Construction of Integrative Cross-Platform Databases for Organ Systems and Development

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***Short Abstract* —Resources that integrate anatomy with data acquired by analysis of gene expression and physiological measurements will enhance the ability of researchers to develop predictive models of animal cell signaling in the context of multicellular organs and systems. Here we present an overview of online digital embryonic atlases for mouse and quail that are being linked to other online databases. The atlases provide the context for cross platform integration with the potential for open source annotation. The approach is being adapted for development of an inner ear organ database that focuses on mechanosensory hair cell structure and function.**

***Keywords* — database, digital atlas, gene expression, inner ear, mechanosensory hair cell, organ development, systems biology**

I. Extended Abstract

ATLASES provide a standard reference for describing specific locations. Traditional embryonic atlases are composed of photographic plates with labels naming specific features within the images. A new generation of digital embryonic atlases is being constructed to supplement traditional atlases [1,2,3]. Updating digital atlases is inexpensive and information can be quickly disseminated over the internet. Unlike printed atlases, several of these digital atlases are three-dimensional and allow a user to visualize anatomy as individual objects or user defined sets of anatomy. Labeled anatomy can be linked to online data resources such as gene expression databases and literature searches. The volumetric nature of these digital atlases also allows a user to "handle" and virtually section embryos. Furthermore, digital atlases can be extended by spatially mapping other data types, such as cell migration routes, fate maps and antibody staining and gene expression patterns. Such mappings will allow the visualization of relationships between various developmental events.

Here we present a series of 3-D embryonic atlases of mouse [1] and [3] quail development based on microscopic Magnetic Resonance Imaging (µMRI). These atlases are freely available online [4,5]. The atlases have inspired an effort to develop an online developmental atlas for the *Xenopus* inner ear that can be used to integrate anatomical information acquired using different imaging methods (confocal, epifluorescence, brightfield, SEM, optical coherence tomography) [6,7,8, 9] with gene expression and pharmacological data [10,11]. The *Xenopus* atlas focuses on the inner ear organs and their sensory receptors for hearing and balance, the mechanosensory hair cells tasked with reception of mechanical stimuli. Analysis facilitated by cross platform integration of the data is expected to shed light on cellular mechanisms that underlie organogenesis, and on processes that can protect, damage, or repair cells of the inner ear.

We will discuss the construction and design of these atlases, how they are being linked to other data sources, and how they can be used in education and research.

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