The gravity- and sound-sensing systems in the fruit fly.

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Our ability to sense gravity and sound relies on specialized vestibular and auditory organs in our ear. Most insects are also sensitive to gravity and sound, to search better environments for survival and mating. To understand the logic how they process such sensory information, we first performed a systematic analysis of the structural and functional organization of the fly "ear" and its brain target. By combining molecular neurogenetics, calcium imaging and behavioral analysis, we found that internal sensory neurons of the fly ear are comprised of specialized clusters that are each required for sound and gravity sensing. These two neuronal groups terminate in different areas of the fly brain. Hence, while the fly's abilities to sense gravity and sound share one sensory organ, gravitactic and acoustic information may be segregated at the very first stage of neural processing. Systematic identification of higher-order neurons that feed into the primary auditory and gravity centres revealed the characteristic of the auditory and gravity pathways, which is reminiscent of the cochlear and vestibular pathways in our brain. Such anatomical similarity predicts that the logic to process sound and gravity information would be conserved between flies and mammals.