

Supplementary Calculations

S1- Volume Measurement in 3D

p arm volume (centromere index) = Total volume of chromosome – q arm volume

% of p arm volume (centromere index) = p arm volume of individual chromosome / total volume of individual chromosome x 100

% of q arm volume = q arm volume of individual chromosome / total volume of individual chromosome x 100

% volume of whole individual chromosome = volume of individual chromosome / total volume of all chromosomes x 100

S2- Length Measurement in 3D

% of p arm length (centromere index) = p arm length of individual chromosome / total length of individual chromosome x 100

% of q arm length = q arm length of individual chromosome / total length of individual chromosome x 100

% length of whole individual chromosome = length of individual chromosome / total length of all chromosomes x 100

S3- Length Measurement in 2D (mFISH spreads)

% of p arm length = p arm length of individual chromosome / total length of individual chromosome x 100

% of q arm length = q arm length of individual chromosome / total length of individual chromosome x 100

Total averaged length of 5 spreads = sum of averaged lengths of 5 spreads / 5

% length of whole individual averaged chromosome of 5 spreads = Total Averaged length of individual chromosomes from 5 spreads / total lengths of all averaged chromosomes (5 spreads) x 100

S4- Calculation for DNA content of chromosomes

Number of base pair (bp) per chromosome = volume of chromosome (nm³) / 5.80 (nm³/ bp)

Number of Mega base pair (Mbp) per chromosome = number of bp per chromosome / 1000000

Where; 1 Mbp = 1000000 bp

S5- Diameter measurement of chromosomes

Diameter of whole chromosome p arm = Sum of p arm diameters of chromatid 1 and chromatid 2

Diameter of whole chromosome q arm = Sum of q arm diameters of chromatid 1 and chromatid 2

Diameter of whole chromosome = Sum of p and q arm diameters of chromosome

Average chromosome diameter = Sum of diameters of 4 whole chromosomes / 4

S6- Calculation for finding center of chromosome position

$dx = x - \langle x \rangle$, called offset x

$dy = y - \langle y \rangle$

$dz = z - \langle z \rangle$

$r = \sqrt{dx^2 + dy^2 + dz^2}$

where $\langle x \rangle$ is the average x, so is the x coordinate of the center point, etc.