INVESTIGATION 3
Notes for the Instructor

PURPOSE

To give students a better feeling for how a STM, AFM, or related SPM instruments operate and how they provide direct evidence for the existence of atoms.

METHOD

All of the SPM devices are based on the underlying principle of being able to detect changes in either a current or force of some kind, as a probe is moved across the surface of a material in atomic-scale increments. Recall the activity with a refrigerator magnet described on pages 14-16 in the "Exploring the Nanoworld" guide. This investigation will simulate the operation of a STM by using a multimeter to measure the resistance at various locations on a six-inch square metal plate onto which a simple pattern made from masking tape has been placed. Fit a piece of counted cross stitch needlepoint fabric over the metal to hide the pattern. A cartesian co-ordinate grid may also be marked on the fabric, if you wish students to include the quadrant or specific points covered by the tape. The alligator clip from one of the leads of the multimeter may be attached to the plate under the fabric at one of the corners while the other lead ends in a probe tip. The uncovered regions of the plate will show a relatively low resistance while those covered by the tape will show a high resistance. The students are then instructed to probe the plate through the spaces in the fabric. This will allow students to "map" the plate and discern the shape from their resistance data. This investigation may be conducted as either a "known" or "unknown" activity, depending on your focus. The procedure as outlined in the investigation itself is only a suggestion and may be modified in many ways.

MATERIALS

metal plate (any clean metal like aluminum cut into six-inch squares will work)

multimeter and leads (should be available from the physics department)

needlepoint fabric (counted cross stitch type)

ANSWERS TO FOLLOW-UP QUESTIONS

1. Student responses will vary.

2. The analogy is a good one in that it illustrates how the systematic recording of resistance data can be used to identify surface features on a material. It does not however have atomic resolution.