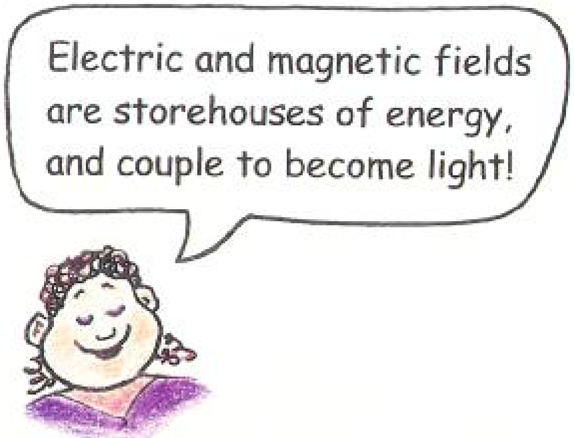
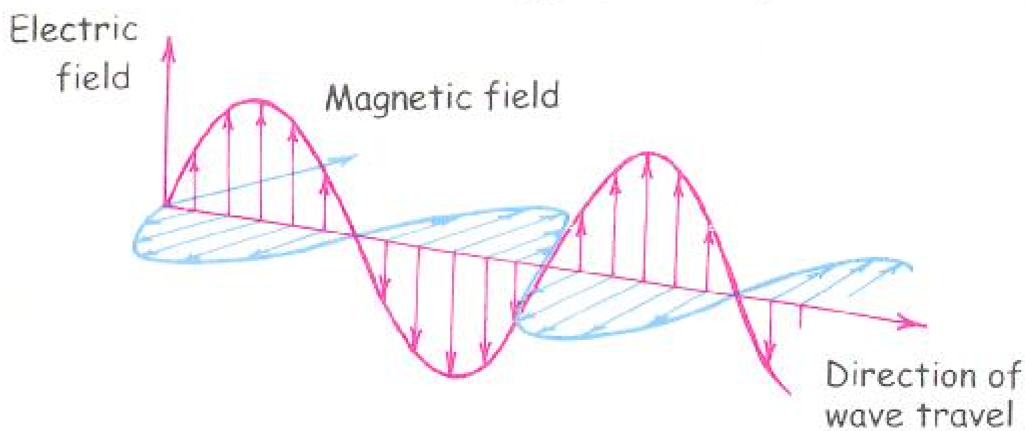
NEXT-TIME QUESTION

Maxwell's equations tell us that a changing magnetic field induces a changing electric field, and vice versa in turn, to produce an electromagnetic wave. Such field induction depends on changes both with respect to *time* and with respect to *distance*—so it depends on *speed*. The speed of propagation of fields inducing and re-inducing each other is *c*, the speed of light.

Why would propagation speeds faster than *c* be inconsistent with the conservation of energy principle?





thanx to Ken Ford

Next-Time Question

Conceptual Physics

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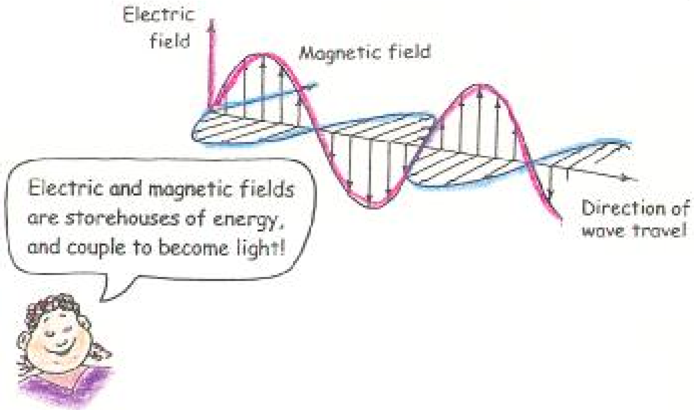

Answer:

For a speed of propagation greater than the critical value c, each changing field would induce a stronger field, resulting in a crescendo of ever-increasing field strengths and ever-increasing energy—clearly a no-no with respect to energy conservation.

For a too-low speed of propagation, each changing field would induce a weaker field, causing the wave to die out. No energy would be transported.

So we find that mutual induction can transfer energy from one place to another at only one critical speed. That's the speed of light!

Interestingly, if the fields were more strongly coupled, they wouldn't have to propagate as fast to maintain balanced strengths. Then light would be slower! How about weaker coupling?

Adapted from page 589 of the classic 1968 textbook, *Basic Physics*, by Ken Ford.

Hewitt Drew it!