

Video Article

December 2013: This Month in JoVE

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Abstract

Here's a look at what's coming up in the [December 2013 issue](#) of [JoVE: The Journal of Visualized Experiments](#).

This holiday season, we bring you techniques for studying carnivorous plants. [Rottloff et al.](#) study *Nepenthes*, also known as pitcher plants. They mostly prey on insects, but some species have been known to trap and digest small lizards, birds, and even rodents. Inside the pitcher are tiny glands that secrete digestive fluid and take up the nutrients released from the prey. Using a mechanized microdissection technique, [Rottloff et al.](#) precisely isolate these glands, which can then be processed for RNA extraction and gene expression analysis. Genes of interest can be directly amplified from the glands without an additional DNA extraction step. This technique facilitates the analysis of specific genes as well as gene expression in the digestive glands of these meat-eating plants.

In [JoVE Bioengineering](#), typical microbial experiments are performed on bulk cultures containing billions of cells. This month, [Gruenberger et al.](#) present a microfluidic cultivation device to study bacterial physiology on a single-cell level. The device is first designed using CAD software and then fabricated out of PDMS. Picoliter bioreactors in the microfluidic device restrict bacteria to monolayer growth. The chip is mounted on a microscope, which is focused on the bioreactors. Bacterial suspension is infused into the chip to seed the bioreactors with single cells. Through time-lapse microscopy, various biological processes can be studied in real time.

In [JoVE Environment](#), we have a protocol that tackles water shortage, a major concern for not only agriculture, but also wetland science, forestry, urban planning, and industry. In the environment, much water is lost through evapotranspiration (a combination of evaporation and plant transpiration). [McElrone et al.](#) use a solar-powered field station to measure surface renewal, which provides estimates of crop evapotranspiration. This system can efficiently quantify water use in real time, facilitating water conservation in multiple settings.

In [Clinical and Translational Medicine](#), image guidance is the cornerstone of many interventional techniques, and advances in optical imaging have revolutionized many health care practices. One such practice is trans-arterial chemo-embolization (TACE), a minimally invasive treatment for hepatic tumors. Chemotherapeutic drugs are delivered to the tumor through its feeding arteries along with an occluding agent, which blocks the blood supply to starve the tumor. In this issue of JoVE, [Tacher et al.](#) use cone-beam computed tomography (CBCT) to guide transarterial chemoembolization. They first perform angiography to visualize the blood vessels and locate the tumor. Then, they acquire CBCT images to verify the supplying vessels and construct a tumor road map, which guides drug delivery to the tumor.

Advanced imaging technologies continue to revolutionize medicine and many other fields. Not surprisingly, 3D optical imaging is the focus of extensive research. In [JoVE Applied Physics](#), we feature a technique called digital fringe projection, which provides dense, superfast 3D measurements of dynamic surfaces. [Ekstrand et al.](#) present the principles of digital fringe projection and illustrate its design and operation. They also demonstrate its many potential uses, including facial function analysis, cardiac mechanics studies, and enhanced video conferencing.

You've just had a sneak peek of the [December 2013 issue](#) of [JoVE](#). Visit the website to see the full-length articles, plus many more, in [JoVE: The Journal of Visualized Experiments](#).

Video Link

The video component of this article can be found at <https://www.jove.com/video/5189/>

Protocol

Microfluidic Picoliter Bioreactor for Microbial Single-cell Analysis: Fabrication, System Setup and Operation

Alexander Gruenberger, Christopher Probst, Antonia Heyer, Wolfgang Wiechert, Julia Frunkze, Dietrich Kohlheyer

In this protocol the fabrication, setup and basic operation of a microfluidic picoliter bioreactor (PLBR) for single-cell analysis of prokaryotic microorganisms is introduced. Industrially relevant microorganisms were analyzed as proof of principle allowing insights into growth rate, morphology and phenotypic heterogeneity over certain time periods, hardly possible with conventional methods.

Surface Renewal: An Advanced Micrometeorological Method for Measuring and Processing Field-Scale Energy Flux Density Data

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Surface renewal is a micrometeorological method that is being used increasingly to determine energy fluxes, but its technical complexity makes it inaccessible to a broad audience. We describe the steps needed to set up and calibrate a surface renewal field station, to acquire and process data, and to correctly interpret results.

Isolation of Viable Multicellular Glands from Tissue of the Carnivorous Plant, *Nepenthes*

Sandy Rottloff¹, Axel Mithöfer², Ute Müller³, Roland Kilper³

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Plants glands are specialized structures responsible for the biosynthesis and secretion of many compounds involved in interactions with the biotic environment. To enable studies on their molecular and biochemical features, a mechanical micropreparation technique was established in order to isolate single metabolically active glands, here from the carnivorous plant *Nepenthes*.

Dual-phase Cone-beam Computed Tomography to See, Reach, and Treat Hepatocellular Carcinoma during Drug-eluting Beads Transarterial Chemo-embolization

Vania Tacher¹, MingDe Lin², Nikhil Bhagat¹, Nadine Abi Jaoudeh³, Alessandro Radaelli⁴, Niels Noordhoek⁴, Bart Carelsen⁴, Bradford J. Wood³, Jean-François Geschwind¹

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Dual-phase cone-beam computed tomography (DP-CBCT) is a useful intraprocedural imaging technique for transarterial chemo-embolization treatment with drug-eluting beads of hepatocellular carcinoma. DP-CBCT has been used to perform three major steps in oncologic interventional radiology: tumor localization (see), navigation and intraprocedural catheter guidance (reach), and intraprocedural evaluation of treatment success (treat).

High-resolution, High-speed, Three-dimensional Video Imaging with Digital Fringe Projection Techniques

Laura Ekstrand, Nikolaus Karpinsky, Yajun Wang, Song Zhang

3D Machine Vision Laboratory, Department of Mechanical Engineering, Iowa State University

This video describes the fundamentals of digital fringe projection techniques, which provide dense 3D measurements of dynamically changing surfaces. It also demonstrates the design and operation of a high-speed binary defocusing system based on these techniques.

Disclosures

No conflicts of interest declared.