official at the China Geological Survey, which commissioned the report, declined to offer details for fear of alarming the public. However, the government's action plan acknowledges that the levels of pollution are serious. A 2012 report by the land ministry found that of 4,929 groundwater monitoring sites in 198 prefecture-level administrative regions across the country, 41% had poor water quality. Almost 17% had extremely poor water quality, with levels of iron, manganese, fluoride, nitrites, nitrates, ammonium and heavy metals exceeding safe limits.

Also last year, an article by Zhang Zhaoji, a hydrogeologist at the Chinese Academy of Geological Sciences' Institute of Hydrology and Environmental Geology in Hebei and project leader for the 2006 survey, reported that in the North China Plain, some 35% of shallow groundwater sampling points had been contaminated by human activities (Z. Zhang *et al.* *J. Jilin Univ. Earth Sci. Edn* 42, 1456–1461; 2012). “Water pollution is a more serious problem than the scarcity of water resources,” says Song Xianfang, a hydrologist at the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) in Beijing, part of the Chinese Academy of Sciences.

The contamination rates are “not a surprise, as China is under rapid urbanization and industrialization that bring problems of water pollution for both surface and groundwater”, says Sun. And, although it is hard to prove cause and effect, there will probably be fallout for public health, experts say. Government reports stated that in 2004, China had 38.8 million recorded cases of tooth-enamel damage owing to fluoride exposure; 2.84 million cases of bone disease owing to fluoride exposure; and 9,686 cases of arsenic poisoning.

“These diseases are closely related to environmental and geological factors [and are] especially associated with contaminated groundwater,” says Yang Linsheng, the director of the department of environmental geography and health at the IGSNRR. The Chinese Center for Disease Control and Prevention did not respond to *Nature's* request for an interview.

In its plan, the government says that it will divide the North China Plain into 30 units for pollution prevention and control, which it will separate into three severity

“Water pollution is a more serious problem than the scarcity of water resources.”

categories — serious, poor and good — to be addressed differently. The details, which have not been publicly released, include an investment of nearly 500 million renminbi (US\$81 million) between 2013 and 2020 for a raft of measures across the country: to increase pollution assessments and establish a database of results; to control river pollution from agriculture and point sources from industry and landfill; to treat of polluted areas; and to conduct more research into clean-up and prevention strategies. Among other things, researchers will look into the effects of shale-gas development on groundwater.

The plan will also beef up environmental regulation. Experts say that will be a key measure, because the country must become more selective in approving industry projects. It must also enhance regulation of polluters, especially small rural companies such as paper mills. Furthermore, farmers must be educated in the proper use of fertilizers. Openness will be crucial in gaining public trust, experts add. “I would advocate data-sharing and transparency in reporting data,” says Zheng Chunmiao, director of the Center for Water Research at Peking University in Beijing. “Without this, people will be anxious.” ■

EDUCATION

Evolution makes the grade

Kansas, Kentucky and other states will also teach climate-change science.

BY LAUREN MORELLO

Five US states have adopted science education standards that recommend introducing two highly charged topics — climate-change science and evolution — into classrooms well before high school.

Released in April, the Next Generation Science Standards are the first effort in 15 years to overhaul US science education nationwide. Twenty-six states, working with non-profit science and education groups, developed the guidelines on the basis of recommendations from the US National Research Council. And the measures are being adopted, even in states where climate change and evolution tend to be avoided in the classroom.

In the past two months, education officials in Rhode Island, Kentucky, Kansas, Maryland and Vermont have all approved the standards by overwhelming margins. At least five more states — California, Florida, Maine, Michigan

BY DESIGN

US state legislatures are increasingly introducing ‘academic freedom’ bills to allow educators to teach creationism. Since 2008, some of these bills would also allow teaching material that promotes climate-change scepticism.

and Washington — may take up the standards in the next few months.

“Whew,” says Minda Berbeco, programmes and policy director at the National Center for Science Education in Oakland, California. “So far, so good.” Swift adoption of the guidelines has been surprising but welcome news for many supporters. Evolution has been a controversial

topic in US education for decades, stretching back to the 1925 ‘monkey trial’ in Tennessee, where the state prosecuted high-school teacher John Scopes for violating a statute that barred the teaching of evolution. In the past decade, those who oppose evolution have sought to enact ‘academic freedom’ laws that would allow creationism to be taught alongside evolution.

Increasingly, that sort of legislation also seeks to promote criticism of mainstream climate science (see ‘By design’). Berbeco says that this allows opponents of evolution and climate-change education to band together. “More people hate evolution and climate change than just evolution alone,” she says.

Laws passed in Louisiana in 2008 and in Tennessee last year allow teachers to present material that undermines global warming and evolution, two subjects that have been specifically singled out in the statutes. Similar bills were introduced this year in Arizona, ►

► Colorado, Kansas and Oklahoma.

The standards are the first national guidelines to incorporate climate change, which is already taught in some schools. But it has proved daunting for many educators, because the subject requires teaching aspects of biology, physics and chemistry. "It's a little piece of everything," says Rouwenna Lamm, deputy director for national outreach at the Alliance for Climate Education in Oakland. The guidelines recommend introducing the subjects early on, teaching students in middle school that human activities, including the burning of fossil fuels, have warmed the planet. As students get older, that idea should be expanded to encompass discussions of climate models and potential policies to limit greenhouse-gas emissions. Likewise, the guidelines recommend teaching evolution before students reach high-school biology classes, the point at which many states tackle concepts such as natural selection and adaptation.

The standards have faced legal challenges in some states, although the framework has so far escaped unscathed. For example, Kansas lawmakers last month narrowly defeated a measure to block state funding to implement the guidelines — quashing the proposal just hours before lawmakers adjourned for the year. In Kentucky, the state board of education unanimously approved the standards on 5 June, but they must now undergo a public hearing and a subsequent legislative review before teaching can begin.

That places the guidelines squarely in the path of a high-powered critic who will help to steer the legislative review: Mike Wilson, Republican state senator and chairman of the Kentucky Senate's education committee, who is a climate-change sceptic and advocate of intelligent design. "Political correctness bears watching and should never be the arbiter of learning," he wrote in a May article published in *The Courier-Journal*, a Kentucky newspaper.

Robert Bevins, a toxicologist and president of Kentuckians for Science Education, an advocacy group formed in February in part to push for the adoption of the standards, says that he is gearing up for a hard fight. "Kentucky has a love-hate relationship with science," he says, noting that the state has a thriving coal industry that has opposed greenhouse-gas regulations and is also home to the Creation Museum near Petersburg.

Richard Innes, an education analyst with the conservative Bluegrass Institute for Public Policy Solutions in Lexington, Kentucky, predicts that the guidelines will be sent back to the state education board for revision after the public hearing this month. But ultimately, he says, "I think the science standards will go through". ■

Some synthetic fluorescent proteins made by DNA2.0 are now freely available to researchers.

BIOTECHNOLOGY

Bioengineers look beyond patents

Synthetic-biology company pushes open-source models.

BY HEIDI LEDFORD

When DNA2.0, a company that synthesizes made-to-order genes, needed to conduct a few routine experiments using a fluorescent protein, its lawyers dug up more than 1,000 US patents covering their use. DNA2.0 decided to avoid the legal thicket by engineering several dozen fluorescent proteins from scratch. But the company, based in Menlo Park, California, was convinced that something had to change.

Last month, DNA2.0 deposited gene sequences encoding three of its fluorescent proteins into an open-access collection of recipes for DNA 'parts', molecular building blocks used to engineer organisms — often bacteria — to carry out specific functions. The company vows not to pursue its patent rights against anyone using the sequences.

Such moves are unusual among larger biotechnology companies, which tend to guard patents fiercely, but for DNA2.0 the choice was strategic, says Claes Gustafsson, the firm's chief commercial officer. Synthetic biologists aim to bring engineering principles to bear on genetic manipulation, and the field's success hinges on the creation of standardized parts that can be combined in predictable ways. The company wants to create incentives for other synthetic-biology firms to design custom organisms for which DNA2.0 can synthesize

the parts. "We have a lot of customers in small biotech companies," Gustafsson says, "and the intellectual-property situation for them is just a nightmare."

Easing that situation will be a key point of discussion next week at the Sixth International Meeting on Synthetic Biology, to be held in London by the BioBricks Foundation, a non-profit organization based in Cambridge, Massachusetts. As patent disputes heat up in some parts of the industry, synthetic biologists are weighing alternatives such as copyrights, which are more straightforward than patents, and open-source parts registries.

Open access to validated molecular components is crucial to the field's success, says Drew Endy, a synthetic biologist at Stanford University in California. Endy says that synthetic biologists are similar to software engineers, with the genetic code as their programming language. The software industry has favoured open-source approaches and copyright protections, because inventions often come faster than patents can be acquired.

The same holds for synthetic biology: if every genetic building block comes with a patent attached, cellular engineers may end up negotiating legal minefields. Few firms will sue a scientist who infringes a patent in the course of academic research, but young synthetic-biology companies are vulnerable.

Two years ago, the BioBricks Foundation