**Supplementary File 1 Parameter values used in Figs. 2 and 3**

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|  | tissue geometry |  |
| parameter | **description** | **value** |
| *Lx* | tip of the tailbud | 385 μm |
| *r* | PSM radius | 25 μm |
| *R* | radius of the half torus for the tailbud | 60 μm |
| *Xc* | *x* position of the center of the half torus | 300 μm |
| *dc* | cell diameter | 11 μm |
| *sr* | magnitude of radius change in Eq. (15) | 0 μm min–1 |

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|  | cell advection Eq. (2) |  |
| *va* | advection speed at the anterior end of the PSM | 1.67 μm min–1 |
| *vp* | strain rate at the posterior domain | 3 μm min–1 |
| *xq* | *x* position at which the strain rate changes | 0.3 |
| *tg* | time at which the advection pattern changes | - |

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|  | cell movement and intercellular force Eqs. (3)-(9) |  |
| *vs* | maximum cell movement speed at the tip of the tailbud | 1.0 μm min–1 |
| *Xv* | normalized length scale of cell mobility gradient | 0.4 |
| *h* | steepness of cell mobility gradient | 3 |
| *Dφ* | polarity noise intensity | 0.026 min–1 |
| *μ* | intercellular force coefficient | 8.71 μm min–1 |
| *μb* | boundary force coefficient | 20 μm min–1 |
| *rb* | length scale of boundary force | 1 μm |

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|  | phase equation Eqs. (10)-(12) |  |
| ω0 | autonomous frequency at the tip of the tailbud | 0.2094 min–1 |
|  | difference in the frequency between anterior and posterior ends of the PSM | 0.66 |
| *k* | shape parameter for frequency profile | 3.07 |
| *Dθ* | phase noise intensity | 0.0013 min–1 |
| *κs* | rate of the increase in coupling strength | 0 min–2 |
| *κ*0 | offset of the coupling strength | 0.07 min–1 |
| *Ta* | period at the anterior end of the PSM *xa* | 30 min |

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|  | PSM shortening Eqs. (13), (14) |  |
| *ua* | speed of PSM shortening | 0 μm min–1 |
| *S* | segment size | 50 μm |
| *c* | sum of *ua* and *va* | 1.67 μm min–1 |
| *ρ*0 | cell density | 0.0015 μm–3 |
| *ζ* | anterior limit of cell addition | 100 μm |