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Simple class apparatus for studying frog skin potentials

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We are using a simple apparatus in first-year biology teaching for studying the transepithelial potential of frog skin. The experiments are useful for teaching the basic ideas involved in active transport and in the measurement of biological potentials.

A piece of skin (20 mm square) is pressed gently between a Perspex disc with a hole (9 mm diameter) drilled in it and a platform containing a pool of Ringer solution (Fig. 1). The disc is weighted down with a brass ring (20 g). Two suitable pieces of skin in good condition can be dissected by inexperienced students even from small

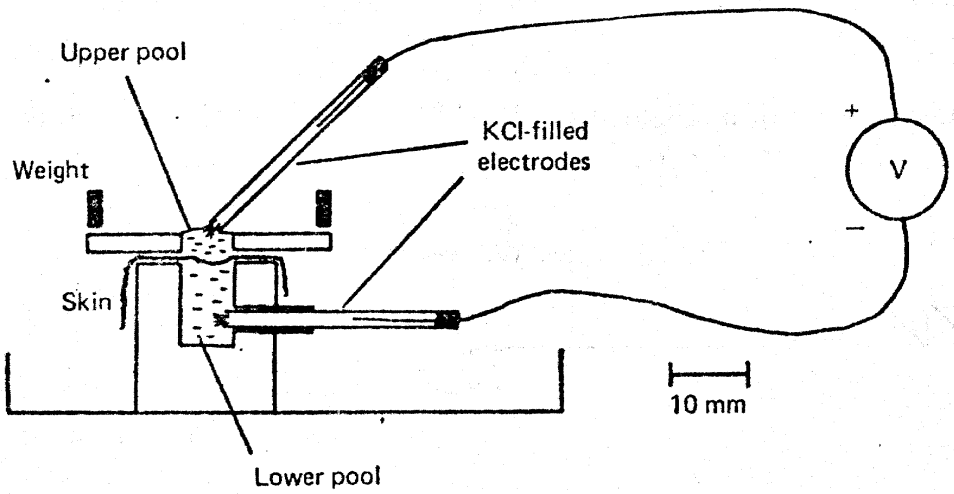

Fig. 1. The apparatus, drawn approximately to scale.

Rana temporaria. The fluid in the lower pool is fixed and stagnant; that in the upper pool, formed by the hole in the disc, is easily exchanged with a Pasteur pipette. The skin can be turned over with little trouble, so the effect of different solutions can be tested on each side.

The electrodes are chlorided silver wires glued into 30 mm lengths of 2 mm diameter glass tubing. The tubing is filled with 3M-KCl and is plugged at the open end with a short wick of cotton wool. One electrode is sealed into the lower pool with silicone rubber tubing; the other is mounted on an adjustable stand with its wick in the upper pool. Voltage measurements are made directly with a digital multimeter (Gould-Advance, Alpha Series: resolution 1 mV; input resistance > 10 MΩ; input current < 1 nA). The base-line potential difference between the two electrodes is measured before mounting the skin and is normally less than 10 mV and stable within ± 2 mV over several hours.

We obtain frog skin potentials of 40–100 mV with Ringer solution on both sides. These are stable enough for experiments over 2–3 hr even without oxygenation and are normally unchanged (± 10 %), apart from inversion, when the skin is turned over. We routinely examine the effects of Na-free (Choline) Ringer and of ouabain (10^{-3} M) applied to both sides, using in all two pieces of skin. The apparatus could easily be adapted for measurements of short-circuit current. We do not consider it particularly suitable for flux measurements, for which a conventional Ussing apparatus is probably preferable.