An XML Language Template Design for Managing a Remote Instrument Educational Outreach Program

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For the past two years we have been operating a remote instrument educational project called Bugscope.[1,2,3] Bugscope is an educational outreach project that provides access to an environmental scanning electron microscope (ESEM) for K-12 classrooms. While the operational aspects of the project require a minimal amount of staff time, the information management for the project is difficult for a small microscopy research group to support without a significant allocation of resources away from the group's principal research goals. In an effort to alleviate this problem we have begun, in the past five months, to develop a software toolkit called 'Information Technology for Outreach Projects' (ITOP) – using the Bugscope project as a test bed. The goal of ITOP is to make it practical for academic research groups to provide scientific resources for educational outreach projects by automating many of the administrative and data handling tasks. The first aim of ITOP is to develop a core data template design (fig. 1) for describing the information elements necessary for managing the Bugscope project. In this abstract we describe how we achieved this using the Extensible Markup Language (XML) and related technologies to implement the data template. More detailed information about XML can be found on the World Wide Web Consortium's (W3C) web site (http://www.w3.org/XML).

XML is a software technology that allows data to be exchanged between clients more readily than with other methods, such as the hypertext mark-up language (HTML). For the most part, data within an HTML web site is static in that HTML Web site developers must decide how multiple clients can view their data and the site is built around that specific presentation. XML allows the clients themselves to decide how the data is viewed, allowing for client customized presentations of the data.[4]

Methods: Our XML data file contains all pertinent data that we collect while managing and running the Bugscope project. Figure 1 illustrates the data that is associated with each of the three categories: *Application Data*, *Session Data*, and *Follow-up Data*. Each time an application for Bugscope is submitted (via the web) the data associated with the classroom, project and school information is added as a "member" to the XML data file. During a session, data relating to the specimen is stored along with microscope control parameters for every image that is acquired. Finally, data elements that track feedback and session evaluation information from the participants are also stored in the XML data file.

XML has allowed us to "containerize" all project information in a single file. Prior to the XML implementation the project used separate text files for each of the data elements. The XML structure has allowed for improved organization and interaction with that data. More importantly, the XML structure allows the data to be easily exported to other clients. An XML schema is used to describe the structure of the data elements within an XML file and to validate the XML data file. This is a

necessary step in making an XML file fully understandable to other clients. Our XML implementation for the ITOP project is available at http://www.itg.uiuc.edu/technology/itop.

Results and Conclusions: By using XML we have shown that a large amount of complex inter-related data associated with supporting remote microscopy projects for educational outreach projects can be easily stored and managed in an XML data file. Different clients can view the data within the XML file in many different formats, and the presentation of the data can be formatted by us or by the clients themselves.

References
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3. http://bugscope.beckman.uiuc.edu
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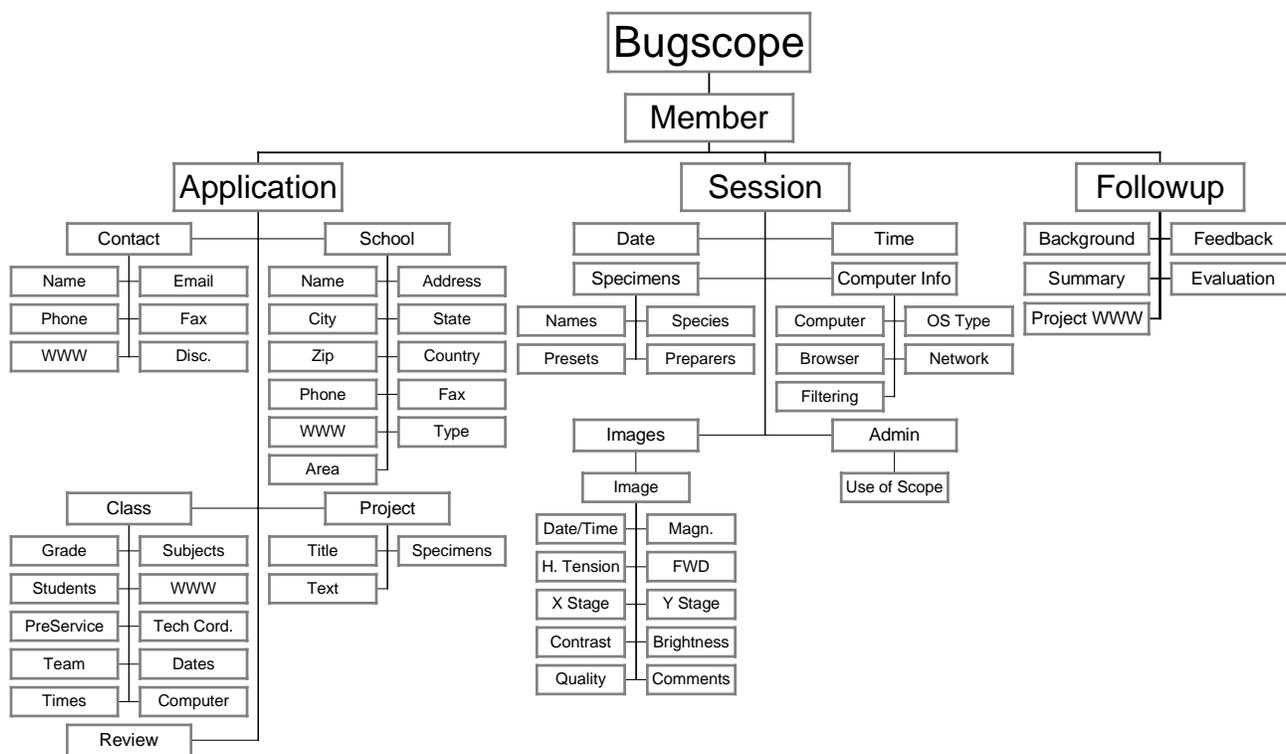5. This research is supported by the National Science Foundation (EIA-0081117)

Figure 1 – Core template design for the Bugscope XML data file.