

# Teaching with Tangibles: A Tool for Defining Dichotomous Sorting Activities

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## Overview

We have developed a tagging strategy, and supporting software, that gives teachers the power to create their own learning activities with tangible user interfaces. Our focus is Dichotomous Sorting, where groups of students are asked to classify specimens based on the presence of certain attributes. Teachers can use their own collections of objects as specimens, and provide their own hints and background materials to help the students.

Our techniques can be used in any application where multiple objects must be identified simultaneously and without constraint. We hope to inspire others to make tangible user interfaces easier to implement.

## Tagging Specimens

We developed a novel bi-directional three-color barcode, so an application can read several barcodes simultaneously with no constraints on position or orientation. A guide bar indicates the width of subsequent bars, and the color representing "1". The next 4 bars represent a binary number (e.g. this picture shows "9"). The remaining 5 bars reflect the values of the first 5. A saturated background color helps the application to find the barcodes. By using a variety of background colors, we can have different-colored barcodes represent different attribute types.



## Teacher Interface: Defining the Learning Activity

We designed a tool that enables teachers to define their own learning activities with tangible user interfaces. Teachers collect their own specimens, or representations of specimens, for the students to sort. Teachers define attributes that characterize the objects, and the possible values that the attributes might have. Teachers specify background information and hints to be given, which can be anything that displays in a web browser. Our software produces an input file for the student interface, and a set of tags that the teacher can print and affix to the underside of the specimens.



## Student Interface: Sorting Objects by Attributes

We created a front-end application that provides guidance without becoming the focus of the activity. Students sort objects on a TICLE table, which has a camera looking up (through the Plexiglas tabletop) at the tags under the objects. A nearby monitor provides instructions, and gives hints when the students need or ask for it.



Here we see children scratching a rock with a nail, to test its hardness.



## Future Work

We plan to have more teachers develop other sample applications, and then test them in the classroom. We plan to freely distribute our software on the internet, along with plans for building a simple (in inexpensive) TICLE table.