as new cultivation methods for less common microbial groups, or microbial identification with integration of new cutting-edge technologies (e.g., next-generation, single-cell, and whole-genome sequencing as well as MALDI-TOF MS). These key E&T topics have not been fully explored and can accelerate the development of new bioproducts and services. Such a role for mBRCs reflects the central position of research infrastructures in innovation in new technologies, and a privileged role in training researchers in how to make the most of such new advances and technologies.

Concluding Remarks

mBRCs are key holders of microbiological resources, data, and expertise which are crucial for research and innovation. Furthermore, E&T is one of the main paths for knowledge transfer between mBRCs and users of microbiological resources in academia and, most importantly, in industry. Nonetheless, this service has received insufficient attention, and has been hampered both by access to limited resources and the absence of information on present and future needs and demands, which has never been previously collected.

There is a much wider market available in the field of E&T, and the demand is likely to increase in the future. mBRCs still rely on outdated methods and tools for E&T, and are clearly underprepared to face this challenge. Further efforts are clearly required in adjusting E&T offer, adapting contents and content delivery whilst focusing on cost-efficiency and efficient advertising to increase visibility. MIRRI's ongoing efforts in this field will facilitate: (i) the pooling of resources, and (ii) the coordination of training content production, courses offered, and their advertisement. Adopting e-learning, b-learning, video, and interactive content will be particularly beneficial due to scalability, and the production of reusable and 'mashable' content [11,14]. Also, this will increase the reach and accessibility of E&T courses, reduce unnecessary face-to-face components, optimize course duration, and reduce costs to mBRCs and end-users. Such improvements will contribute significantly to the sustainability of mBRCs.

Improving the current E&T offered by mBRCs is a complex task, but an essential one if we want to increase its quality and effectiveness, improve their alignment with the needs of end-users, and thus assist in fueling the current and future waves of innovations in biotechnology.

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Forum

Septal Junctions in Filamentous Heterocyst-Forming Cyanobacteria

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In the filaments of heterocyst-forming cyanobacteria, septal junctions that traverse the septal peptidoglycan join adjacent cells, allowing intercellular communication. Perforations in the septal peptidoglycan have been observed, and proteins involved in the formation of such perforations and putative protein components of the septal junctions have been identified, but their relationships are debated.

The N_2-Fixing Cyanobacterial Filament

Some cyanobacteria grow as chains of cells (filaments or trichomes) that can be hundreds of cells long. The cyanobacteria have a Gram-negative-type cell envelope, and the cyanobacterial filament consists of individual cells surrounded by their peptidoglycan layers but enclosed in a

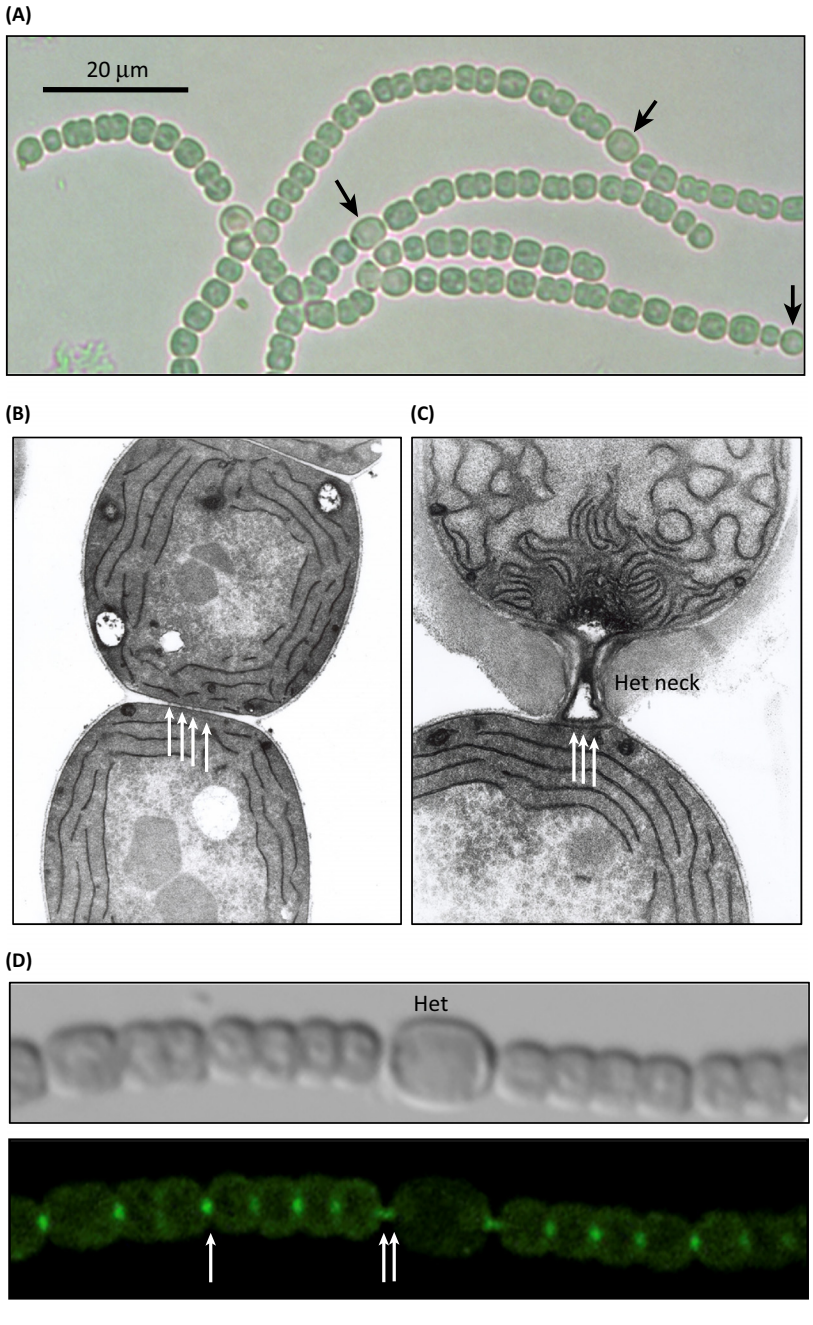

Figure 1. The Filament of an N_2-Fixing Heterocyst-Forming Cyanobacterium, *Anabaena* sp. Strain PCC 7120. (A) Optical micrograph showing fragments of *Anabaena* filaments consisting of vegetative cells and heterocysts (some indicated by arrows). (B) Electron micrograph of a portion of a filament of *Anabaena* showing the septum between two vegetative cells in which thin structures perpendicular to the cytoplasmic membranes of the adjacent cells are visible (white arrows). These structures are known as septal junctions and are thought to join the adjacent cells. (C) Electron micrograph of the junction between a heterocyst (top) and a vegetative cell (bottom) where septal junctions are visible (white arrows). The polar region of the heterocyst known as the 'heterocyst neck' is indicated (Het neck). The site of the cyanophycin granule (a cell inclusion that serves as a nitrogen reservoir), lost during sample preparation, is seen as a split white space in the heterocyst neck and close to it. (Samples prepared and electron micrographs taken as described in [7,9].) (D) Fragment of a filament of *Anabaena* sp. strain CSAM137 containing vegetative cells and a heterocyst (Het). Strain CSAM137 is *Anabaena* sp. strain PCC 7120 bearing a *sepJ–gfp* gene fusion [10]. Bright-field (top) and GFP green fluorescence (bottom) are shown. Fluorescence from GFP (green fluorescent protein) is observed as single spots in the septa between vegetative cells (single arrow), a localization that identifies SepJ as a possible component of septal junctions, and as two spots in the heterocyst–vegetative cell septa (double arrow). (Micrographs taken as described in [10].) All micrographs are from the authors' laboratories.