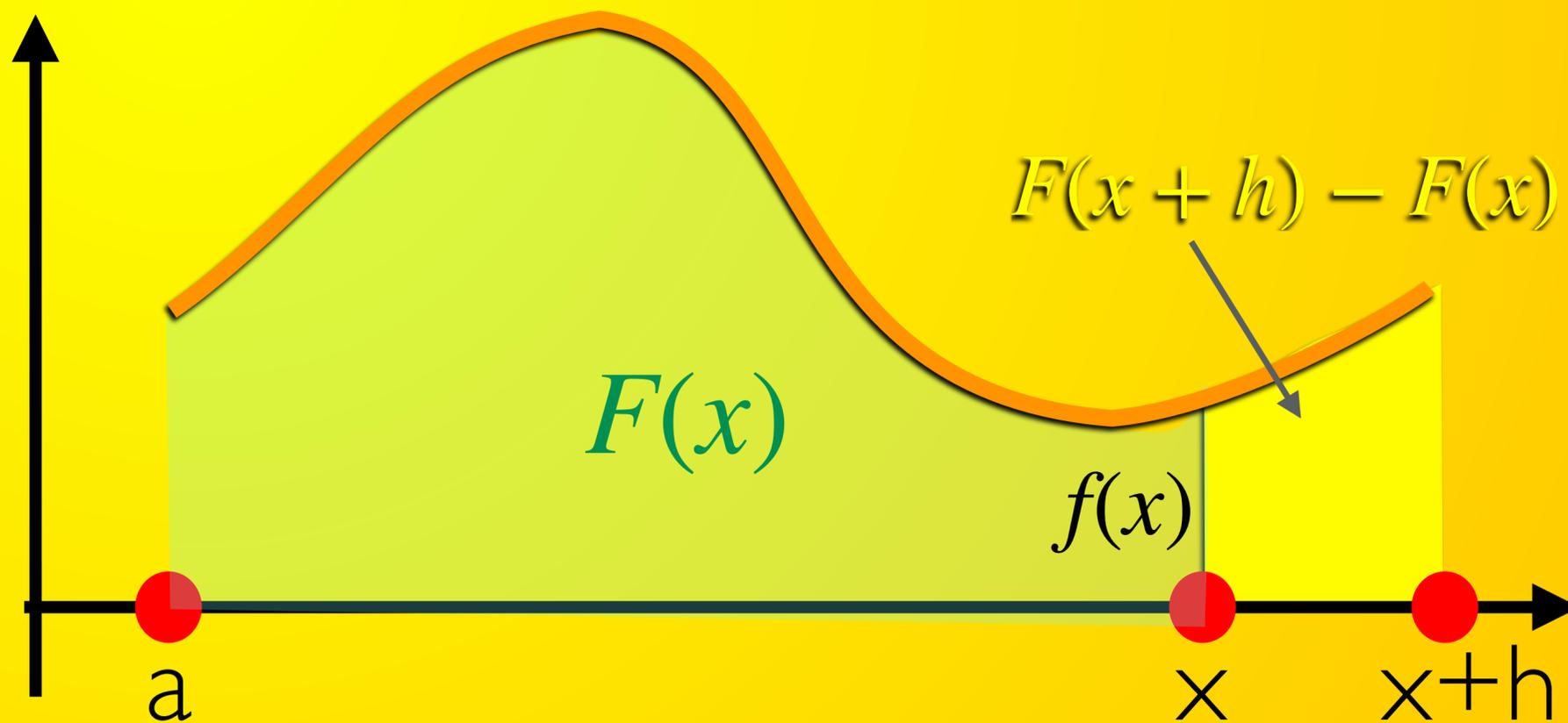
C $\int_0^x f'(t) dt = f(x) - f(0)$

PART 1

$$\frac{d}{dx} \int_a^x f(t) dt = f(x)$$

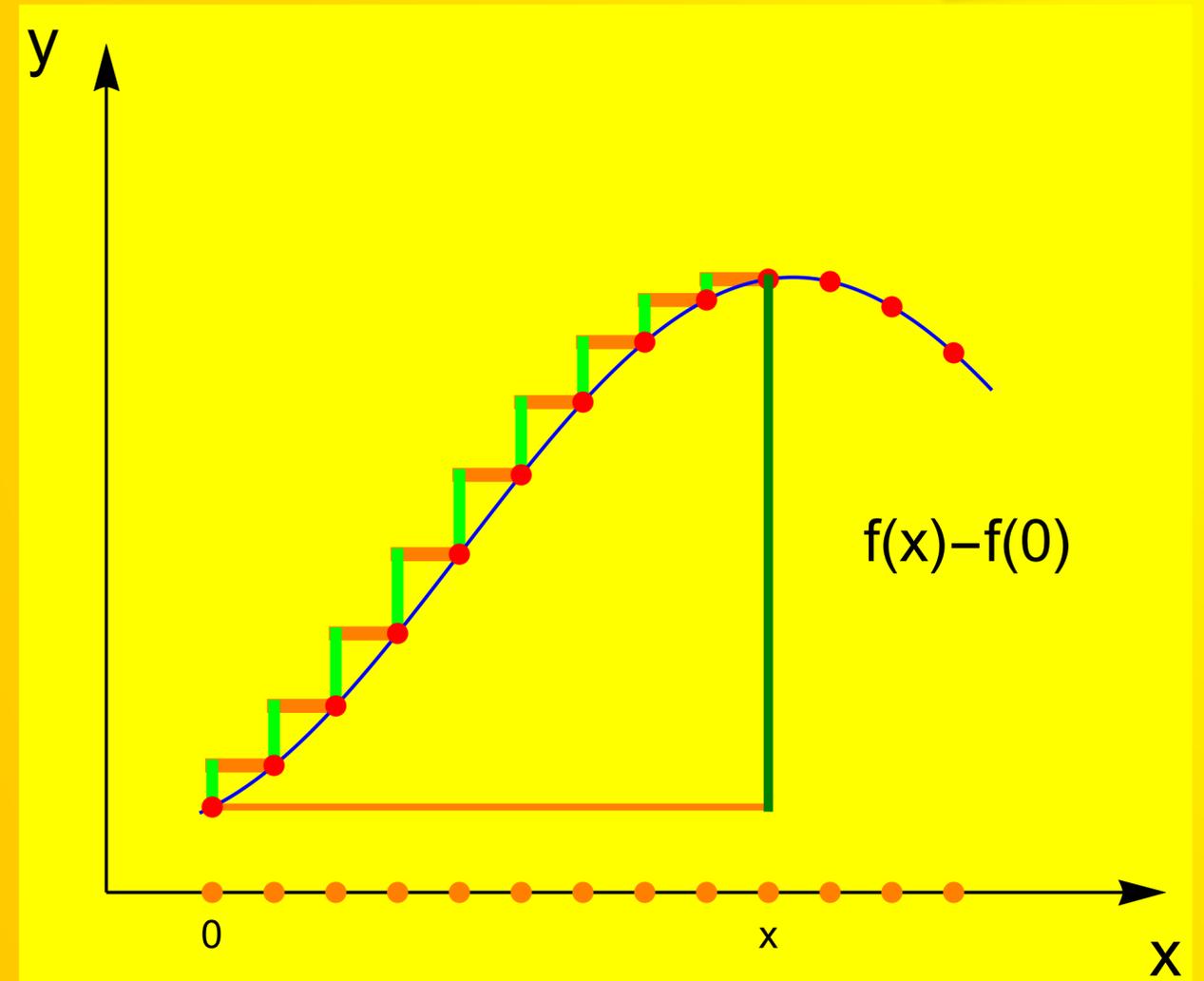
Proof:

$$\frac{F(x+h) - F(x)}{h} \sim f(x)$$



PART 2

$$\int_0^x f'(t) dt = f(x) - f(0)$$



Total sum of changes add up to net change

ANTI DERIVATIVE

An anti derivative f is a function
 $F(x)+c$, where $F'=f$

Example: the anti-derivative of
 $\cos(x)$ is $\sin(x)+c$.

EXAMPLES

A

$$\int_0^{\pi} \cos^2(t) dt$$

B

$$\int_0^2 t^3 + 4t dt$$

C

$$\int_1^3 \frac{1}{x+4} dx$$

D

$$\int_0^1 e^{7x} dx$$

E

$$\int_1^2 \log(x)/x dx$$

F

$$\int_1^3 x\sqrt{x+1} dx$$

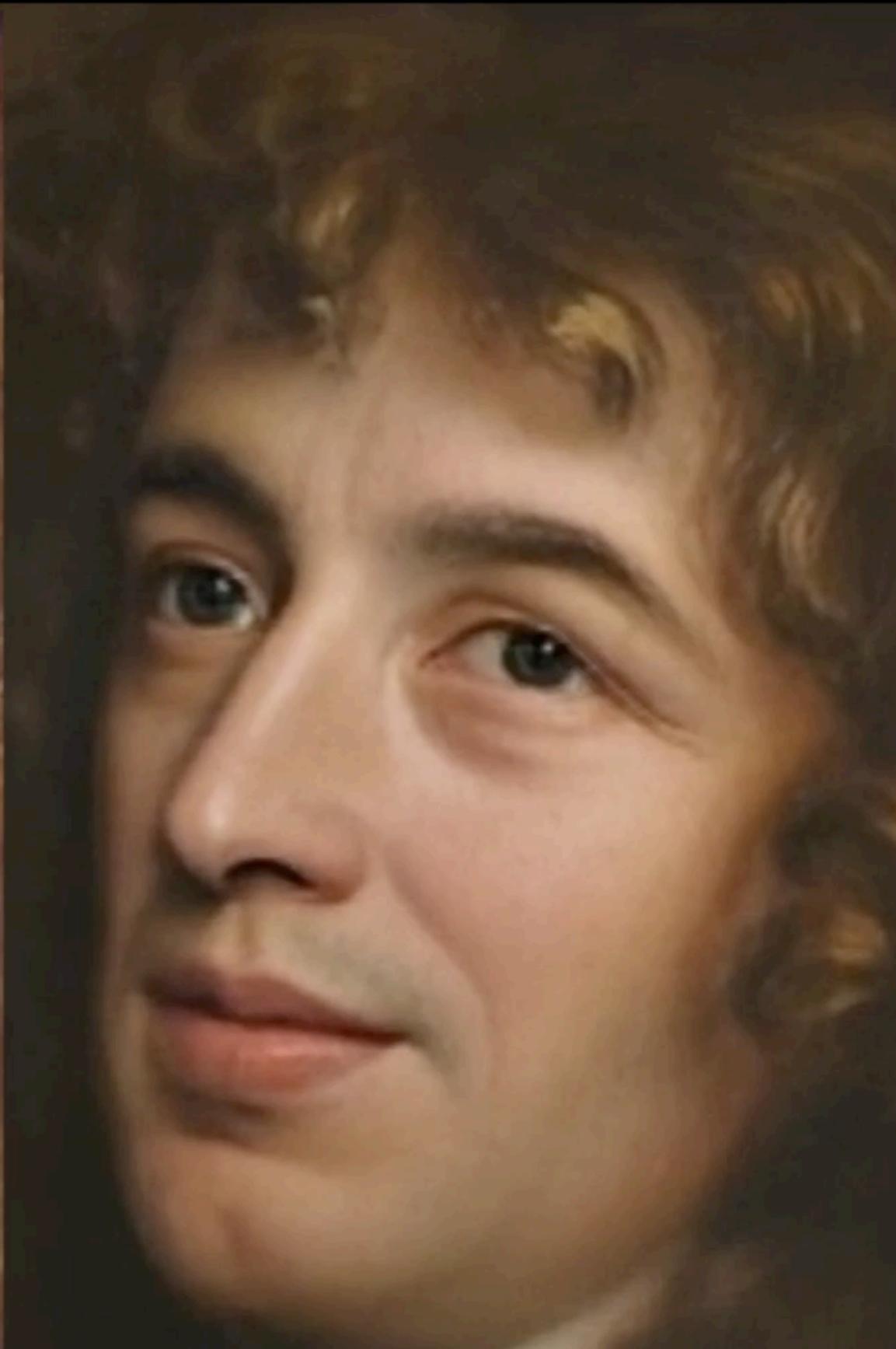








Huygens



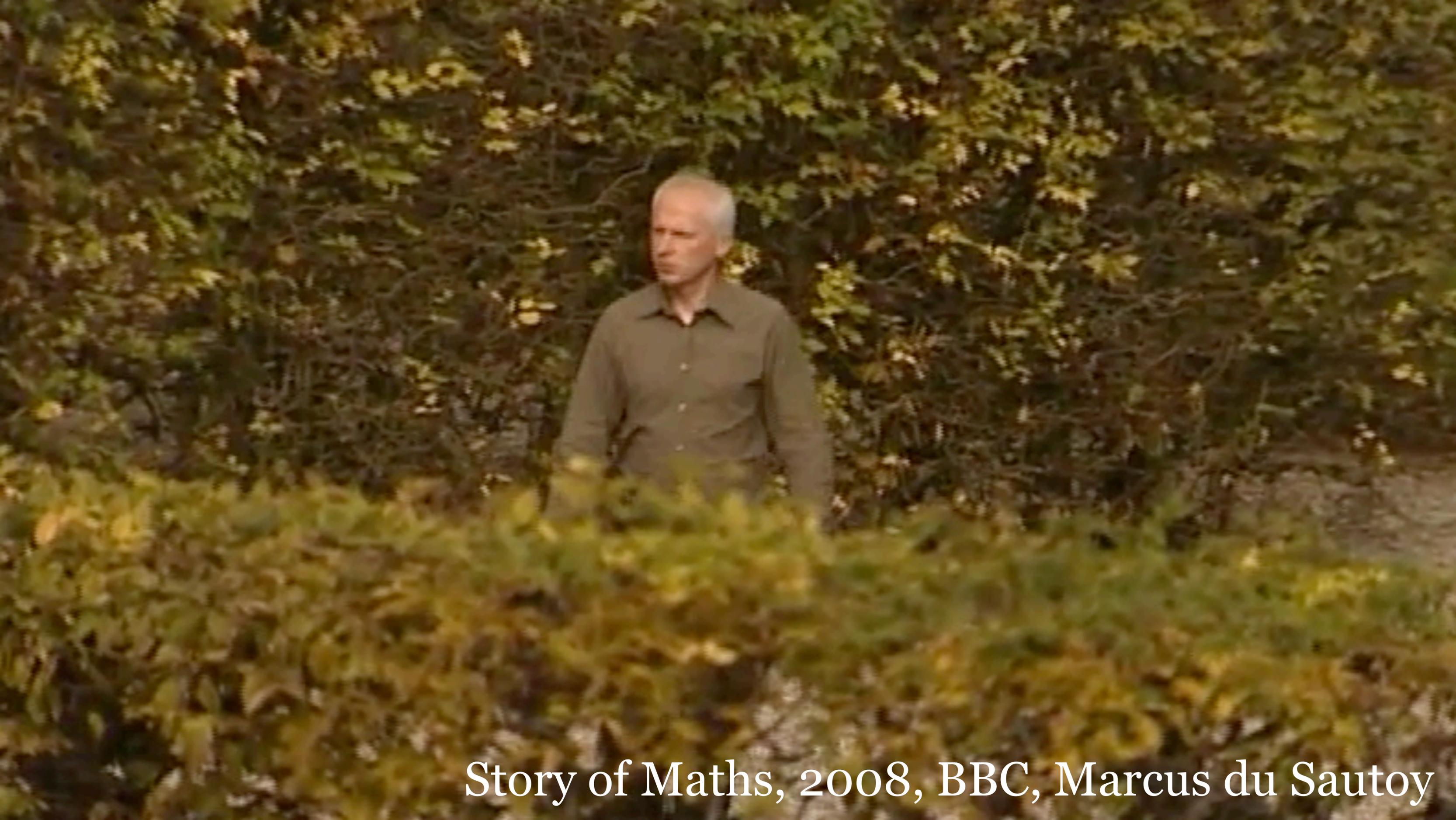
Barrow



Hooke

ISSAAC NEWTON





Story of Maths, 2008, BBC, Marcus du Sautoy

HISTORY

NEWTON, 1666

I'VE INVENTED
CALCULUS!



LEIBNIZ, 1674

I'VE INVENTED
CALCULUS!



REA
A L

Cal



"ISAAC NEWTON" APPLE TREE

Here is the scion of the storied apple tree which is believed to have led to Sir Isaac Newton's discovery of the law of gravity. A gift from John Astin, A&S '52, and Valerie Sandobal Astin, this sapling was derived from a tree at the National Institute of Standards & Technology, itself a scion from the original tree at Newton's home in Lincolnshire, England, and honors former Johns Hopkins fellow Allen V. Astin, PhD, physicist, electronics pioneer, and Director of NIST from 1951-1969. We are deeply grateful to the Astin family for their many contributions to our institution and for this grand piece of scientific history.

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A QUICKIE:

$$\int_0^1 t^3 + t^5 dt$$

JAM

A

$$\int_0^{2\pi} \sin^2(3x) \, dt$$

A

$$\int_2^3 4e^{5x} \, dt$$

The End