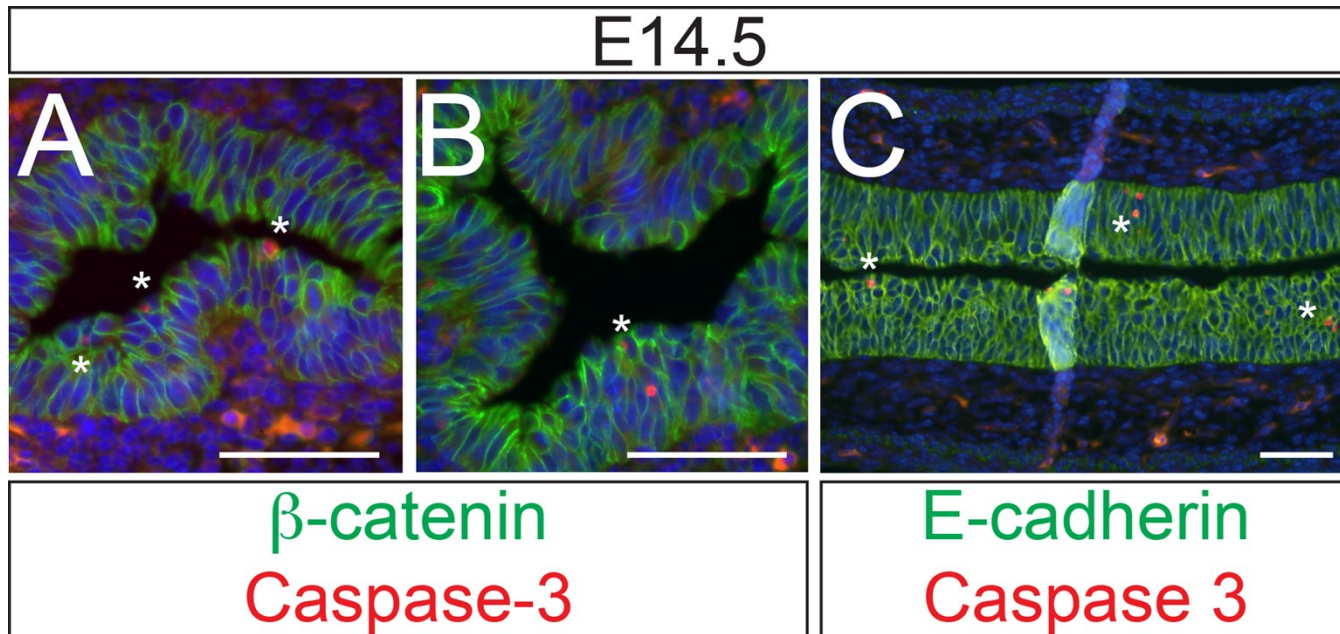
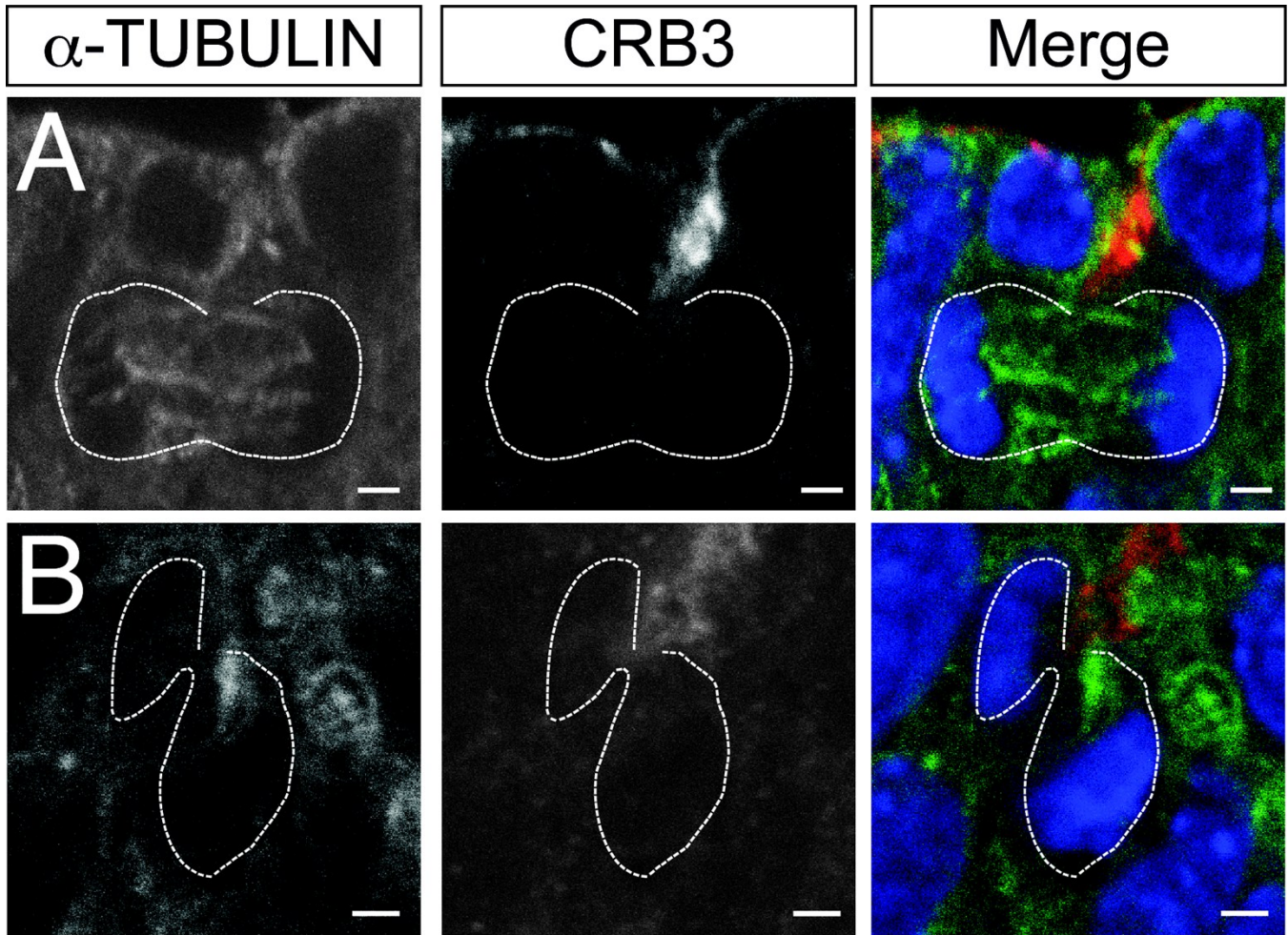


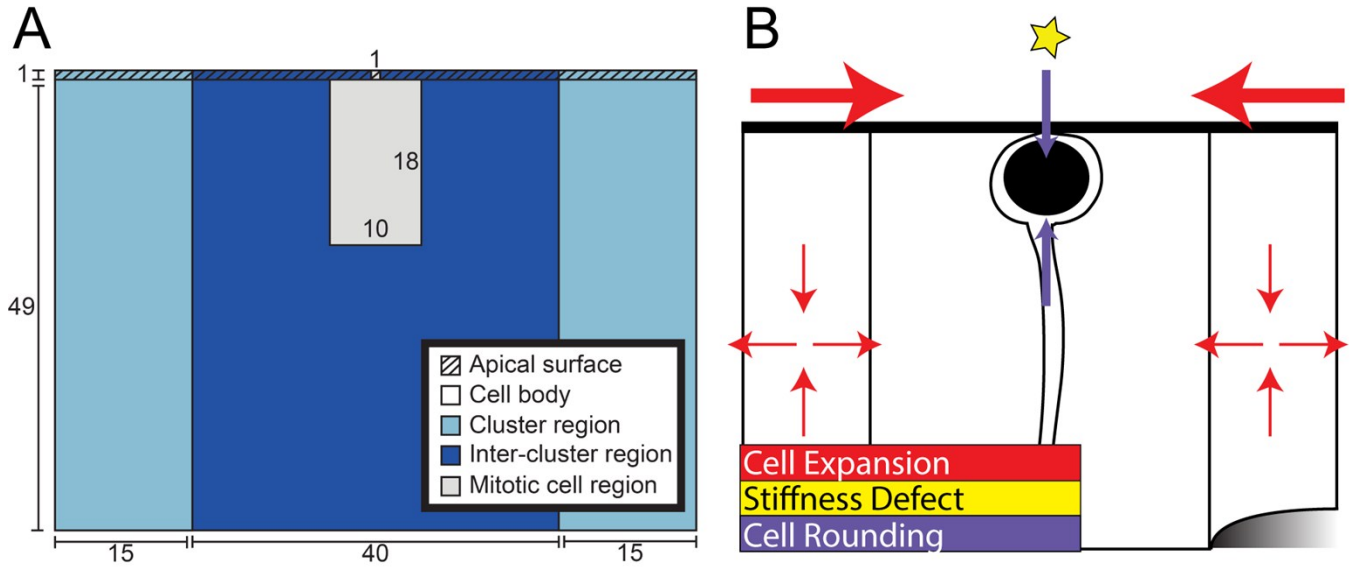
Electronic Supplementary Material



**Supplementary Figure 1. Apoptosis is infrequent in the early intestine.** (A, B) Cross-sections of the intestine at E14.5, demonstrating rare apoptotic events (asterisks, Caspase-3, red) in the epithelium containing nascent villi ( $\beta$ -catenin, green). (C) Longitudinal section at the same time, showing the rarity of apoptosis in the epithelium (E-cadherin, green). Scale bar = 50  $\mu$ m.



**Supplementary Figure 2. Dividing cells at fold tips do not exhibit internalized CRB3.** Two examples of dividing cells (outlined) at tips of apical folds, stained for antibodies against CRB3 (red) in (A) anaphase and apparent. Scale bar = 2  $\mu$ m.



**Supplementary Figure 3. Geometry and variables used in the computational model.** (A) Schematic of the *in silico* representation of the early intestinal epithelium, with dimensions given in  $\mu\text{m}$ . (B) Three features of the physical forces within the epithelium were reconstituted in the model: cell expansion over clusters (red arrows), apical compliant defect at a mitotic cell (yellow star) and vertical contraction associated with mitotic cell rounding (purple arrows).

	Apical			Cell body		
	Above cluster	Between clusters	Mitotic cell contact	Above cluster	Between clusters	Mitotic cell body
Young's modulus (kPa)	10	10	2	0.5	0.5	0.5
Poisson's ratio	0.495	0.495	0.495	0.495	0.495	0.495
C10 (kPa)	1.67	1.67	.336	.0839	.0839	.0839
D1 (kPa <sup>-1</sup> )	0.006	0.006	0.03	0.12	0.12	0.12
Expansion (°C <sup>-1</sup> )	(0.5, 0)	(0, 0)	(0, -0.3)	(0.1, -0.1)	(0, 0)	(0, -0.3)

**Supplementary Table 1. Mechanical properties assumed for the Holzapfel-Gasser-Ogden material model in Abaqus.** C10 and D1 are the moduli corresponding to the distortional and volumetric contributions to the strain energy function, respectively.

**Supplementary Movie 1. Visualization of the 2D FEM model for cluster expansion with no compliant spot and no cell rounding.** Scale shows vertical displacement in  $\mu\text{m}$  with the negative denoting downward displacement. The final frame corresponds to Figure 6A.

**Supplementary Movie 2. Visualization of the 2D FEM model for cluster expansion with a compliant spot and no cell rounding.** Scale shows vertical displacement in  $\mu\text{m}$  with the negative denoting downward displacement. The final frame corresponds to Figure 6B.

**Supplementary Movie 3. Visualization of the 2D FEM model for cluster expansion with a compliant spot and cell rounding.** Scale shows vertical displacement in  $\mu\text{m}$  with the negative denoting downward displacement. The final frame corresponds to Figure 6C.

**Supplementary Movie 4. Visualization of the 2D FEM model for a compliant spot and cell rounding without cluster expansion.** Scale shows vertical displacement in  $\mu\text{m}$  with the negative denoting downward displacement. The final frame corresponds to Figure 6D. Simulation terminated halfway to prevent numerical divergence of computations due to excessive mesh distortion.