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Nonlinear Dynamics of Soft-Matter: Continuum Mechanics in the Classroom

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Recent efforts in soft-condensed matter physics has generated a renewed interest in the fundamental physics of continuum systems. There has been a recognition that a wide variety of systems, from glasses to foams to granular material, exhibit similar behavior with regard to their dynamics. Even under conditions of external driving, these systems are often "jammed". In other words, they exhibit a solid like response to the external driving. With sufficient driving force, there is a transition to a flowing state as the system "unjams". This flowing state is generally comprised of nonlinear rearrangements of particles within the system. The question has been raised as to whether or not this represents a general new state of matter, or if the details of each individual system is relevant. At the same time, the interest in the response of complex fluids, such as foams and granular matter, that are composed of mesoscopic, or even macrosopic, sized "particles" (such as sand grains), has raised interesting questions concerning the application of continuum mechanics to these systems. Both the nonlinear response of these materials and the application of continuum mechanics raise fundamental physics questions that are generally not covered in typical undergraduate (or even graduate) curricula. This talk will not only review some of the important questions in this field, but also present suggestions as to its integration into the undergraduate curriculum.