What optimization principle explains the zebrafish vasculature?[1]

SHYR-SHEA CHANG, KYUNG IN BAEK, TZUNG HSIAI, MARCUS ROPER, Univ of California - Los Angeles — Many multicellular organisms depend on biological transport networks; from the veins of leaves to the animal circulatory system, to redistribute nutrients internally. Since natural selection rewards efficiency, those networks are thought to minimize the cost of maintaining the flow inside. But optimizing these costs creates tradeoffs with other functions, e.g. mixing or uniform distribution of nutrients. We develop an extended Lagrange multiplier approach that allows the optimization of general network functionals. We also follow the real zebrafish vasculature and blood flows during organism development. Taken together, our work shows that the challenge of uniform oxygen perfusion, and not transport efficiency, explain zebrafish vascular organization.

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