

# **Brinsea**

## Maxi II Advance Classroom Pack

### **Pack Contents**

Maxi II Advance Incubator  
EcoGlow 20 chick brooder  
OvaView egg candling lamp  
OvaScope egg viewer  
Feed trough  
1 Quart Drinker  
100ml Incubation Disinfectant Concentrate  
8 Slotted plastic enclosure panels  
Lesson Plan on CD-ROM

Please check the contents of the pack and contact your dealer or Brinsea Products if anything is damaged or missing. To register each of your new Brinsea products please visit [www.brinsea.com](http://www.brinsea.com) and follow the link under Customer Service on the top navigation of the home page to qualify for your free 3 year guarantee.

### **Introduction**

The Brinsea Maxi II Advance Classroom Pack provides the equipment needed to artificially incubate and rear 'precocial' species (i.e. chicks able to walk, eat and drink immediately after hatching) such as domestic species including bantams, peafowl and ducks and game birds such as quail and pheasant.

Detailed operating instructions for the incubator, brooder, candling lamp and OvaScope egg viewer are included with each component of the pack. Please take time to read the instructions and familiarise yourself with the products. Successful incubation requires control of a number of factors and it is important to follow recommendations in the instructions to obtain the best hatch.

### **Getting Started**

The incubator needs to be located in a heated (minimum 62°F / 17°C), draft free location out of direct sunlight. Set the equipment up and allow it to operate for a couple of days before setting eggs to ensure it has stabilised and to familiarise yourself with the controls.

Eggs may be stored (ideally at about 60°F / 15°C and turned daily) for up to 14 days if necessary though fresher eggs are more likely to hatch.

Follow the detailed instructions supplied with the incubator for more information.

## **Hatching**

Be sure to have the brooder set up in time for the hatch. Read the instructions for the brooder carefully. Chicks make a lot of mess so cover surfaces to protect them where necessary. Have some chick crumb or similar feed for new chicks ready.

Assemble the enclosure by slotting the panels in one another. The sides conserve heat inside the brooder and protect the chick from drafts. The brooder & enclosure should have textured, absorbent litter on the floor. If the floor is slippery the chicks can damage their legs. Paper towel works best in the classroom and should be replaced daily. Set the drinker and feeder in the enclosure. Keep topped up with fresh water and chick starter crumbs which are obtainable at any feed or farm supply store.

Warning: Some very small chicks (e.g. quail) can drown in a drinker so place clean pebbles around the trough to prevent this.

When eggs hatch leave them in the incubator for around 24 hours to dry. They still get the nutrients they need from the absorbed yoke. Avoid opening the incubator too frequently as it is important to maintain high humidity for other hatching eggs. Once dry, move the chicks to the brooder enclosure and immediately offer food and water. If a chick fails to thrive move it back to the incubator for longer. Closely monitor new chicks for the first few days when they are most vulnerable.

The chicks will consume a surprising amount of food and water (and kick plenty around them). Check on levels frequently. Clean the floor of the enclosure daily.

As the chicks grow they will become more independent of the warmth of the brooder and will quickly require larger housing arrangements. Be sure to have homes ready for the chicks.

Note: A specific plan for disposing of the chicks should be worked out before undertaking an incubation project. Never give the chicks to the children for pets. You should try to find them homes within a few days of hatching. The first suggestion is to give the chicks to someone who has proper brooding facilities, experience and the interest to raise the chicks. The next suggestion is to get in touch with the Extension service of the nearest University Animal or Poultry Science department. They usually have contacts with local farmers who might be willing to supply eggs and/or take chicks back. Finally the local Society for the Prevention of Cruelty to Animals might also be able to either locate someone who will take proper care of the chicks or dispose of them humanely as a last resort.

### **Registered Design**

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## Technical Notes

### Humidity in Incubation

No aspect of incubation causes more confusion and concern than humidity. When other factors appear correct humidity is often blamed for poor hatches but whether too high or too low may still be in doubt. It doesn't have to be so; a few simple procedures can take the mystery out of humidity and put control back in the hands of the operator.

Humidity is one of four primary variables which must be controlled during egg incubation - the others being temperature, ventilation and movement (turning). Humidity is the most difficult of the four to monitor accurately and to control and therefore is commonly misunderstood. The operator instructions that accompany all incubators give guidelines to achieve correct humidity levels for most species under normal conditions and in the majority of cases this gives excellent results so first check that you have followed these guide lines. However there are times when incorrect humidity levels do cause problems and further steps are needed to check that humidity levels are correct. This article explains the effect of different humidity levels, measurement of humidity and the best techniques for achieving correct humidity levels.

Before spending time and effort checking incubation humidity levels it is essential to ensure that temperature and egg turning are correct - refer to the unit's operating instructions. Also check that the eggs are fertile and the parent stock healthy, properly fed and free from in-breeding.

#### The effect of humidity upon the incubating egg

Egg shells are porous - they allow water to pass through, and so all eggs, whether being incubated or not, dry out slowly. The amount of water that an egg loses during incubation is important and this is determined by the humidity levels within an incubator; if the humidity level is higher then the egg will 'dry out' more slowly than if the humidity is lower.

All eggs have an air space at the round end and as water is lost through the shell it is replaced by air drawn through the shell into the air space which gradually increases in size. This air space plays a crucial part in hatching. It is the first air that the fully developed chick breathes and the space allows the developed chick some movement inside the shell to allow it to manoeuvre into hatching position.

If the incubation humidity has been too high the egg will have lost too little moisture and the chick will be rather large. In this case the air space will be too small, the chick's respiration will be affected and the young bird will have difficulty breaking out of the shell because of the lack of space. Commonly with excess incubation humidity chicks will die just before or after having broken through the shell in one place ('pipped') either through weakness because of the lack of air to breathe in the shell or because of lack of space to turn and cut around the shell with their bill. Often, because of pressure within the egg, the bill protrudes too far out of the initial hole preventing the normal anti-clockwise progress of the bill chipping the shell from *inside*. The bill becomes gummed up with drying mucus.

Low incubation humidity levels lead to small chicks with large air spaces by the time the hatch is due. These chicks will tend to be weak and may also die just before, during or just after hatching. It should be noted in general that a slightly lower humidity level than optimum is likely to be less disastrous than a slightly higher than ideal level.

It is important also to understand that humidity does not directly affect embryo development unless the egg is seriously dehydrated. Only temperature and egg turning affect growth of the embryo directly. Humidity is important only to achieve the right balance between excessive dehydration and space within the egg as it reaches full term. Thus a temporary error in humidity can be corrected later provided the error is observed and the right action taken. Death of an embryo at early or mid term stages of incubation is not usually attributable to incorrect humidity.

### Measurement of humidity.

Many materials are capable of absorbing water or water vapor and air is one of them. Water vapor is a gas like any other gas, and air is a mixture of gases, one of which is usually water vapor. The difference is that the amount of water vapor varies widely whereas the other gases which make up our atmosphere remain fairly constant. The range of vapor may be from none to a certain maximum which the air can absorb. This *maximum* increases with temperature and is known as *saturation* level.

There are two commonly used ways to define humidity and the differences need to be clearly understood. These are:

#### **Relative Humidity (RH)** expressed as a percentage.

This is a measure of the amount of vapor in air compared with the maximum that could be absorbed at that particular temperature. This is why relative humidity (RH) is quoted as a percentage. For example an incubation RH level of 50% might be quoted. This means that at incubation temperature the air in the incubator contains half of its maximum possible water vapor capacity. Because maximum possible water content increases at higher temperature, if the temperature was increased but no additional water added then the % RH level would drop. The air would become dryer.

A good way of imagining this effect is to think of a bath sponge. When the sponge is squeezed to half its normal size clearly it can hold less water. Imagine a half squeezed sponge soaked in water until no more can be absorbed (saturated) this is analogous to cold air at 100% RH - no more water can be absorbed. If the sponge is allowed to expand completely then, although the amount of water has not changed, the sponge is *relatively* dryer than before because it has greater capacity to absorb water. This is analogous to warmer air containing the same amount of water vapor which will now have a much lower RH level. Conversely when air cools the capacity of the air to hold water vapor reduces and % RH levels will rise. If the air temperature drops below the saturation point (100%RH) the water vapor condenses. An example of this is dew forming on a cold night after a warmer day.

#### **Wet Bulb temperature**

This is the temperature (in degrees C or F) of a thermometer with a moist cotton wick around its bulb. Evaporation of water from the wick cools the bulb by an amount *related* to the relative humidity. This cooling effect is the same as the chill we feel when we step out of a shower. It is the difference between Wet Bulb temperature and air temperature that is important, so air temperature or Dry Bulb temperature must also be known to define the RH. In incubators the Dry Bulb temperature is constant (we hope!) so WB is often quoted on its own.

Direct measurement of RH is not easy. Cheap hygrometers are available but you get what you pay for; we have seen cheap instruments reading 30% different from out of the same new pack! More expensive direct reading digital instruments have improved in recent years and are not so prone to calibration drift but still need to be re-calibrated occasionally. A very reliable method of measuring RH without spending a lot of money, is to measure wet and dry bulb temperatures and convert the information to %RH by using a simple chart.

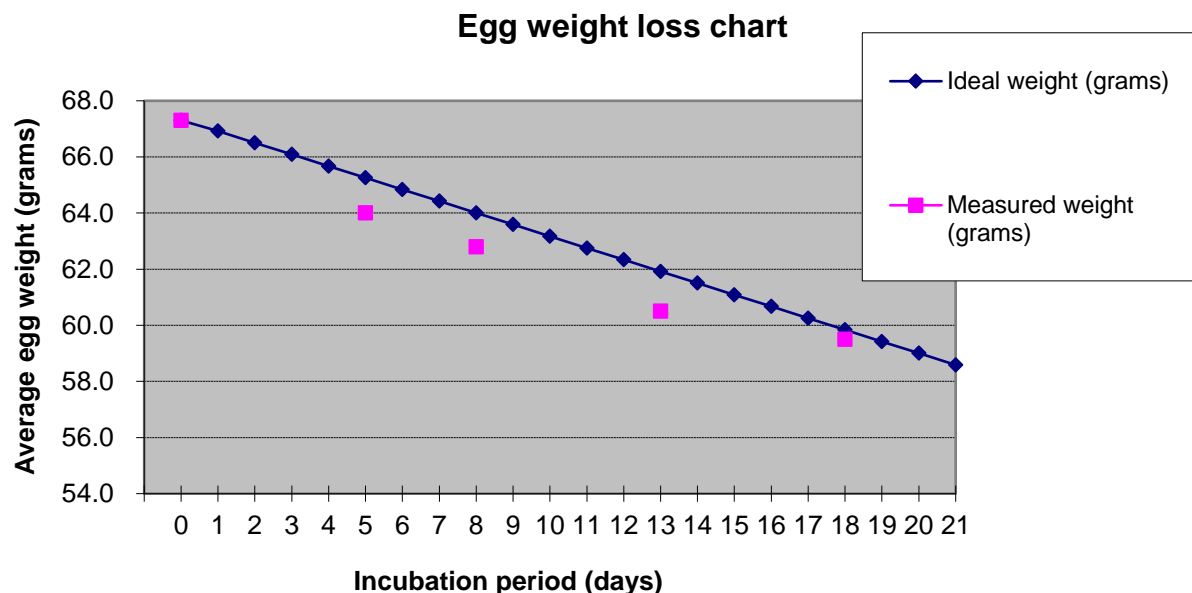
Thermometers for measuring Wet and Dry bulb temperatures are usually identical; the wet bulb instrument just has a wick around the bulb. There are two special cases where Wet and Dry bulb readings are the same; when the air is saturated (100%RH), and when the wet wick has dried out!

A further complication is that it is difficult to measure humidity in 'still air' incubators. Wet bulb thermometers do not work well in near static air conditions. The other problem is that the temperature will vary by several degrees from the top of a still air incubator to the bottom and so RH readings will vary with height too. Fortunately the humidity level in still air incubators is probably less critical than fan assisted (forced draught) machines.

### Achieving correct humidity levels

There is a fairly easy and reliable way of measuring RH indirectly and, more importantly, directly measuring the *effect* that RH level has on the egg. This is by weighing the eggs to monitor their water loss over the incubation period. Most species of bird need to lose between 13 and 18% of their weight from the time of setting the eggs in an incubator to hatching. Data is available on many species but as a rough guide, domestic hens, waterfowl and game birds should lose 13 or 14%, parrot species and many other altricial species around 14 to 18%. By measuring the weight of the eggs at intervals during incubation and comparing this to the expected weight needed to achieve the ideal weight loss by hatching time, it is possible to see when the rate of water loss is too great due to humidity being too low or vice versa. Eggs can be weighed individually or in convenient groups (trays?) and averaged.

In practice this means drawing a graph (see below) with incubation time in days along the x-axis and weight up the y-axis. The average weight of eggs when set (day 0) can be entered and the ideal hatching weight (average day 0 weight less, say 14%) can be plotted on the day the hatch is due. These two points are joined to give the ideal weight loss line. Average weights can then be taken every three or four days and plotted on the graph. If the actual average weights are lower than the ideal then humidity levels need to be increased and vice versa. Thus any deviation from the ideal weight loss line can be corrected as incubation progresses. The important point is to reach the ideal weight loss by hatching day; some deviation from the ideal weight loss line earlier in incubation will not cause damage.



***The graph above shows the average actual weights of incubating eggs against the ideal weight loss line - Note that the greater than ideal weight loss in the earlier stages of incubation has been corrected by hatching day.***

### Altering incubation humidity levels

All incubators should have the facility to evaporate water inside the egg chamber and thereby adjust humidity levels. Two controllable factors influence humidity levels: water surface area and the amount of fresh air the incubator draws in. Most incubators have two or more water pans to give some flexibility over evaporation rates. Remember that it is the total surface area of water that matters not the depth. So to increase humidity levels fill more pans and reduce ventilation by either adjusting the control or blocking up to half of the ventilation holes. Some ventilation must be maintained to allow the chicks to breathe. Refer to the operator instructions for your model. In exceptional circumstances it may be necessary to further increase the surface area of evaporation by using evaporating pads or blotting paper to soak water from the vessels in the incubator. Do not spray the eggs with water - the increase in humidity is very short lived and bacteria may be spread.

A third factor does affect incubation humidity levels and this is the ambient (or environmental) humidity level outside the incubator. Clearly if the air being drawn into the incubator contains very little water then incubation humidity levels will be lower (all else being equal) than if outside air is very humid. As explained above, cold air cannot contain much water vapor so when cold winter air is warmed in temperature the RH level will be very low (remember the sponge!). This happens in heated houses in winter and in incubators. The result is that, in general, humidity levels will tend to be lower in your incubator in winter than in summer and so water evaporation and ventilation levels should be adjusted with this in mind. Because eggs are more likely to be damaged by excess incubation humidity, one common mistake is to use the same regime of water and ventilation in the summer that was successful in the winter. In warm summers it may be that no water is needed in the incubator until hatching time because the combination of warm, damp ambient air plus the water given off by the eggs themselves gives sufficient RH levels.

There is no evidence of any change in ambient humidity levels associated with global temperature change as a result of the Greenhouse Effect. Small climatic temperature changes are insignificant when compared to seasonal variations and so although it may be fashionable, there is no justification in blaming a poor hatch on global warming.

### Humidity and Hatching

The humidity levels required as the chick emerges are different from those earlier in incubation. For the last day or so of incubation humidity levels need to be much higher than earlier on. By 'pipping' stage the projected weight loss of the eggs should have been achieved. High humidity levels are now required to prevent the down of the chick and shell membranes drying too fast as air gets to them and becoming stuck and difficult to separate. In natural incubation membranes do not dry as quickly because the parent bird covers the eggs and reduces evaporation but in an incubator drying membranes can be a problem. The actual level of humidity is not too critical for hatching but usually needs to be at least 60% RH. Humidity levels drop rapidly when the incubator is opened and take much longer than temperature levels to re-establish. Try to avoid the temptation of opening the incubator often when chicks are emerging to keep humidity high.

*Relative Humidity (SI symbol  $\phi$ ) is defined as: Vapor pressure / Saturated vapor pressure. A more useful measure for calculation purpose is Percent Saturation (SI symbol  $\mu$ ). This is defined as: mass of vapor per mass of dry air / mass of saturation vapor per mass of dry air. Numerically the difference between the two measures is quite small and usually ignored.*

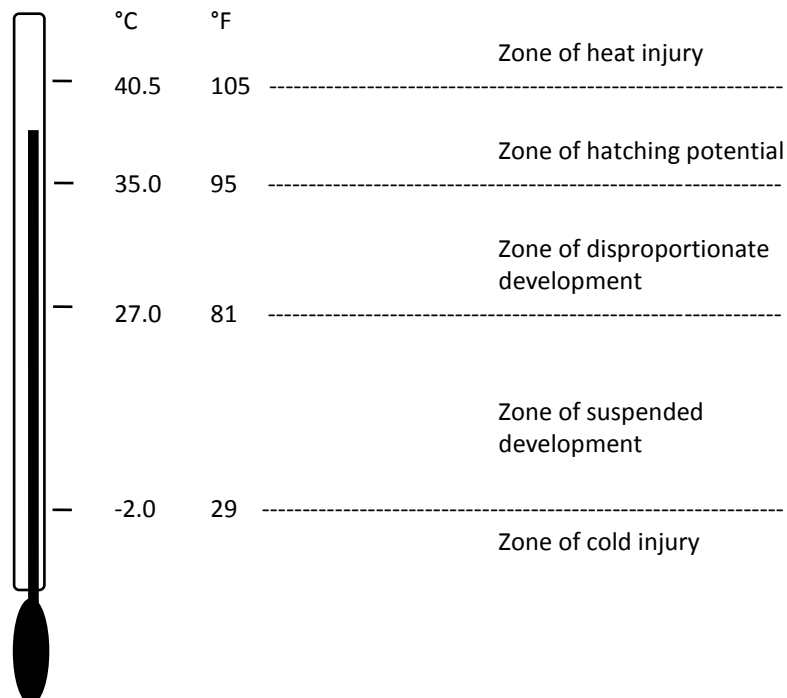
### What if the power goes off?

This is a question frequently asked by anxious incubationists, usually *after* the event which came unexpectedly and the query is therefore 'what damage is likely to have been done?' Occasionally the power shutdown can be predicted and the concern is to keep damage to a minimum.

With the emergency situation in mind as well as the more subtle question about daily cooling of eggs during incubation, we have attempted to set out some of the more fundamental research information together with our own experiences and suggestions.

A review by H. Lundy of research carried out by a number of scientists over many years identified five temperature zones each of which is characterized by its major affect on the developing embryo. These zones are not clear cut. There is some overlapping and the time for which the embryo is exposed and the age of the embryo blur the limits.

### Lundy's five incubation Temperature Zones



In common with most scientific work on incubation, this data assumes an incubator with a fan (virtually no temperature differences within the incubator) and was based on chicken eggs.

These zones are further explained as follows:

#### Zone of heat injury (above 104.9°F/40.5°C)

At continuous temperatures above 104.9°F (40.5°C) no embryos would be expected to hatch. However the effect of short periods of high temperature are not necessarily lethal. Embryos up to 6 days are particularly susceptible, older embryos are more tolerant. For example, embryos up to 5 days may well be killed by a few hours exposure to 105.8°F (41°C) but approaching hatching time they may survive temperatures as high as 110°F (43.5°C) for several hours.

Zone of hatching potential (104.9 - 84.5°F /35 - 40.5°C)

Within a range of 84.5 - 104.9°F (35 to 40.5°C) there is the possibility of eggs hatching. The optimum (for hens) is 100.4°F (37.8 °C), above this temperature as well as a reduced hatch there will be an increase in the number of crippled and deformed chicks. Above 104.9°F (40.5 °C) no embryos will survive.

Continuous temperatures within this range but below optimum retard development and increase mortalities. However it is again evident that early embryos are more susceptible to *continuous* slightly low temperatures than older embryos. Indeed, from 16 days on it may be beneficial to lower the incubation temperature by up to 3.6°F (2°C). I emphasize the word 'continuous' because the effects of short term reduction in temperature are different and are discussed later.

Zone of disproportionate development (80.6 - 95°F /27 - 35°C)

Eggs kept above 80.6°F (27°C) will start to develop. However the development will be *disproportionate* in the sense that some parts of the embryo will develop faster than others and some organs may not develop at all. Below 95°F (35°C) no embryo is likely to survive to hatch. Typically the heart is much enlarged and the head development more advanced than the trunk and limbs.

The temperature at the lower end of this range is sometimes referred to as 'Physiological zero' - the threshold temperature for embryonic development. Unfortunately different organs appear to have different thresholds resulting in an unviable entity.

Zone of suspended development (28.4 - 80.6°F /-2°C - 27°C)

Below about 80°F (27°C) no embryonic development takes place. Prior to incubation, eggs must be stored in this temperature range (preferably around 59°F /15°C).

Zone of cold injury (28.4°F/-2°C)

Below this threshold ice crystals will start to form in the egg and permanently damage may be done to internal structures. Eggs may lie for some considerable time in temperatures close to freezing without suffering damage.

The analysis above gives us a fair idea of what may be happening to embryos kept *continuously* or for long periods within these temperature bands. Of course continuous incubation at any temperature other than near optimum is of little practical interest because it will not result in live birds but this information does give a better understanding of what may happen if eggs should be accidentally overheated or chilled.

Further scientific data has resulted from experiments concerned specifically with intermittent chilling of eggs. There is evidence that, during the early phase of incubation, chilling of eggs to below 'physiological zero' (say 77°F /25°C) does less harm than chilling to temperatures *above* that level. Embryos up to 7 days old may well survive cooling to near freezing for 24 hours or more without damage. The cooling delays hatching but not by as much as the period of chilling - so there appears to be some degree of compensation. The older the embryo, the more likely it is to die as a result of chilling to *below* 80.6°F /27°C but the effect on surviving embryos is not detrimental.

Other experiments have concentrated on cooling eggs less severely to temperatures within the zone of 'disproportionate development'. In virtually all such experiments, *increases* in hatchability have been reported varying from 2% to 25%, or even higher in the case of ducks and geese. There is some doubt as to whether the effect is due to changes in humidity, CO2 level or to chilling alone.



A number of conclusions from this data which have practical implications:

- 1 Cooling eggs for short periods, say 30 to 40 minutes, on a regular basis (say once every 24 hours) at any stage during incubation has no detrimental effect and is probably of benefit.
- 2 If eggs are likely to be cooled for longer periods (more than 3 hours) the way they should be treated depends upon their state of development. If the eggs are newly set the best plan is to cool them fairly quickly down to 41 - 68°F (5 - 20°C) and hold them in this range - put them in the fridge! It may also be best to treat eggs this way up to about the 14th day, although greater losses must be expected if severe cooling occurs later in incubation.  
If power loss occurs when the eggs are near hatching, incubator temperature is less critical, but severe chilling will cause mortalities. It is preferable therefore, to take reasonable steps to limit heat loss by keeping the incubator shut and raising the temperature of the room if possible. The metabolic heat from the embryos will keep them warm for quite a long time.
- 3 Avoid maintaining eggs in early stages of incubation for long periods of time in the 'zone of disproportionate development' (80.6 - 95°F/27 - 35°C). This will result in a large number of deaths and abnormalities.
- 4 Avoid subjecting the eggs to over-temperature at any time but particularly in the early days of incubation.

Remember that incubator thermometer readings will not be the same as embryo temperatures when cooling or heating occurs. The eggs will lag behind the air temperature. For example, cooling hens eggs by taking them out of the incubator into a room at 68°F /20°C for 30-40 minutes is likely to cool the internal egg temperature by only 7 - 10°F (3 - 5°C). Eggs smaller or larger than hens eggs will react quicker or slower accordingly.

There is very little data on the effects of cooling eggs of other species. Duck eggs and to an even greater extent, goose eggs, are said to benefit from periodic cooling. Our own experience seems to confirm this and we know of instances where the eggs of both duck and domestic geese have been subjected to severe cooling for prolonged periods without harm.

There is an obvious analogy with the natural process in cooling eggs periodically. Most species of bird leave the nest for short periods to feed. It is quite possible that the resulting cooling and re-heating provides a stimulus to the embryo which actually encourages growth. If the effect is more pronounced in ducks and geese it may be because the requirement has, to some extent, been bred out of hens by years of artificial incubation. It would follow that totally wild species may be even more susceptible to a cooling stimulus. Certainly there is no evidence to suggest that short term cooling is likely to be harmful.

Hopefully these explanations will enable bird breeders to assess the likelihood of damage from accidents. It should certainly allay any fears about the cooling that may accompany the manual turning or inspection of eggs!

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