

EDUCATION

Seeds of Knowledge

Teaching science as a set of accumulated facts can fail to convey the process whereby scientists discovered those facts. As science education experts urge teachers to shift toward a more process-centered pedagogy, the question arises of how early in the schooling process such an approach can be implemented. Smith *et al.* present the results of a series of lessons in which kindergarten students (5 to 6 years old) actively participated in uncovering the properties of seeds. Instead of simply learning key words relating to seed growth, students took part in a directed discussion modeled after a scientific conference, in which they could share ideas and learn from each other. After raising conflicting ideas over what defines a seed, the students were guided to design experiments in order to test their ideas and reach a resolution. Seeds (and non-seeds) were planted under a variety of different conditions, and students recorded their daily observations, methods, and ideas for future experiments in their science notebooks. A second conference was then held to discuss the results. The conference discussions suggested even quite young children are capable of engaging in scientific reasoning. — MM

Sci. Children **47**, 48 (2009).

BIOMEDICINE

Friend and Foe Alike

The immune system protects against infection and disease, but there are numerous examples where it has switched sides, as in autoimmune diseases and in cancer. Cells become cancerous when they acquire genetic mutations that enable them to evade the regular controls on growth. In addition, stomach (*Helicobacter pylori*) and liver (hepatitis viruses B and C) cancers have been associated with infection-induced inflammation, which involves immune cells, such as macrophages, and inflammation signaling molecules that can promote tumorigenesis. Research on the mechanisms of inflammation-induced carcinogenesis has focused mainly on the innate branch of the immune system, primarily the NF- κ B intracellular signaling pathway.

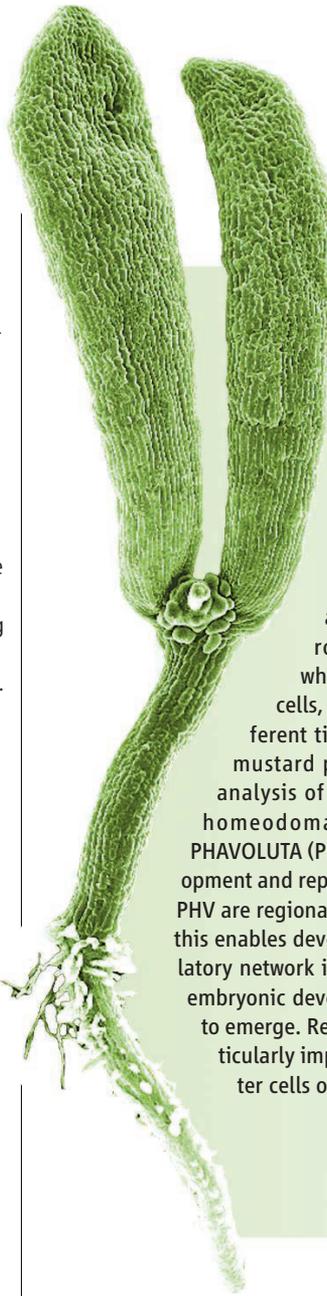
Colorectal cancer has been linked to inflammation of the colon (colitis), which can be caused by bacterial infections. Wu *et al.* have found that the human bacterium enterotoxigenic *Bacteroides fragilis* (ETBF), which induces colitis, can promote colon cancer in a mouse model of the disease. They observed that ETBF activated the transcription factor Stat3 and promoted the generation of interleukin-17 (IL-17)–producing T helper cells (T_H-17 cells). Blocking IL-17 with neutralizing antibodies inhibited ETBF-induced colon cancer in these mice. Thus, colorectal cancer in humans may be caused by bacterial infection and mediated by a T cell immune response. — HP

Nat. Med. **15**, 1016 (2009).

MATERIALS SCIENCE

Squeezing Holes

Most materials stretched in one dimension will contract in the other two, a property captured in the substrate's positive Poisson's ratio. Auxetic materials, in contrast, expand in a lateral direction when stretched, or correspondingly



PLANT SCIENCE

Support Shoots, Repress Roots

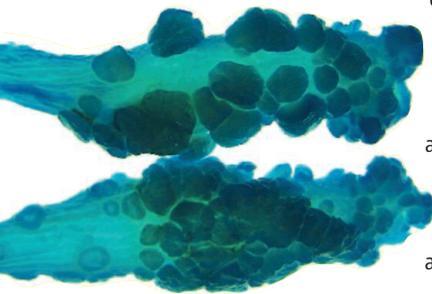
Most flowering plants grow at both ends. The growth of leaves and flowers derives from the shoot apical meristem, and the growth of roots derives from the root meristem. Although the meristems, which are clusters of undifferentiated stem cells, have much in common, they generate different tissues and structures. Studying the small mustard plant *Arabidopsis*, Grigg *et al.* offer an analysis of how the meristems come to differ. Two homeodomain proteins, PHABULOSA (PHB) and PHAVOLUTA (PHV), support shoot apical meristem development and repress root meristem development. PHB and PHV are regionally repressed by a microRNA pathway, and this enables development of the root meristem. This regulatory network is in place as early as the 32-cell stage of embryonic development, when the root stem cells begin to emerge. Repression of PHB and PHV seems to be particularly important for establishing the quiescent center cells of the root meristem. — PJH

Curr. Biol. **19**, 1485 (2009).

shrink in a lateral direction when compressed. Bertoldi *et al.* consider a two-dimensional rubber sheet punctuated with an array of circular holes that shows auxetic behavior only under compression. The sheet initially has a positive Poisson's ratio, which decreases with increasing compressive strain. The holes deform into orthogonal ellipses, as there is insufficient space for all of them to collapse in the same direction. Using finite element simulations, the authors find that a minimum void fraction of 0.34 is needed in order to obtain auxetic behavior. Below this value, the compression leads to a macroscopic instability whereby an entire row of holes collapses to accommodate the strain, leaving the rest of the sample mostly undeformed. The void density also influences the critical strain at which the Poisson's ratio becomes negative; thus, it should be possible through engineering the specific void pattern to make a highly tunable compressively auxetic material. — MSL

Adv. Mater. **21**, 10.1002/adma.200901956 (2009).

CREDITS (TOP TO BOTTOM): GRIGG ET AL., 1485 (2009); DR. SHAO GUANG WU



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