**ECONOMICS**

**Increasing Turnover**

Used car salesmen and yard sale bargain hunters depend on secondary markets, in which the seller of a good is not the first to have sold the good. These markets are crucial for the efficient reallocation of resources to meet changing demands. Yet regulations on the use and trade of some goods can influence the efficiency with which a secondary market functions. Such is the case with the U.S. wireless spectrum market. Much has been written about the Federal Communications Commission’s (FCC’s) use of auctions to make initial allocations of bandwidth; less is known about how licenses are later bought and sold. Mayo and Wallsten analyzed FCC records on license transfer since 1994 to assess how regulatory control and approval processes influenced the emergence and function of a secondary spectrum market. Their findings suggest that steps taken by the FCC in the early 2000s to improve secondary markets have had a positive impact. The volume of trading has become comparable to the volume of initial allocations. Also, the average time needed to approve trades has diminished from 150 days for a personal communications service license in 1998 to less than 50 days in 2005. — BW


**CHEMISTRY**

**Make or Break**

In the past several years, increasingly selective chemical methods have emerged to append different groups to specific sites along the periphery of aromatic rings. Two recent studies focus instead on manipulating the ring framework itself. Donohoe and Bower show that a widely used olefin metathesis catalyst can direct the formation of furan rings by stitching together an enone and an allylic alcohol. An advantage of this process is the ease with which diverse functional groups can be introduced through substitution of the precursors. The immediate product of metathesis is pushed along to the final aromatic cycle by either a separate acid catalyst or a Heck protocol that append an additional aryl substituent.

Sattler and Parkin work from the other end of the spectrum, showing that an intact quinoxaline falls rather dramatically apart on contacting a tungsten complex. Aromatic carbon bonds are among the strongest in organic molecular skeletons, yet in this product—formed at 90°C and characterized crystallographically—two carbon atoms previously bounding an edge of the ring are separated and linked independently to the tungsten center. Their hydrogen substituents are also lost in the process. Though the mechanism remains uncertain, the authors postulate that insertion of the tungsten into the C-H bonds precedes C-C scission. — JSY


**APPLIED PHYSICS**

**Remember, Repeat After Me**

Quantum information processors in which information is encoded in single photons require the development of multiple components, to generate the single photons, store them, and then reliably read them from memory. Continued on page 925
ory and pass them on. Light, however, is always on the move, usually quickly, and so solid-state quantum memories represent a crucial component, as they would allow the bits of information to be stored while other bits can be manipulated. Afzelius et al. present a solid-state quantum memory in which an absorbed photon is stored as an electronic excitation within a rare earth ion–doped crystal. The energy levels and optical transitions of the crystal can be controlled and manipulated by a series of laser pulses, so that the absorbed photon can be stored for several tens of microseconds. The process can then be reversed to retrieve the photon from the stored electronic state. Such a robust on-demand quantum memory and repeater should prove invaluable for long-distance quantum communication networks. — ISO


**DEVELOPMENT**

The Fantastic Fourth No Longer

The number of exogenously expressed factors that can reprogram somatic cells into what are called induced pluripotent stem cells (iPSCs) has grown over the past 3 years. The original quartet of transcription factors—Oct4, Sox2, Klf4, and c-Myc—heads a list that includes familial relatives of the last three and other proteins such as the transcription factor Nanog and the RNA-binding protein Lin28. Oct4 had appeared to be indispensable and thus had been considered an essential part of the reprogramming code.

However, Heng et al. report that Oct4 can be replaced. They screened 19 nuclear receptors and found that exogenous expression of the nuclear receptor Nr5a2 in mouse embryonic fibroblasts could enhance reprogramming efficiency by a factor of 4 as compared to the famous four factors alone. Moreover, Nr5a2 could in fact replace Oct4 and act with Sox2, Klf4, and c-Myc to reprogram somatic cells. The gene expression and chromatin modification profiles of these iPSCs (like the iPSCs generated by expression of the original four factors) were more similar to those of embryonic stem cells than those of mouse embryonic fibroblasts. Furthermore, the target genes of Nr5a2 overlap with targets of Sox2 and Klf4 that are important in embryonic stem cell identity, such as Nanog. — LDC

Cell Stem Cell 6, 167 (2010).

**CELL BIOLOGY**

One-Way Ticket

Within the nucleus, chromatin is spatially organized, and the intranuclear locations of genes can be correlated with their transcriptional activity. Ahmed et al. have identified two DNA sequences in chromatin that target genomic loci to the nuclear envelope in yeast. Peripheral targeting of genes, particularly those activated by stresses such as heat shock or nutrient deprivation, such as INO1, is linked to active transcription. Using deletion analyses and engineered plasmids, the authors identified an eight-base sequence in the promoter of INO1, that when mutated, inhibited targeting of ectopic INO1 to the nuclear periphery, as well as its transcriptional activation. They also identified several protein components of the nuclear pore complex (the exit channels from the nucleus to the cytoplasm) that were required for this localization. For peripheral targeting of the endogenous INO1 gene, a second sequence in an upstream gene was also required. Searching through the genome, the authors identified 94 promoters that contained the eight-base targeting sequence, many of which were activated by heat shock, suggesting a common mechanism of activation and peripheral localization. — HP


**MOLECULAR BIOLOGY**

An RNA Mimic of DNA

RNAs—of the types known in the classical world as ribosomal, transfer, and messenger—are critical for the readout of DNA sequence into protein. On the other hand, numerous regulatory processes are governed by the modern upstarts known collectively as noncoding RNAs. Kino et al. have used a yeast two-hybrid screen to search for genes encoding binding partners for the DNA binding domain of the human glucocorticoid receptor and come upon a noncoding RNA known as growth arrest–specific (Gas) 5, so-called because this single-stranded RNA accumulates in cells exposed to conditions that prevent growth. The glucocorticoid receptor is a ligand-activated transcription factor, and Gas5 binds to the receptor, inhibiting its ability to activate its target genes. The authors propose that a portion of the Gas5 RNA may mimic the glucocorticoid receptor binding site in DNA, establishing another means of modulating the transcriptional activities of nuclear receptors. — LBR

Sci. Sig. 3, ra8 (2010).