Figure 1. Chromosome territories and genes in three-dimensional (3D) space. Fluorescence in situ hybridization (FISH) visualizes the spatial organization of the genome. (*A*) Chromosomes exist in the form of chromosome territories in the interphase nucleus. The DNA of each chromosome occupies a spatially well-defined fraction of the nuclear volume, typically about $1-2$ μm in diameter. Chromosome 11 (green) in the nucleus (blue) of MCF10A breast cancer cells is shown. (*B*) Individual genes appear as distinct spots. *MYC* (red) and *TGFBR2* (green) in MCF10A cells are shown. (*C*) The position of a chromosome or a gene can be expressed as the distance from the center of the nucleus or relative to other genes. The distribution of chromosomes and genes is nonrandom with some chromosomes (red) preferentially occupying internal positions and others (green) occupying peripheral positions. The nonrandom radial positioning also gives rise to nonrandom genome neighborhoods. (*D*) The distribution of a gene is probabilistic. Mapping of the position of the *IGH* gene in human lymphocytes in several hundred individual cells shows that its distribution is distinct from a random distribution; however, the *IGH* locus can be found in variable locations in individual cells. Each red dot represents the position of an *IGH* allele in a single cell. (*C*, Modified from Meaburn and Misteli 2007.)

Epigenetics, Second Edition © 2015 Cold Spring Harbor Laboratory Press