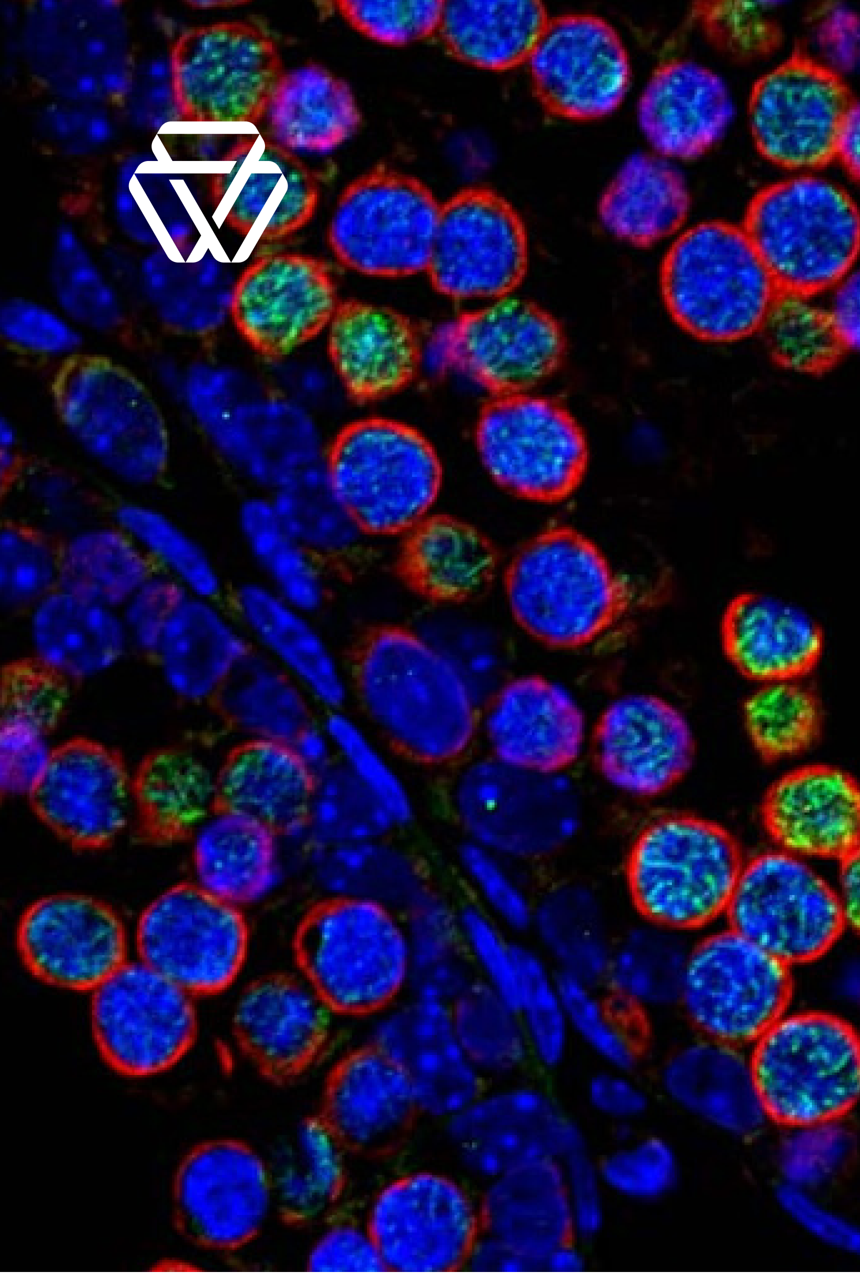

Growth and development: uncovering the basics

Whitehead Institute researchers study how our cells achieve the incredible feat of working together to build a body. During embryonic development, individual cells must perform in perfectly orchestrated harmony. Dynamic processes occur inside of and between cells to coordinate rapid, major changes as the embryo grows from a single cell to a complex organism, and subtle differences in gene expression and regulation can lead to significant changes in development, with implications for future health.

Member **David Bartel** investigates how gene expression is regulated both in and by RNAs. Messenger RNAs (mRNAs) are the intermediaries between genes and protein products. Bartel's group discovered how mRNAs are regulated differently early in embryonic development, when cells do not make new mRNAs, versus later on when new mRNAs are made, and identified the conditions that trigger the shift in regulation. Bartel has also made fundamental discoveries regarding microRNAs, regulatory molecules that target mRNAs and so help to orchestrate the precise shifts in gene expression that are required during development and growth.

Director and Member **Ruth Lehmann** studies germ cells, the cells that become eggs or sperm. Her group has discovered important details about how germ cells are set aside very early in embryonic development, how they migrate to the gonads, and how the gonads take shape. They continue to explore the gene networks involved in these crucial aspects of development.

Member **Pulin Li** investigates how cells communicate with each other to coordinate their behavior. During development, many individual cells must organize to form tissues and organs. They must work in synchrony to ensure that each cell ends up in the right place at the right time, performing the right functions, to build a larger whole. Li's group studies the signals that cells use—including how they travel, are regulated, and are acted upon—to understand how bodies develop and continue to coordinate multicellular behaviors.

Member **David Page** studies the genetic differences between human males and females, and the developmental and clinical implications of these differences. His group focuses on the largest source of genetic variation in humans: sex chromosome constitution. Cells of human males and females have 45 chromosomes in common, including the "active" X chromosome (Xa). In male cells, the 46th chromosome is a Y; in female cells it is an "inactive" X (Xi). Page's group has found that the Xi and Y chromosomes play a much more active role in gene expression and regulation than previously thought, with likely implications for sex differences in health and disease.

Member **Peter Reddien** studies how animals can regenerate missing tissues. Reddien lab researchers have discovered many of the mechanisms and principles governing regeneration in planarians, regenerative flatworms that can grow back essentially their entire bodies. For example, the researchers have detailed how planarians generate and maintain a body blueprint that allows them to regrow body parts in the right locations and on the right scale. They have also found that planarians' stem cells can take more flexible paths between different cell fates than previously understood. Their work can provide insights into how bodies develop, and may prove useful for regenerative medicine.

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