
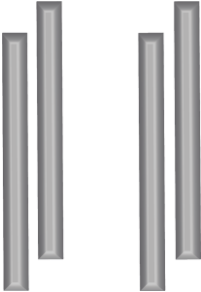




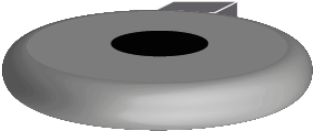
Component	Experiments (current, or previous publications)	Specification	Notes
<b>Lenses</b>			
<a href="#">Keyence VHZ20R</a>	<ul style="list-style-type: none"> <li>Tills et al 2013 Proc Roy Soc B, 280 20131479.</li> <li>Tills et al 2016 JEMBE, 480, 54-61.</li> <li>Truebano et al 2018 JEB 221: 171629.</li> <li>Tills et al 2013 BMC Bioinformatics 14:37.</li> </ul>	20 – 200 X magnification	Extremely high depth of field lens, excellent for low magnification imaging of aquatic embryos, 20-200 X digital magnification. <b>Approx cost = £5,000</b>
<a href="#">Keyence VHZ100R</a>	<ul style="list-style-type: none"> <li>Tills et al 2013 BMC Bioinformatics 14:37.</li> <li>Rudin-Bitterli et al 2014 PLoS One 9: e113235.</li> </ul>	100 – 1000 X magnification	High depth of field 100 - 1000 X digital magnification lens. <b>Approx cost = £6,000</b>
<a href="#">Keyence VHZ500R</a>		500 – 5000 X magnification	High magnification lens, good for imaging Protozoa. <b>Approx cost = £6,500</b>
<a href="#">Qioptiq Optem Micro Lens</a>	<ul style="list-style-type: none"> <li>Hallett et al Sci. Tot. Env. 2016 543 37-43.</li> <li>Rudin-Bitterli et al 2016 JEB, 219: 1076.</li> <li>Tills et al 2013 Biol. J. Linn. Soc. 110, 581-590.</li> </ul>	Wide range of operating possibilities due to being highly customisable.	Highly modular lens system with a wide range of magnification using combinations of auxillary lenses and TV tubes. <b>Approx cost = from £2,000</b>
<b>Lighting</b>			
<a href="#">CCS LDR2-42-SW2</a>		An angled 42 mm OD LED ring light for focussed dark field lighting	<b>Approx cost = £600</b> (with power supply)
<a href="#">Keyence CA-DRW4F</a>	<ul style="list-style-type: none"> <li>Tills et al 2013 BMC Bioinformatics 14:37</li> <li>Tills et al 2013 Biol. J. Linn. Soc. 110, 581-590.</li> <li>Tills et al 2013 Proc Roy Soc B, 280 20131479.</li> <li>Tills et al 2016 JEMBE, 480, 54-61.</li> </ul>	A non-focussed 43 mm OD LED ring light.	<b>Approx cost = £600</b> (with power supply)
<a href="#">Schott EasyLED gooseneck lights</a>		Gooseneck spotlights, can be mounted on optic stainless steel support pole.	A useful lighting apparatus for imaging different types of specimen, although less

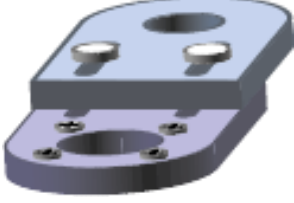
			suited to repeatable lighting. <b>Approx cost = £300</b>
<b>Motorised stages</b>			
<a href="#">Marzhauser SCAN IM 130 x 85</a>	<ul style="list-style-type: none"> <li>• Truebano et al 2018 JEB 221: 171629.</li> </ul>	A motorised stage with 130 x 85 mm of travel – sufficient for a multiwell plate.	The Marzhauser Scan Tango XY stage is a very reliable and robust stage with very good technical and MicroManager support. Platform independant MicroManager support. Controlled with the <a href="#">Tango Desktop controller</a> <b>Approx cost = £7,000 (with controller)</b>
<a href="#">Prior ES111 Optiscan stage</a>	<ul style="list-style-type: none"> <li>• Tills et al 2013 BMC Bioinformatics 14:37</li> <li>• Tills et al 2013 Biol. J. Linn. Soc. 110, 581-590.</li> <li>• Tills et al 2013 Proc Roy Soc B, 280 20131479.</li> <li>• Tills et al 2016 JEMBE, 480, 54-61.</li> </ul>	A motorised stage with 125 x 75 mm of travel – sufficient for a multiwell plate.	A cost effective stage with platform independant MicroManager support. Controlled with previous versions of the <a href="#">ES11 Controller</a> . <b>Approx cost = £6,000 (with controller)</b>
<a href="#">Prior ES107 Inverted Optiscan stage</a>		A motorised stage with 114 x 75 mm of travel – sufficient for a multiwell plate. Inverted so suitable for reduced working distance optics.	An inverted XY stage, good for samples requiring high magnification to get the necessarily small working distance required, for example using the VHZ500R lens. Note that this stage requires different support leg offsets in the aluminium base owing to its greater footprint.

			<b>Approx cost =</b> £8,000 (with controller)
<u>Cameras</u>			
<a href="#">Allied Vision Technologies Pike 421B</a>	<ul style="list-style-type: none"> <li>• Tills et al 2013 BMC Bioinformatics 14:37</li> <li>• Tills et al 2013 Biol. J. Linn. Soc. 110, 581-590.</li> <li>• Tills et al 2013 Proc Roy Soc B, 280 20131479.</li> <li>• Tills et al 2016 JEMBE, 480, 54-61.</li> <li>• Rudin-Bitterli et al 2014 PLoS One 9: e113235.</li> </ul>	Monochrome 2048 x 2048, 7.4 µm pixels.	An excellent camera for darkfield imaging, used with dc1394b FW800 connection. Great MicroManager support owing to new developments with the IIDC driver. Allows custom ROI, recording of full 14 bits and precise manipulation of frame rates via control over packet size. Image capture time is recorded with high precision. <b>Approx cost =</b> £5,000
<a href="#">Allied Vision Technologies Pike 210C</a>	<ul style="list-style-type: none"> <li>• Hallett et al Sci. Tot. Env. 2016 543 37-43.</li> </ul>	Color 1980 x 1080, 7.4 µm pixels	A lower resolution model of the Pike 421C colour camera <b>Approx cost =</b> £5,000
<a href="#">The Imaging Source</a>		Resolution from 0.4-5 MP. Monochrome and colour.	Various colour and monochrome models from the DMK range successfully used. <b>Approx cost =</b> from £300
<a href="#">QImaging Retiga (R3 and R6)</a>		QImaging R3 = 3MP and QImaging R6 = 6 MP. Monochrome and colour.	USB 3.0 cameras available in monochrome and colour, with excellent image quality. However, note that drivers for MicroManager are only available for Windows.

			<b>Approx cost =</b> £4,000 / £4,500
<b>Incubation chambers</b>			
<a href="#">Okolab Cryo Boldline</a>	<ul style="list-style-type: none"> <li>Tills et al 2016 JEMBE, 480: 54-61.</li> <li>Tills et al 2015 Mar Genom, 25: 259-260.</li> <li>Tills et al 2018 Ecol Evol, in press.</li> </ul>	Min T = 10-15 °C below ambient, Max T = 60 °C, sample resolution = 0.01 °C . Humidity > 90%. Compatible with digital and manual OKO-Lab gas mixers.	Enables heating and cooling of samples in multiwell plates, with humidification (to reduce evaporation) and excellent data logging facilities. Can also be used with <a href="#">gas mixing modules</a> , including combined mixing of nitrogen, oxygen and carbon dioxide. OKO-Labs can design gas mixing units to user specifications if required. <b>Approx cost =</b> £15,000
<a href="#">Okolab electrically heated chamber</a>	<ul style="list-style-type: none"> <li>Truebano et al 2018 JEB 221: 171629.</li> </ul>	Min T = 3 °C above ambient, Max T = 60 °C. Sample resolution = 0.1 °C Humidity > 90 %.	Allows heating of sample within multiwell plates using electrical filament heaters built into an incubation chamber. System integrates this with data logging and controlled temperature humidification. This particular model is discontinued. <b>Approx cost =</b> £6,000
<b>Custom parts</b>			
Aluminium base		<b>Material :</b> HE9 aluminium plate - 20 mm x 300 mm x 220 mm  <b>Material cost :</b> £65	

		<p><b>Machining</b> : Four tapped holes added to underside for attaching threaded feet (aids in level and keeping stable), and four untapped holes with centres matching the mounting points of the motorised stage - to which the aluminium legs will attach.</p>	
Aluminium legs		<p><b>Material</b> : HE9 aluminium pole - 25 mm diameter x 600 mm</p> <p><b>Material cost</b> : Approx £45</p> <p><b>Machining</b> : Both ends of each leg should be tapped to allow attachment to the motorised stage and aluminium base - via machine bolt</p>	
Aluminium optic support block		<p><b>Material</b> : HE9 aluminium block - 50 mm x 100 mm x 50 mm.</p> <p><b>Material cost</b> : Approx £30</p> <p><b>Machining</b> : Four vertical holes for attaching to the aluminium base via machine bolt, one large vertical hole to receive the stainless steel optic pole and two horizontal threaded holes for grub screw tightening of the</p>	

		stainless steel optic pole.	
Stainless steel optic pole		<p><b>Material</b> : 304 stainless steel pole, 15 mm diameter x 900 mm</p> <p><b>Material cost</b> : Approx £18</p> <p><b>Machining</b> : No machining necessary, unless cutting to length is required</p>	
Delrin lens support mount		<p><b>Material</b> : Delrin thermoplastic - 150 mm diameter x 100 mm length</p> <p><b>Material cost</b> : Approx £50</p> <p><b>Machining</b> : Delrin machined to a circular profile using a lathe. The profile should be circular (diameter to suit the optics carrier chosen - see below) have a central hole for receipt of the lens (see below), a horizontal slit for tightening, using a recessed machine bolt, and a lip on the upper side so that it is supported by the optics carrier component that is chosen.</p>	
Acrylic light mount		<b>Material</b> : Acrylic 10 mm x 200 mm x 100 mm	

		<p><b>Material cost :</b> Approx £5</p> <p><b>Machining :</b> Acrylic lighting mount, best produced using a CNC machine. Profile tailored to suit the light chosen and it is mounted on the stainless steel optic pole, secured using a grub screw and subsequently can be moved both vertically and laterally for optimisation and convenience.</p>	
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