899 P.2d 663 (1995)
321 Or. 285

STATE of Oregon, Respondent on Review,
v.
Albert R. O'KEY, Petitioner on Review.

CC TM90-5122; CA A70279; SC S40926.

Supreme Court of Oregon, In Banc.

Argued and Submitted September 2, 1994.
Decided July 7, 1995.

669 *669 John Henry Hingson III, Oregon City, argued the cause on behalf of petitioner on review. On the petition were Stephen A. Lovejoy, Lincoln City, and Jenny Cooke, Portland.

Jonathan Fussner, Asst. Atty. Gen., Salem, argued the cause on behalf of respondent on review. With him on the response to the petition were Theodore R. Kulongoski, Atty. Gen., and Virginia Linder, Sol. Gen., Salem.

David K. Allen, Salem, and Chris J. Shine, Portland, filed a brief on behalf of *amicus curiae* Oregon Crim. Defense Lawyers, Inc.

UNIS, Justice.

This case concerns the admissibility of Horizontal Gaze Nystagmus (HGN) test evidence in a prosecution for driving under the influence of intoxicants (DUII), ORS 813.010.

FACTS AND PROCEDURAL BACKGROUND

On July 8, 1990, at about 12:30 a.m., Oregon **State** Trooper Gregory saw defendant leaving a social event held at the Philomath rodeo grounds. Trooper Gregory noticed that defendant was having trouble walking. After he watched defendant drive away in a pickup truck, make wide turns, and fail to react promptly to a green traffic light, Trooper Gregory stopped defendant. Trooper Gregory smelled alcohol and saw a number of empty beer cans in the back of the pickup truck. Defendant had trouble removing his driver's license from his wallet and could not find his vehicle registration. Defendant admitted to having consumed about four to six beers between 3 p.m. and midnight.

Trooper Gregory asked defendant to perform a series of field sobriety tests.[1] The tests administered to defendant included the one-leg stand test, the walk-and-turn test, the finger count test, the Romberg balance test, the finger-to-nose test, and the HGN test.[2] Trooper Gregory administered the HGN test to defendant in accordance with OAR 257-25-020(1)(a) (March 1990), quoted *infra,* 321 Or. at 294-95, 899 P.2d at 673-74.

670 *670 The HGN test, as discussed more fully below, involves the measurement of the angle of onset of nystagmus, or jerky movement, as the eye tracks a steadily moving object, such as a finger, pencil, or pen-size flashlight. Trooper Gregory testified that defendant's eyes displayed jerky pursuit, endpoint nystagmus, and nystagmus at 40 degrees in both eyes. Trooper Gregory also testified that defendant had trouble performing several of the other field sobriety tests. Based on the results of the field sobriety tests administered, Trooper Gregory arrested defendant for DUII. After the arrest, defendant refused, when requested, to submit to a chemical test of his breath for the purpose of determining his blood alcohol content (BAC).

The **state** requested a pretrial omnibus hearing to determine the admissibility of HGN test evidence. At that hearing, the **state** contended that HGN test evidence is admissible to prove both that defendant was driving a vehicle while under the

influence of intoxicants and that defendant's BAC was .08 percent or more. Defendant argued (1) that HGN test evidence must satisfy the standard regarding the admissibility of scientific evidence established by this court in ***State** v. Brown,* 297 Or. 404, 687 P.2d 751 (1984), and (2) that such evidence is inadmissible because it does not satisfy that standard. After hearing and evaluating extensive scientific testimony and evidence concerning the HGN test, the trial court held (1) that HGN test evidence is scientific evidence that must meet the standard for admissibility of scientific evidence enunciated in *Brown,* (2) that HGN test evidence "may be of substantial probative value and may be helpful to the trier of fact in determining the issues of whether a defendant was under the influence of intoxicants and whether his (or her) blood alcohol level was at least .08%," but (3) that "the probative value of the [HGN test evidence] is outweighed by the danger of unfair prejudice because of the potential for error and subjectivity of [the] test." Accordingly, the trial court entered an order excluding HGN test evidence at defendant's trial.

Pursuant to ORS 138.060(3),[3] the **state** appealed. The Court of Appeals initially affirmed without opinion. ***State** v. **O'Key**,* 115 Or.App. 102, 835 P.2d 964 (1992). The Court of Appeals then granted the **state's** motion for reconsideration and, on reconsideration, reversed the order of the trial court, concluding that the HGN test meets the admissibility requirements for scientific evidence under *Brown.* ***State** v. **O'Key**,* 123 Or.App. 54, 858 P.2d 904 (1993). The Court of Appeals held that the HGN test evidence was admissible (1) to establish that defendant was under the influence of alcohol and (2) to "corroborate a chemical analysis of the blood or breath and assist the trier of fact in the evaluation of the accuracy of an intoxilyzer or blood analysis result." 123 Or.App. at 60, 858 P.2d 904.

We allowed review to determine whether HGN test evidence is admissible in a prosecution for DUII and, if so, for what purposes. We now hold that HGN test evidence is admissible in a prosecution for DUII to establish that a person was under the influence of intoxicating liquor, but is not admissible under ORS 813.010(1)(a) to establish a person's BAC, *i.e.,* that a person was driving while having a BAC of .08 percent or more. Admissibility is subject to a foundational showing that the officer who administered the test was properly qualified, that the test was administered properly, and that the test results were recorded accurately. Accordingly, we affirm in part and reverse in part the decision of the Court of Appeals. We reverse the order of the district court.

IS THE ADMISSIBILITY OF HGN TEST EVIDENCE LEGISLATIVELY RECOGNIZED?

The admissibility of HGN test evidence is an issue of first impression in this court. We first address the question whether HGN test evidence must satisfy the standard for admission of "scientific" evidence, which standard we discuss below. The
671 **state** contends that *671 HGN test evidence need not comply with that standard, because the legislature, by ORS 801.272 (*see supra,* note 1), has delegated to the Oregon **State** Police (OSP) the authority to approve field sobriety tests and that, pursuant to that authority, the OSP has approved the HGN test by adoption of OAR 257-25-020(1), which provides in part:

> "Each field sobriety test, as described below, is specifically found to meet the requirements of ORS 801.272:
>
> "(a) Horizontal Gaze Nystagmus * * *."

ORS 801.272 delegates to the OSP the authority to choose field sobriety tests after consultation with the Board on Public Safety Standards and Training. The **state** contends that, because this delegation mentions "trier of fact," it manifests the legislature's approval of the admissibility of the results of whatever field sobriety tests may be chosen by the OSP. We disagree.

ORS 801.272 is a definitional statute that describes what is considered to be a "field sobriety test"; it does not purport to provide for the admission of field sobriety tests into evidence in a trial in a court of law or other adjudicative proceeding. Although the legislature has delegated to the OSP, after consultation with the Board on Public Safety Standards and Training, the determination of what constitutes a "field sobriety test," the legislature did not delegate to the OSP the authority to decide what evidence is admissible in a prosecution for DUII. It follows that approval of the HGN test by the

OSP does not mean that HGN test evidence is admissible.

IS HGN TEST EVIDENCE "SCIENTIFIC" EVIDENCE?

We next turn to the question whether HGN test evidence is "scientific" evidence. If it is, then HGN test evidence must comply with the standard for admission of "scientific" evidence; otherwise, it need not. Neither the Oregon Evidence Code nor the unofficial commentary to that code defines "scientific" evidence. Rather, as this court recognized in *Brown,* 297 Or. at 408, 687 P.2d 751, the Oregon legislature, in adopting the Oregon Evidence Code, left for judicial decision the standard to be used in determining the admissibility of "scientific" evidence. Without attempting precisely to define "scientific" evidence, this court in *Brown* stated that "[t]he term `scientific' * * * refers to evidence that draws its convincing force from some principle of science, mathematics and the like." *Id.* at 407, 687 P.2d 751. In ***State** v. Milbradt,* 305 Or. 621, 631, 756 P.2d 620 (1988), this court, without attempting to further define "scientific" evidence, held that psychological syndrome evidence is a form of "scientific" evidence that will be admitted into evidence only if the foundational requirements for admission of scientific evidence are established.[4]

This court's definition of "scientific" evidence in *Brown* recognizes that it is difficult to set a more definitive boundary between "scientific" evidence and "technical or other specialized knowledge," which are the other types of evidence requiring expert proof.[5] As Professors Mueller and Kirkpatrick **state**:

"Most expert testimony rests at least partly on science. In many areas the scientific underpinning is well established and the criteria set out in [Rules] 702 and 703 work well. The requirements are essentially three: The witness must qualify as
672 an expert, his testimony must be helpful ([Rule] 702), and he must have an adequate *672 basis for what he says ([Rule] 703). Under these criteria an enormous amount of conventional scientific evidence is routinely admitted." Christopher B. Mueller & Laird C. Kirkpatrick, *Modern Evidence* § 7.8, 990 (1995).

Evidence perceived by lay jurors to be scientific in nature possesses an unusually high degree of persuasive power.[6] The function of the court is to ensure that the persuasive appeal is legitimate. The value of proffered expert scientific testimony critically depends on the scientific validity of the general propositions utilized by the expert. *See* John William Strong, *Language and Logic in Expert Testimony: Limiting Expert Testimony by Restrictions of Function, Reliability, and Form,* 71 Or.L.Rev. 349, 361 (1992) (explaining this concept). Propositions that a court finds possess significantly increased potential to influence the trier of fact as scientific assertions, therefore, should be supported by the appropriate scientific validation. *Id.* at 368. This approach "ensure[s] that expert testimony does not enjoy the persuasive appeal of science without subjecting its propositions to the verification processes of science." *Id.*

After this court's decisions in *Brown* and *Milbradt,* the term "scientific" was explicated, albeit in the context of the parallel federal rules, by the Supreme Court of the United States in *Daubert v. Merrell Dow Pharmaceuticals,* 509 U.S. ___, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993). We find that explication helpful to our present discussion.[7] In *Daubert,* the Supreme Court, in interpreting the legislatively-enacted Federal Rules of Evidence in the same way as any other statute, adopted a test for admission of scientific evidence in federal courts. That test is discussed below. In *Daubert,* the Supreme Court emphasized that under FRE 702, which is identical to OEC 702, "the subject of an expert's testimony must be `scientific * * * knowledge.'" *Id.,* 509 U.S. at ___, 113 S.Ct. at 2795, 125 L.Ed.2d at 480-81. According to the Supreme Court, the adjective "scientific" "implies a grounding in the methods and procedures of science," and "knowledge" means ideas inferred from known facts or "accepted as truths on good grounds." *Id.,* 509 U.S. at ___, 113 S.Ct. at 2795, 125 L.Ed.2d at 481. "[T]o qualify as `scientific knowledge' [within the meaning of FRE 702], an inference or assertion must be derived by the scientific method." *Id.* The scientific method is a validation technique, consisting of the formulation of hypotheses, followed by observation or experimentation to test the hypotheses. *Id.,* 509 U.S. at ___, 113 S.Ct. at 2796-97, 125 L.Ed.2d at 483. Whenever a litigant claims that a particular scientific technique or theory is valid, that claim is a hypothesis requiring empirical verification. *Id.*

We need not attempt precisely to distinguish "scientific" from other types of expert testimony under the Oregon Evidence
673 Code. For now, we hold that, in the absence *673 of a clear case, a case for judicial notice,[8] or a case of *prima facie*

legislative recognition, trial courts have an obligation to ensure that proffered expert scientific testimony that a court finds possesses significantly increased potential to influence the trier of fact as "scientific" assertions is scientifically valid. This is especially true in cases where the proffered expert scientific testimony is innovative, nontraditional, unconventional, controversial, or close to the frontier of understanding. Once a trial court has decided that proffered expert scientific testimony is scientifically valid and has admitted such evidence for the particular purpose to which it is directed, and that decision is affirmed by this court in a published opinion, it will become precedent controlling subsequent trials.[9]

In determining whether HGN test evidence is "scientific" evidence, a brief description of the HGN test is helpful. The HGN test is designed to detect whether a person's eyes demonstrate nystagmus under certain conditions. Nystagmus is a physiological phenomenon, which has been defined as "an involuntary rapid movement of the eyeball." Richard Sloane, *The Sloane-Dorland Annotated Medical-Legal Dictionary* 504 (1987). Although there are many types of nystagmus, the type used in field sobriety testing is labeled "horizontal gaze nystagmus" (HGN). HGN "is an involuntary, rapid oscillation of the eyes which occurs when a person looks to the side at an object, and is characterized by an involuntary pendular (back and forth) jerking movement of the eye." Mark A. Rouleau, *Unreliability of the Horizontal Gaze Nystagmus Test,* 4 Am.Jur. Proof of Facts 3d 439, 446 (1989) (footnote omitted). Stated differently, HGN is "[a]n inability of the eyes to maintain visual fixation as they are turned from side to side (in other words, jerking or bounding)." *People v. Leahy,* 8 Cal.4th 587, 592, 34 Cal.Rptr.2d 663, 665, 882 P.2d 321, 323 (1994).

The procedure for administering the HGN test is set forth in OAR 257-25-020(1)(a) (March 1990):

"(A) The police officer must have received training in the administration of the [HGN] test by the Oregon **State** Police, BPST or other governmental entity prior to its administration under this rule. The officer shall use a stimulus (such as a finger, pencil, or penlight) held vertically in front of the person's face about 15 inches away from the person's nose. The person tested must hold their head still. The officer, during the administration of the testing procedures, may conduct any
674 or all of the following three procedures and *674 observations in whatever order the officer deems appropriate.

> "(B) The officer shall move the stimulus from the center of the nose to the side, checking for the lack of smooth pursuit of the eyes as they track the stimulus.
>
> "(C) The officer shall check for distinct nystagmus at the maximum deviation of each eye.
>
> "(D) The officer shall check for the onset of nystagmus prior to 40 degrees in each eye."[10]

Under that procedure, each eye is checked for three possible clues that the person tested is under the influence of intoxicating liquor: (1) Angle of onset—the more impaired by alcohol that a person becomes, the sooner the jerking will occur as the eyes move to the side (one point is awarded if nystagmus is present when an officer holds a stimulus at a 40-degree angle); (2) maximum deviation— the greater the alcohol impairment, the more distinct the nystagmus is when the eyes are as far to the side as possible (one point is awarded if endpoint nystagmus is present); (3) smooth or jerky pursuit —a person impaired by alcohol cannot follow a slowly moving object smoothly with his eyes (one point is awarded if jerky pursuit is observed). A score of six points is possible, three for each eye. According to the United States Department of Transportation National Highway Traffic Safety Administration (NHTSA), if the person tested scores four or more points, that person's BAC is above .10 percent. NHTSA DOT-HS-806-512, *Improved Sobriety Testing* (1984) (*reprinted in* 2 Donald H. Nichols, *Drinking/Driving Litigation,* ch. 26, app. A (1995).

The HGN test is premised on the general proposition that the automatic tracking mechanisms of the eyes are affected by alcohol. Comment, *Can Your Eyes Be Used Against You? The Use of the Horizontal Gaze Nystagmus in the Courtroom,* 84 J.Crim.L. & Criminology 203, 203 (1993). Stated differently, the theory behind the HGN test "is that there is a strong correlation between the amount of alcohol a person consumes and the angle of onset of the nystagmus." Gayle Tronvig Carper & William McCamey, *Gaze Nystagmus: Scientific Proof of DUII?,* 77 Ill.B.J. 146, 147 (1988). As the BAC increases, the gaze nystagmus becomes more noticeable. *Id.* As people become more impaired by alcohol, "the distance they are required to move their eyes to the side in order for the jerking motion to occur lessens." *Id.*

The use of the HGN test has become an issue of admissibility for courts since the test was adopted by the NHTSA in

1984.[11] Regarding admissibility, courts have disagreed about whether the test is "scientific." Several courts consider the HGN test no more scientific than other field sobriety tests. *See, e.g.,* ***State*** *v. Sullivan,* 310 S.C. 311, 426 S.E.2d 766 (1993); ***State*** *v. Murphy,* 451 N.W.2d 154 (Iowa 1990); ***State*** *v. Bresson,* 51 Ohio St.3d 123, 554 N.E.2d 1330 (1990). The rationale for this approach is that the HGN test is not based on scientific expertise, but only on the personal observations of the officer who administered the test.

Other courts have rejected that analysis, holding that the HGN test is a scientific technique, requiring compliance with the appropriate foundational showing for the admission of scientific evidence. *See, e.g., Leahy,* 8 Cal.4th at 587, 34 Cal.Rptr.2d at 663, 882 P.2d at 321; *Yell v.* ***State****,* 856 P.2d 996 (Okla.Crim.App.1993); ***State*** *v. Garrett,* 119 Idaho 878, 811 P.2d 488 (1991); ***State*** *v. Superior Court,* 149 Ariz. 269, 718 P.2d 171 (1986); ***State*** *v. Witte,* 251 Kan. 313, 836 P.2d 1110 (1992); ***State*** *v. Cissne,* 72 Wash.App. 677, 865 P.2d 564 (1994). The rationale for this latter approach is that the
675 HGN test is *675 distinguished from other field sobriety tests because science, rather than common knowledge, provides the legitimacy for HGN testing.

We agree with the latter view. The HGN test provides evidence that purports to draw its convincing force from a principle of science, namely, the asserted scientific proposition that there is a causal relationship between consumption of alcohol and the type of nystagmus measured by the HGN test. *See* Comment, 84 J.Crim.L. & Criminology at 203 (the HGN "test is premised on the fact that the automatic tracking mechanisms of the eyes are affected by alcohol"). The value of HGN testing depends critically on the demonstrated scientific validity of that proposition. Moreover, the proposition that alcohol consumption causes nystagmus possesses significantly increased potential to influence the trier of fact as a "scientific" assertion.

We also note that, although the function of the HGN test, like other field sobriety tests, is to spot "observable symptoms" or "signs" of alcohol impairment, it is different from other field sobriety tests because it rests on a manifestation of alcohol consumption not easily recognized or understood by most people. *Id.* at 205. The relationship between the effects of alcohol on the central nervous system, the nystagmus phenomenon, and the HGN test is not within the realm of common knowledge of the average person. *Id.* Other field sobriety tests, such as the walk-and-turn test, the one-leg-stand test, and the modified finger-to-nose test, obtain their legitimacy from effects of intoxication based on propositions of common knowledge. *See* ***State*** *v. Clark,* 286 Or. 33, 39-40, 593 P.2d 123 (1979) (taking judicial notice of a list of commonly known "observable symptoms or `signs' of alcohol intoxication," which does not include the nystagmus phenomenon).[12]

For the foregoing reasons, we conclude that HGN test evidence is "scientific" evidence. Accordingly, we must determine whether HGN test evidence meets the admissibility requirements for "scientific" evidence.

STANDARD FOR ADMISSION OF "SCIENTIFIC" EVIDENCE

"[T]raditional admissibility standards for expert testimony as set forth in the Oregon Evidence Code" govern the admissibility of proffered scientific evidence. *Brown,* 297 Or. at 408, 687 P.2d 751. Addressing the admissibility of polygraph evidence, this court held that OEC 401, 702, and 403 are to be applied to determine the admissibility of proffered scientific evidence. *Id.* at 416, 687 P.2d 751. Under OEC 401, "`[r]elevant evidence' means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence." *See also* ***State*** *v. Hampton,* 317 Or. 251, 255-56, 855 P.2d 621 (1993) (discussing relevancy standard set forth in OEC 401). "[P]roffered evidence[, although relevant, nonetheless] may be subject to exclusion under one of the exceptions to the admissibility of relevant evidence in OEC 402 (*e.g.,* decisional law)."[13] ***State*** *ex rel. Juv. Dept. v. Beasley,* 314 Or. 444, 450, 840 P.2d 78 (1992).

OEC 702, which defines the permissible sphere of expert testimony, provides:

"If scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or to determine
676 a fact in issue, a witness qualified as an *676 expert by knowledge, skill, experience, training or education may testify thereto in the form of an opinion or otherwise."

The requirement in OEC 702 that the evidence or testimony "assist the trier of fact to understand the evidence or to determine a fact in issue" is intended to serve multiple functions, such as:

> "(1) supplying general propositions which will permit inferences from data which the trier of fact would otherwise be forced to find meaningless; (2) applying general propositions to data so as to generate inferences where the complexity of the body of propositions applied, the difficulty of the application, or other factors make the expert's conclusion probably more accurate or precise than that of the trier of fact; (3) modifying, qualifying, and refining general propositions which the trier of fact may reasonably be expected to use; and (4) adding specialized confirmation and, thus, confidence to general propositions otherwise likely to be assumed more tentatively by the trier." Strong, 71 Or.L.Rev. at 360.

Once the testimony is determined to be relevant under OEC 401, helpful under OEC 702, and not barred by OEC 402, it will be excluded only if its probative value is substantially outweighed by one or more of the countervailing factors set forth in OEC 403, which provides:

> "Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay or needless presentation of cumulative evidence."

In evaluating the incremental probative value of the proffered evidence, the court must assume that the evidence will be believed by the trier of fact. When the incremental probative value of the proffered scientific evidence is relatively slight, and when the jury is likely to overvalue or be misled into giving the evidence undue weight, the likelihood of exclusion under OEC 403 is enhanced.

In applying OEC 401, 702, and 403, the court must identify and evaluate the probative value of the proffered scientific evidence,[14] consider how that evidence might impair rather than help the trier of fact, and decide whether truthfinding is better served by admission or exclusion. *Brown,* 297 Or. at 409, 687 P.2d 751. In *Brown,* this court identified a number of factors that could affect a trial court's decision on admissibility of proffered scientific evidence:

> "(1) The technique's general acceptance in the field;
>
> "(2) The expert's qualifications and stature;
>
> "(3) The use which has been made of the technique;
>
> "(4) The potential rate of error;
>
> "(5) The existence of specialized literature;
>
> "(6) The novelty of the invention; and
>
> "(7) The extent to which the technique relies on the subjective interpretation of the expert." 297 Or. at 417, 687 P.2d 751.

677 Those factors were not intended to be exclusive,[15] nor were they intended to be *677 taken as a mechanical checklist of foundational requirements. "What is important is not lockstep affirmative findings as to each factor, but analysis of each factor by the court in reaching its decision on the probative value of the [proffered scientific] evidence under OEC 401 and OEC 702." *Id.* at 417-18, 687 P.2d 751 (footnote omitted).

In *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2794, 125 L.Ed.2d at 480, which as previously noted was decided after *Brown,* the Supreme Court held that the "general acceptance" test, formulated in *Frye v. United States,* 293 F. 1013 (D.C.Cir.1923),[16] was superseded by the adoption of the Federal Rules of Evidence. Under the Federal Rules of Evidence, the Court concluded that the admission or exclusion of expert scientific evidence in federal courts must be judged under the standards announced in FRE 702, 401, 402, and 403, the federal counterparts to OEC 702, 401, 402,

and 403.[17] *Daubert,* 509 U.S. at ___ - ___, 113 S.Ct. at 2794-98, 125 L.Ed.2d at 480-84.

The Court held that trial judges have an important role to play as "gatekeepers," charged with the responsibility of ensuring that proffered expert scientific testimony must be "not only relevant, but reliable." *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2795, 125 L.Ed.2d at 480.[18] The Court first focused on the language of FRE 702, which clearly contemplates some degree of regulation in the admission of expert testimony concerning "scientific * * * knowledge." Unless the proffered evidence is supported by appropriate validation, it cannot qualify as "scientific knowledge," *id.,* 509 U.S. at ___, 113 S.Ct. at 2795, 125 L.Ed.2d at 480-81, and "appropriate validation" refers to scientific validity, *id.,* 509 U.S. at ___, 113 S.Ct. at
678 2796-98, 125 L.Ed.2d at 483-84.[19] *678 Thus, admissibility of scientific evidence requires a showing that it is based on scientifically valid principles.[20]

The Court then turned to the helpfulness standard of FRE 702, which requires "a valid scientific connection to the pertinent inquiry." *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2796, 125 L.Ed.2d at 482. Simply put, the scientific evidence must be pertinent to the issue to which it is directed. "[S]cientific validity for one purpose is not necessarily scientific validity for other, unrelated purposes." *Id.* As long as the proffered scientific evidence rests on sound scientific reasoning or methodology (*i.e.,* is scientifically valid) and properly can be applied to the facts in issue, it meets the requirements of FRE 702, even if the conclusion is novel[21] or controversial. *Daubert,* 509 U.S. at ___ n. 11, 113 S.Ct. at 2796 n. 11, 125 L.Ed.2d at 482 n. 11.[22]

Thus, under the *Daubert* approach, a trial court, faced with a proffer of expert scientific testimony, must determine at the outset, pursuant to FRE 104(a),[23] whether the proposed evidence is based on scientifically valid principles and is pertinent to the issue to which it is directed. 509 U.S. at ___ n. 10, 113 S.Ct. at 2796 n. 10, 125 L.Ed.2d at 482 n. 10. The proponent of the evidence has the burden of establishing those matters by a preponderance of the evidence. *Id.*

The Supreme Court emphasized that, in performing this vital "gatekeeping" function, numerous factors will bear on the inquiry, and it therefore declined to set out a definitive checklist or test. *Id.,* 509 U.S. at ___, 113 S.Ct. at 2796, 125 L.Ed.2d at 482. The Supreme Court did, however, list four factors (somewhat overlapping the factors mentioned in *Brown*) that *may* be relevant to the inquiry, but also noted that none of them is decisive, nor is the list exhaustive.

One factor under *Daubert* is whether the theory or technique in question "can be (and has been) tested." 509 U.S. at ___, 113 S.Ct. at 2796-97, 125 L.Ed.2d at 482-83. (Although *Brown* does not specifically list this factor, one of the factors mentioned in *Brown* is "[t]he availability of other experts to test and evaluate the technique." 297 Or. at 418 n. 5, 687 P.2d
679 751.) This consideration *679 includes an evaluation of the testing procedures used, the number of studies undertaken, and criticisms of those procedures. *Daubert* views science as an empirical enterprise and emphasizes the need for validation through testing:

> "Ordinarily, a key question to be answered in determining whether a theory or technique is scientific knowledge * * * will be whether it can be (and has been) tested. `Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified;[24] indeed, this methodology is what distinguishes science from other fields of human inquiry.'" *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2796, 125 L.Ed.2d at 482-83 (quoting Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of Agent Orange and Bendictin Litigation,* 86 NW U.L.Rev. 643, 645 (1992)).

A second factor is whether the theory or technique has been subject to peer review and publication (*Brown* refers to this as the existence of specialized literature, 297 Or. at 417, 687 P.2d 751). Peer review and publication provide the opportunity for others in the field to examine and critique the reasoning or methodology behind scientific theory. Publication, however, is no longer a *sine qua non* of admissibility; it does not always go hand-in-hand with validity. *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2797, 125 L.Ed.2d at 483.[25] In some cases, valid but innovative theories or propositions will not have been published, either because they are too particular, too new, or of limited interest. *Id.* "But submission to the scrutiny of the scientific community is a component of `good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected." *Id.* (citing Zinman, *Reliable Knowledge: An Exploration*

of the Grounds for Belief in Science 130-33 (Cambridge U. 1978); Relman & Angell, *How Good Is Peer Review?,* 321 New Eng.J.Med. 827 (1989)). The fact of publication (or lack thereof) in a peer-reviewed journal thus will be a relevant, although not dispositive, consideration. *Id.*

A third factor is the "known or potential rate of error" and the existence of operational standards controlling the technique's operation (mentioned in *Brown,* 297 Or. at 417 n. 5, 687 P.2d 751). *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2797, 125 L.Ed.2d at 483.

A fourth factor is the degree of acceptance in the relevant scientific community (mentioned in *Brown,* 297 Or. at 417 n. 5, 687 P.2d 751). *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2797, 125 L.Ed.2d at 483.[26] "Widespread acceptance can be an important factor in ruling particular evidence admissible, and a known technique that has been able to attract only minimal support within the community may properly be viewed with skepticism." *Id.* (citation and internal quotation marks omitted).

Quite importantly, the "overreaching subject" of this multifactor, "flexible" inquiry "is the scientific validity—and thus the evidentiary relevance and reliability—of the principles that underlie a proposed submission. The focus [of the inquiry] must be solely on principles and methodology, not on the conclusions that they generate." *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2797, 125 L.Ed.2d at 483-84.

680 *680 In *Daubert,* the Supreme Court pointed out that, in assessing a proffer of expert scientific testimony under FRE 702, a trial court should also be mindful of other applicable evidentiary rules, such as FRE 703, 706, and 403. 509 U.S. at ___, 113 S.Ct. at 2797-98, 125 L.Ed.2d at 484. Scientific evidence resting on out-of-court statements not in evidence must satisfy the reasonable reliance standard of FRE 703. *Id.* FRE 706 allows the court, in its discretion, to procure the assistance of an expert of its own choosing. *Id.*[27] FRE 403 permits the exclusion of scientific evidence if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of issues, or misleading the jury. *Id.* The Court further explained that, because of the risk that expert testimony can be both powerful and quite misleading because of the difficulty in evaluating it, the trial court should exercise more control over expert witnesses than over lay witnesses in counterbalancing possible prejudice with probative force. *Id.* (quoting Weinstein, *Rule 702 of the Federal Rules of Evidence is Sound; It Should Not Be Amended,* 138 F.R.D. 631, 632 (1991)).

Moreover, *Daubert* expressed faith in the ability of the jury system to function effectively—that juries can (or will) "separate the wheat from the chaff"—in the face of a scientific challenge. The Court reaffirmed the value of traditional trial mechanisms, such as cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof, in acting as checks on the credibility of admitted scientific evidence. *Daubert,* 509 U.S. at ___, 113 S.Ct. at 2798, 125 L.Ed.2d at 484.

The decisional process to be applied for admission and exclusion of scientific evidence articulated in *Daubert* is, in our view, an appropriate further development of the decisional process that we first discussed in *Brown* and followed in *Milbradt. Brown* is based on the Oregon Evidence Code, which is modeled on the federal paradigm. Both *Daubert* and *Brown* reject a "bright line test," and the "multifactor" observations they offer suggest a flexible approach to admission or exclusion of scientific evidence. Both *Daubert* and *Brown* allow *Frye's* "general acceptance" standard to be considered as one factor in the trial court's decision about admissibility. In addition, both suggest other (some overlapping) indicia of legitimacy, none of which is dispositive.[28] Both decisions view the validity of a particular scientific theory or technique to be the key to admissibility. Both require trial courts to provide a screening function to determine whether the proffered scientific evidence is sufficiently valid to assist the trier of fact. Under both decisions, a trial court should exclude "bad science" in order to control the flow of confusing, misleading, erroneous, prejudicial, or useless information to the trier of fact. Under both decisions, the task of the trial court is to protect the integrity of the trial process. Given the degree of congruence of *Brown* and *Daubert,* we find the aspects of the *Daubert* decision discussed above to be persuasive, and we adopt them. Faced with a proffer of expert scientific testimony, an Oregon trial court, in performing its vital role as "gatekeeper" pursuant to OEC 104(1), should, therefore, find *Daubert* instructive.[29]

681 *681 PURPOSE FOR WHICH HGN TEST EVIDENCE IS OFFERED

Before applying the multifactor test to determine the admissibility of HGN test evidence, we must examine the purpose for which the scientific evidence is being offered.[30] The **state** is offering HGN test evidence as tending circumstantially—that is, inferentially—to make more probable a fact of consequence, namely "being under the influence of intoxicating liquor."[31] That fact of consequence is an essential element of DUII, which the **state** must prove beyond a reasonable doubt. *See* ***State*** *v. King,* 316 Or. 437, 852 P.2d 190 (1993) (analyzing ORS 813.010, the DUII statute).

In this court, for the first time, the **state** acknowledges that HGN test evidence is *not* admissible to prove that a defendant was driving while having a BAC of .08 percent or more. Statutory law requires, as the **state** now concedes,[32] that the offense of DUII with a .08 percent or more BAC may be proved *only* by a "*chemical analysis of the breath or blood of the person* made under ORS 813.100, 813.140 or 813.150." ORS 813.010(1)(a) (emphasis added).[33] An HGN test does not involve a chemical analysis of breath or blood. Hence, an HGN test is not a chemical test under ORS 813.010(1)(a). Under ORS 813.010(1)(a), HGN test evidence is not, therefore, admissible to prove that a person had a BAC of .08 percent or more.

APPLICATION OF STANDARD FOR ADMISSION OF SCIENTIFIC EVIDENCE TO HGN TEST EVIDENCE

We now apply the multifactor test to discern whether HGN test evidence is scientifically valid to establish one of the statutory alternative methods of proving DUII, that is, impairment by use of intoxicating liquor, ORS 813.010(1)(b). In addressing those factors, we rely on the extensive scientific testimony and evidence given at the omnibus hearing in the
682 trial court,[34] pertinent *682 legal and medical literature on the subject received in evidence at that hearing, and numerous other sources in the area.[35]

Testability or falsifiability. The theory underlying the HGN test, namely, that there is strong correlation between the amount of alcohol a person consumes and the angle of onset of the nystagmus, and the validity of HGN test evidence can be (and has been) tested.

In the mid-1970s, the NHTSA, under the auspices of the Department of Transportation, began conducting research into the development of a standardized battery of psychophysical tests, which could be administered in the field, to aid police officers in evaluating persons suspected of driving under the influence of intoxicating liquor. The HGN test was developed in the Southern California Research Institute (SCRI) by Professors Tharp, Burns, and Moskowitz under a contract with the NHTSA. In 1977, after evaluating six potential sobriety tests that could be administered in the field to aid officers in discriminating BAC levels, a NHTSA research study found that, not only are signs of alcohol impairment in the eyes easily assessed by visual observation, but that, among the psychophysical roadside tests, tests of the eyes afford the most sensitive means for assessing whether a driver is legally impaired by alcohol. The 1977 report recommended three field sobriety tests developed by SCRI (the one-leg-stand test, the walk-and-turn test, and the HGN test). NHTSA, DOT-HS-802-424, *Psychophysical Tests for DWI Arrest* (1977). That study found that HGN was a highly sensitive index of alcohol impairment. *Id.*

Another study by SCRI for NHTSA, in 1981, standardized procedures for administering the scoring of those three field sobriety tests. NHTSA, DOT-HS-805-864, *Development and Field Test of Psychophysical Tests for DWI Arrests* (1981), *reprinted in* 2 Nichols, *Drinking/Driving Litigation,* ch. 26, app. C. In that study, participating officers were able to classify 81 percent of volunteers above or below 0.10 percent BAC. The study concluded that the HGN test was an "outstanding useful tool for the officer at the roadside."

Numerous other reports of both field tests and laboratory investigations and studies concerning the HGN test are published in the legal, medical, and optometric fields.[36] Exhaustive bibliographies or listings of the literature associated with HGN, which include the publications and reports of research done for the NHTSA, are found in **State's** Exhibit 18; ***State*** *v. Superior Court,* 149 Ariz. at 280-82, 718 P.2d at 182-184; *Witte,* 251 Kan. at 326-30, 836 P.2d at 1119-21; and Rouleau, 4 Am.Jur.Proof of Facts 3d at 490-95.

683 *683 The NHTSA's studies have received both praise and criticism. Supporters favor the HGN test, because individuals cannot voluntarily control HGN, tolerance to alcohol does not affect the test, and language barriers are not a problem. Comment, 84 J.Crim.L. & Criminology at 208-09. The HGN test is also favored because "an officer properly trained in the use of the test can get a more accurate indication of the individual's level of [alcohol impairment]." *Id.* In addition, the HGN test is reported to be the most accurate of the roadside sobriety tests to gauge alcohol impairment.

> "When an officer `grades' a suspect according to the aforementioned six point scale, the officer's accuracy rate is reported to be seventy-seven percent. The walk-and-turn test provides a correct diagnosis sixty-eight percent of the time, and the one-leg stand has an accuracy rate of sixty-five percent. However, when the HGN test is combined with the walk-and-turn test, there is an eighty percent accuracy rate." Comment, 84 J.Crim.L. & Criminology at 209-10 (footnotes omitted).

The HGN test as developed by the NHTSA, however, has been criticized regarding its reliability and the incidence of false positives.[37] It has been asserted that, "[a]s most optometrists know, many suspects will have jerky eye movements even with a 0.00 [percent] BAC." Eric Harperin & Robert L. Yolton, *Is the Driver Drunk? Ocularmotor Sobriety Testing,* J. Am. Optometric Ass'n. 654, 657 (1986). It has been noted that "[s]ome 50 to 60 [percent] of all individuals exhibit gaze nystagmus indistinguishable from alcohol gaze nystagmus if they deviate their eyes more than 40 degrees to the side." Rouleau, 4 Am.Jur.Proof of Facts 3d at 452 (citing Toglia, *Electronystagmography: Technical Aspects and Atlas* (1976)). Moreover, the NHTSA research has been criticized for its failure to describe the conditions under which the field tests were given. Comment, 84 J.Crim.L. & Criminology at 211. A study published in 1956 found nystagmus commenced in individuals with a BAC as low as 0.018 percent. In half the cases studied, nystagmus was displayed an average of 50 minutes after all alcohol had left the blood. Rouleau, 4 Am.Jur. Proof of Facts 3d at 439, 454.

In 1985, J.L. Norris, of the Santa Clara County (California) Laboratory of Criminalists, reviewed the efficacy of the HGN test to determine whether officers under field conditions were able to predict a person's BAC by determining the angle of onset of gaze nystagmus. Norris reported research findings that there was virtually no correlation between the actual BAC, as measured by a blood test, and the predicted value based on the angle of onset of HGN. Rouleau, 4 Am.Jur.Proof of Facts 3d at 453 (citing Norris, *The Correlation of Angle of Onset of Nystagmus with Blood Alcohol Level: Report of a Field Trial,* 25 (No. 6) Journal of Forensic Science Society 476 (1985)). The study did show a high correlation between the breath alcohol reading and the level predicted by the angle of onset of nystagmus. The report stated:

"`Since the police officers are the ones operating the breath testing equipment, it appears that, in at least some of the cases, an already known breath alcohol value may have influenced the determination of the angle of onset. Simply put, the police fudged the [HGN] determination to correspond with the already known correct answer determined by the breath test result. However, since they did not know what the correct answer was when the blood sample was tested (since someone else did the analysis), they could not come close to the correct BAC.'" *Id.* at 453 (quoting Pangman, *Horizontal Gaze Nystagmus: Voodoo Science,* 2 (No. 3) DWI Journal: Law & Science (March 1987)).

Peer review and publication (the existence of specialized literature). Defendant concedes that there is extensive
684 specialized literature in the relevant scientific disciplines *684 that thoroughly examines and critiques the reasoning and methodology of the HGN test. Publication of studies and laboratory investigations of the nystagmus phenomenon dates back to the mid-1950s. Substantial specialized literature has been published regarding the effect of alcohol on the eyes, including studies in this country, Sweden, West Germany, and Japan. *See supra,* 321 Or. at 310, 899 P.2d at 682 (citing listings of numerous publications scrutinizing the HGN test).

The known or potential rate of error. As discussed above, research studies indicate that the potential rate of error of a properly-administered HGN test is lower than for all other field sobriety tests that routinely are admitted into evidence. Because there are a number of potential causes for misdiagnosis, it is recognized that a few cautions seem appropriate regarding the HGN test procedure. First, there is a small but significant number of people who have chronic nystagmoid eye movements. Second, people who have high refractive errors could have trouble seeing the test target with their glasses removed and may therefore have problems with the test. Third, many people will have jerky eye movements even with 0.00 percent BAC. Nearly anything that affects the inner ear labyrinth, including alcohol, will cause nystagmus. The

evidence in the record shows that about three percent of the population suffers from non-alcohol-induced nystagmus and that, within that group, there are 50 to 100 causes of the phenomenon. Examples of causes of non-alcohol-induced nystagmus include caffeine, nicotine, eyestrain, motion sickness, epilepsy, streptococcus infections, measles, vertigo, muscular dystrophy, multiple sclerosis, influenza, hypertension, sunstroke, changes in atmospheric pressure, and arteriosclerosis. Comment, 84 J.Crim.L. & Criminology at 212. Depressants and convulsants can cause HGN, and sleep loss can change the angle of onset by about five degrees. Non-alcohol-induced nystagmus, however, typically is asymmetrical (one eye only), whereas alcohol-induced nystagmus is the same in both eyes. Officers are trained to look for that aspect.

To counter the foregoing concerns, part of the training that officers undergo instructs them to ask, before administering the HGN test, whether the person has a head injury, is ill, or is taking medication.

> "Even absent physiological problems or the presence of other substances that can cause nystagmus, the research project commissioned by the [NHTSA] reported that the angle of onset of [HGN] at a BAC of 0.10 [percent] decreases about 5 degrees when circadian rhythms reach their nadir. Consequently, police officers should adjust their criteria by about 5 degrees between midnight and 5 a.m." Rouleau, 4 Am.Jur. Proof of Facts 3d at 455-56 (internal quotation marks omitted).

Moreover, as Dr. Yolton testified, if the examining officer moves the stimulus too rapidly or moves the stimulus slightly above the smooth pursuit line, the results will be distorted.

In spite of the number of potential causes for error, we find that, when properly administered and scored by a qualified officer, the HGN test does appear to be a fairly reliable indicator of alcohol impairment. This is true even though other causes for nystagmus cannot be ruled out.

Existence and maintenance of standards governing the use of the HGN test. Standards governing the use of the HGN test do exist. Those standards provide safeguards governing the use of the HGN test. In 1984, the NHTSA published a manual for the purpose of teaching police officers the most effective means of determining alcohol impairment through field sobriety tests, including the HGN test. *See* NHTSA, DOT HS-806-512, *Improved Sobriety Testing, reprinted in* 2 Nichols, *Drinking/Driving Litigation,* ch. 26, app. A. The NHTSA manual sets forth the standards for administering and scoring the HGN test, as well as detailed instructions regarding test conditions. The OSP manual and OAR 257-25-020 comport with the standards in the NHTSA manual. Those standards and instructions are in use nationwide. They are the result of exhaustive testing and refinement. As Dr. Burns, Lieutenant Hayes, and Sergeant Studdard testified, the NHTSA standards and instructions have evolved over time in light of experience.

685 *685 *The degree of HGN test's acceptance in the relevant scientific community.* To determine the degree of the HGN test's acceptance, we first must identify the relevant scientific community to which the HGN belongs. In ***State** v. Superior Court*, the Arizona Supreme Court addressed the question whether there has been general acceptance in the relevant scientific community of the HGN test and its results. After discussing the different professional fields that might be interested in the validity of the HGN test, that court concluded that the appropriate disciplines that comprise the relevant scientific community include persons trained in behavioral psychology, highway safety, neurology, and criminalistics, who are concerned with detecting violators of DUII laws. 149 Ariz. at 278, 718 P.2d at 180. The court noted that no argument had been made why the relevant scientific community should include persons knowledgeable in pharmacology or ophthalmology. *Id.*

In holding the HGN test to be sufficiently reliable to satisfy the *Frye* test for the purpose of establishing the presence of alcohol in the blood, but not to establish a BAC of .10 percent or more, the Arizona Supreme Court found that several propositions had gained general acceptance in the relevant scientific community:

> "(1) HGN occurs in conjunction with alcohol consumption; (2) its onset and distinctness are correlated to BAC; (3) BAC in excess of .10 percent can be estimated with reasonable accuracy from the combination of the eyes' tracking ability, the angle of onset of nystagmus and the degree of nystagmus at maximum deviation; and (4) officers can be trained to observe these phenomena sufficiently to estimate accurately

whether BAC is above or below.10 percent." *Id.,* 149 Ariz. at 279, 718 P.2d at 181.[38]

See also Garrett, 119 Idaho at 881, 811 P.2d at 491 (citing ***State** v. Superior Court* with approval, the Supreme Court of Idaho also ruled that the HGN test satisfies the *Frye* standard).

Six years after the decision in ***State** v. Superior Court,* the issue whether the HGN evidence satisfies the *Frye* admissibility requirements was before the Supreme Court of Kansas in ***State** v. Witte*. The court in *Witte* held that the **state** had failed to lay a proper foundation for admissibility under the *Frye* standard. *Witte,* 251 Kan. at 328-29, 836 P.2d at 1121. In reaching its decision, the Kansas Supreme Court made an exhaustive review of the numerous studies on the HGN test since ***State** v. Superior Court*. The court observed that its research "indicates that the reaction within the scientific community [to the HGN test] is mixed." *Witte,* 251 Kan. at 326, 836 P.2d at 1119. After citing and discussing several articles that were published after the Arizona decision was issued (some of which endorse the HGN test and its accuracy and others of which disagree with the Arizona court's conclusions), the Supreme Court of Kansas disagreed with the Arizona court's conclusions, insisting that the HGN test had not been accepted generally within the scientific community. *Id.,* 251 Kan. at 329, 836 P.2d at 1121. *Witte* noted specific difficulties with the potential rate of error, discussed *supra,* 321 Or. at 312-13, 899 P.2d at 683-84. The *Witte* court also commented on problems with the physical application of the HGN test in the field, noting that, although the angle of lateral deviation is critical to the test, the test results of the NHTSA were obtained through the use of mechanical devices that held the head stable and measured the angle. 251 Kan. at 327-28, 836 P.2d at 1119-20. Officers administering the test in the field, on the other hand, estimate the angle without mechanical assistance. Visual estimations of the angle, however, lead to inaccurate and inconsistent results. *Id.* "The stability of the suspect's head, another critical factor, is also questionable when the test is conducted at the roadside." *Id.,* 251 Kan. at
686 328, 836 P.2d at 1120. Finally, the court noted that lighting conditions *686 and common substances such as nicotine, caffeine, and aspirin also could lead to nystagmus. *Id.* In remanding the case to the trial court to determine whether HGN test evidence "is sufficiently reliable to be admissible for any purpose," the *Witte* court concluded:

> "If the Arizona Supreme Court had this evidence before it, it may not have held that HGN evidence satisfies the *Frye* admissibility requirements. The reliability of the HGN test is not currently a settled proposition in the scientific community." *Id.,* 251 Kan. at 329, 836 P.2d at 1121.

Having conducted the review that we hold to be relevant, we reach a different conclusion than that reached by the *Witte* court. Our review of the record in this case, the legal and medical literature on the HGN test, including various publications and research studies concerning the HGN test, and our own research lead us to conclude that the scientific disciplines of pharmacology, ophthalmology, and to a lesser extent optometry should be included with behavioral psychology, highway safety, neurology, and criminalistics in the relevant scientific community. Each of those disciplines has been involved in the study of alcohol-induced nystagmus.

Our research also leads us to conclude that the following propositions have gained general acceptance within the relevant scientific community: (1) HGN occurs in conjunction with alcohol consumption; (2) its onset and distinctness are correlated to BAC; (3) in conjunction with other field sobriety tests (*e.g.,* the walk-and-turn test and the one-leg-stand test),[39] the HGN test is a reliable indicator of whether a driver is impaired by alcohol,[40] and (4) officers can be trained to observe these phenomena sufficiently to detect alcohol impairment.

The Expert's Qualifications. The accuracy of the HGN test depends on the examining officer's qualifications to administer the test and accurately record the test results. OAR 257-25-020(1)(a)(A), quoted *supra,* 321 Or. at 294, 899 P.2d at 673, requires that the police officer who administers the HGN test must have received prior training in its administration by the OSP, the Board on Public Safety Standards and Training, or other qualified governmental entity.

The use that has been made of the HGN test. This factor includes non-judicial uses and experience with the HGN test. *See United States v. Downing,* 753 F.2d 1224, 1239 (3d Cir.1985) (listing non-judicial uses and experience with the process or technique as a factor). "The [HGN] test has been in use for more than 30 years, but it has not been widely applied in the United States until recently." John P. Ludington, Annot., *Horizontal Gaze Nystagmus Test: Use in Impaired Driving Prosecution,* 60 ALR 4th 1129, 1131 (1988). Today, the use of the test as a field sobriety test to detect impairment

by alcohol has spread to every **state** in the nation.[41] HGN testing is one of the battery of field sobriety tests approved by the NHTSA, which instructs police agencies nationwide. The OSP, pursuant to ORS 801.272, has adopted the HGN test as an approved field sobriety test and has been training officers in its use since 1984.

687 *687 *The extent to which other courts admit HGN test evidence.* Many jurisdictions admit HGN test results as evidence of DUII. Arizona (***State** v. Superior Court,* 149 Ariz. 269, 718 P.2d 171 (1986)); Louisiana (***State** v. Armstrong,* 561 So.2d 883 (La.Ct.App.1990)); Iowa (***State** v. Murphy,* 451 N.W.2d 154 (Iowa 1990)); Montana (***State** v. Clark,* 234 Mont. 222, 762 P.2d 853 (1988)); Ohio (***State** v. Bresson,* 51 Ohio St.3d 123, 554 N.E.2d 1330 (1990)); Texas (*Richardson v. **State***, 766 S.W.2d 538 (Tex.Ct.App.1989)); and the Ninth Circuit Court of Appeals (*U.S. v. Van Griffin,* 874 F.2d 634 (9th Cir.1989)), are illustrative of the jurisdictions that hold that HGN test evidence may be admitted into evidence at a DUII trial as evidence of driving under the influence of intoxicants. *See also* Ludington, 60 A.L.R.4th 1129 (collecting **state** and federal cases dealing with the admissibility of HGN test evidence).

The novelty of the HGN test. Defendant concedes that the use of the HGN test is no longer novel. As noted, although the HGN test has not been widely applied in the United States until recently, it has been in use for three decades.

The extent to which the HGN test relies on the subjective interpretation of the officer administering the test. The HGN test is based on subjective visual observation. The officer who administers the test has no physical sample to take to a laboratory. Comment, 84 J.Crim.L. & Criminology at 215. A defendant is not able to have an expert examine the evidence. *Id.* Test conditions cannot be duplicated, and the test results cannot be verified. Thus, a defendant cannot contradict much of the officer's testimony. The validity of HGN test evidence depends in part on the examining officer's ability to administer the test, to interpret the test results, and to relate accurately his or her perceptions.

Nevertheless, observation by an officer of the presence of nystagmus is no more subjective than the observation by an officer of other indicia of alcohol impairment, such as swaying, staggering, having bloodshot eyes, or using slurred speech.

Presence of safeguards in the HGN test. HGN test evidence is not readily preserved as a tape recorder may preserve slurred speech or an Intoxilyzer printout card may preserve a breath test result. Nevertheless, the HGN test does not lack safeguards any more than do numerous other field sobriety tests routinely admitted in court. Officers are trained to keep a notebook listing performance on all field sobriety tests, including the HGN, to refresh their recollection and to provide defense counsel with an avenue for cross-examination.

After evaluating the numerous factors in connection with OEC 401 and OEC 702, we conclude that the general proposition supporting HGN test evidence—that alcohol consumption causes nystagmus—is scientifically valid. We further conclude that, when offered as evidence that the driver was under the influence of alcohol, HGN test evidence is relevant under OEC 401, because it would tend to make more probable the existence of the consequential fact of being under the influence of intoxicating liquor than without such evidence. That there may be explanations for the presence of nystagmus other than the use of alcohol does not diminish the relevancy of HGN test evidence. *See Hampton,* 317 Or. at 255, 855 P.2d 621 ("The possibility that an inconsistent or contradictory inference may reasonably be drawn from the offered item of evidence does not destroy that item's relevancy so long as the inference desired by the proponent is also a reasonable one.").[42]

HGN test evidence also meets the helpfulness requirement in OEC 702. HGN test evidence is pertinent, to the same extent as are other field sobriety tests, to the issue to which it is directed, namely, whether a defendant was under the influence of intoxicating liquor. Moreover, such evidence may be of assistance to the trier of fact in one or more of the ways the "helpfulness" standard in OEC 702 is intended to serve. *See supra,* 321 Or. at 298-99, 899 P.2d at 675-76
688 (discussing *688 multiple functions served by "helpfulness" requirement in OEC 702).

SHOULD HGN TEST EVIDENCE BE EXCLUDED UNDER OEC 403?

We now turn to the issue whether HGN test evidence, which is relevant when offered to show whether a driver was under the influence of intoxicating liquor, should be excluded under OEC 403, the text of which is set out *supra,* 321 Or. at 299,

899 P.2d at 676. Relevant evidence may be excluded under OEC 403 only if its persuasive force is substantially outweighed by any of the articulated dangers or considerations alone or in combination. ***State** v. Johanesen,* 319 Or. 128, 136, 873 P.2d 1065 (1994). "This requires that the probative value of the evidence be compared to the articulated reasons for exclusion and permits exclusion only if one or more of those reasons `substantially outweigh' the probative value." *Id.* OEC 403 generally favors admissibility,[43] while concomitantly providing the means of excluding distracting evidence from the trial. *Id.* The "substantially outweighed" phrasing in OEC 403, in effect, places the burden on the party seeking exclusion of the evidence.

The existence of one or more of the articulated reasons for exclusion set forth in OEC 403 is a preliminary question of fact under OEC 104(1). *Beasley,* 314 Or. at 453 n. 17, 840 P.2d 78. In making its determination, the court is not bound by the rules of evidence except those with respect to privileges. OEC 104(1).

In this case, the trial court excluded HGN test evidence under OEC 403, concluding that the probative value of such evidence was substantially outweighed by the danger of unfair prejudice "because of the potential for error and subjectivity of [the] test." "Notwithstanding the usual deference to trial court discretion,[44] we as an appellate court retain our role to determine the admissibility of scientific evidence under the Oregon Evidence Code." *Brown,* 297 Or. at 442, 687 P.2d 751. [45]

689 *689 We conclude that HGN test evidence is not unfairly prejudicial. In the context of OEC 403, "unfair prejudice" does not mean "evidence is harmful to the opponent's case—a central reason for offering evidence." *Hampton,* 317 Or. at 259 n. 15, 855 P.2d 621. Rather, it means an undue tendency to suggest a decision on an improper basis, commonly although not always, an emotional one. ***State** v. Pinnell,* 311 Or. 98, 105-06 n. 12, 806 P.2d 110 (1991). "Unfair prejudice" describes a situation in which the preferences of the trier of fact are affected by reasons essentially unrelated to the persuasive power of the evidence to establish the fact of consequence.

We also find that the admission of HGN test evidence and evidence to refute it will not unduly prolong the trial, unduly burden the courts, or unduly delay the administration of justice. *Cf. Brown,* 297 Or. at 441, 687 P.2d 751 (admission of polygraph in all cases would unduly burden the court and delay the administration of justice). The reasoning and methodology regarding the HGN test can be explained with reasonable clarity. The test, which takes approximately 90 seconds to administer, has three parts, the phenomena to be explained are uncomplicated (the eyes jerked, or they stayed still, or they moved smoothly), and more than four out of six points on the six-point test tend to make probable the person's impairment from alcohol.

We also do not believe that HGN test evidence will cause a trier of fact to base his or her decision on an emotional, irrational, or other similarly improper basis unrelated to the probative force of the evidence. Although the scientific nature of the HGN test, its scientific name, and its potential for error do present some risk of misleading the jury, we are not convinced that HGN test evidence will have an inappropriate effect on the jury. *Cf. Brown,* 297 Or. at 438-42, 687 P.2d 751 (excluding polygraph evidence on the basis, *inter alia,* of the potential misuse and overvaluation by the trier of fact). Although HGN is scientific in nature and does convey the imprimatur of science, the scientific principles underlying the HGN test are not such that the trier of fact would overvalue the evidence or would accept the results of the test without question. Nor do we believe that the admission of HGN test evidence for the limited purpose of establishing "being under the influence of intoxicating liquor" will tend to divert or lead the trier of fact from the issues in a DUII proceeding, confuse the issues, or reduce the trier of fact's concern with accuracy. Opposing counsel will have the opportunity through cross-examination and rebuttal evidence to question the relevance or probative value of the evidence.[46] In either situation, jurors' skepticism about the test evidence may lead them to reject or give little weight to the evidence. In our view, the end result from the admission of HGN test evidence for the limited purpose of establishing that a defendant was under the influence of intoxicating liquor, in all likelihood, will be enlightenment, not confusion.

For the foregoing reasons, we conclude that HGN test evidence, when offered to prove that a defendant was under the influence of intoxicating liquor, is not excluded by OEC 403.

CONCLUSION

We hold that, subject to a foundational showing that the officer who administered the test was properly qualified, the test was administered properly, and the test results were recorded accurately, HGN test evidence is admissible in a DUII
690 proceeding to establish that a defendant was under the influence of intoxicating liquor[47] but, under *690 ORS 813.010(1)(a), is not admissible to prove that a defendant had a BAC of .08 percent or more.

The decision of the Court of Appeals is affirmed in part and reversed in part. The order of the district court is reversed.

[1] ORS 801.272 provides:

"`Field sobriety test' means a physical or mental test, approved by the Department of **State** Police by rule after consultation with the Board on Public Safety Standards and Training, that enables a police officer or trier of fact to screen for or detect probable impairment from intoxicating liquor, a controlled substance, or a combination of intoxicating liquor and a controlled substance."

[2] The field sobriety tests described in OAR 257-25-020(1) include the HGN test, the walk-and-turn test, the one-leg stand test, the Romberg balance test, the modified finger-to-nose test, the finger count, the alphabet, counting, and the internal clock.

[3] ORS 138.060 provides:

"The **state** may take an appeal from the circuit court or the district court to the Court of Appeals from:

"* * * * *

"(3) An order made prior to trial suppressing evidence[.]"

[4] Similarly, in *Plemel v. Walter,* 303 Or. 262, 735 P.2d 1209 (1987), this court applied ***State** v. Brown,* 297 Or. 404, 687 P.2d 751 (1984), in a civil case. In *Plemel,* the plaintiff sought to establish the paternity of her child by introducing statistics derived from blood test results regarding the probability of paternity. This court held that the putative father's "paternity index" was highly probative under *Brown,* but also presented a "substantial danger of misleading the trier of fact" under OEC 403. *Plemel,* 303 Or. at 273-78, 735 P.2d 1209. Therefore, the court concluded that the putative father's paternity evidence was admissible, subject to certain conditions. *Id.* at 278-79, 735 P.2d 1209.

[5] *See also Daubert v. Merrell Dow Pharmaceuticals,* 509 U.S. ___, ___, 113 S.Ct. 2786, 2800, 125 L.Ed.2d 469, 487 (1993) (Rehnquist, C.J., concurring in part and dissenting in part) (suggesting that there is no clear demarcation between scientific, technical, and specialized knowledge).

[6] "There is virtual unanimity among courts and commentators that evidence perceived by jurors to be `scientific' in nature will have particularly persuasive effect." John William Strong, *Language and Logic in Expert Testimony: Limiting Expert Testimony by Restrictions of Function, Reliability, and Form,* 71 Or.L.Rev. 349, 367 n. 81 (1992) (citing cases). *See People v. Leahy,* 8 Cal.4th 587, 595, 34 Cal.Rptr.2d 663, 667, 882 P.2d 321, 325 (1994) ("[l]ay jurors tend to give considerable weight to scientific evidence when presented by experts with impressive credentials"); ***State** ex rel. Hamilton v. City Court of City of Mesa,* 165 Ariz. 514, 518, 799 P.2d 855, 859 (1990) ("[o]ne danger inherent in the use of scientific evidence is that the jury may accord it undue significance because it associates `science' with truth"); 3 Jack B. Weinstein, Margaret A. Berger, & Joseph M. McLaughlin, *Weinstein's Evidence* ¶ 702[03], 702-50 (1995) (jurors may be overly impressed with the aura of reliability surrounding scientific evidence and thereby surrender their role of critical assessment).

[7] We decide this case under the Oregon Evidence Code. When we cite a decision of the Supreme Court of the United States in interpreting a provision of the Oregon Evidence Code, we do so because we find the views there expressed persuasive, not because we consider this court bound to do so by our understanding of federal doctrines. *Daubert* rests on an interpretation of the Federal Rules of Evidence, a federal statute. As a statutory case, rather than a constitutional case, *Daubert* is not binding on the states. That is true even though the Oregon Evidence Code is modeled on the Federal Rules of Evidence.

[8] The proponent of evidence derived from a particular scientific technique or test that this court has found to be scientifically valid need not introduce expert foundational testimony to demonstrate scientific validity. The validity of such scientific evidence, if not assumed, may be established by judicial notice. *See* John William Strong, *Judicial Notice in Evidence* § 3.20, 3-16 (Oregon CLE 1986) (judicial notice may be used to obviate the necessity of introducing expert testimony about the validity of the scientific principles upon which a particular scientific technique or test rests, which this court has found to be scientifically valid). *See also Daubert,* 509 U.S. at ___, n. 11, 113 S.Ct. at 2796 n. 11, 125 L.Ed.2d at 482 n. 11 (scientific principles "that are so firmly established as to have attained the status of scientific law, such as the laws of thermodynamics, properly are subject to judicial notice"); Christopher B. Mueller & Laird C. Kirkpatrick, 3 *Federal Evidence* § 353, 662 (2d ed 1994) (sometimes the necessary validity finding for scientific evidence can be made by judicial notice).

[9] Although *Brown* focused on "novel" scientific evidence, it is not limited to "novel" scientific evidence. We agree with the following observation by Professor Strong:

"The chief difficulty with novelty as a limitation is * * * that it too strongly suggests a focus upon the subject matter of the testimony as opposed to the real matter of concern, the particular general propositions relied upon by the witness. Moreover, no particular reason of logic or good sense exists to immunize particular areas or principles simply on the basis of longevity or the fact that their introduction antedated imposition of the new standard. Supposedly valid `science' has not infrequently been unmasked. Nor is such a limitation needed in order to avoid wasting time on foundation proof for sufficiently established principles. Judicial notice should suffice to obviate this need, at least until such time as a challenge on reliability grounds has been mounted." Strong, 71 Or L Rev at 367 (footnotes omitted).

See also Daubert, 509 U.S. at ___ n. 11, 113 S.Ct. at 2796 n. 11, 125 L.Ed.2d at 482 n. 11 (stating similar principle).

[10] The OSP has amended the rule to provide that the officer shall check for the onset of nystagmus "prior to 45 degrees in each eye." OAR 257-25-020(1)(a)(C) (February 1993).

[11] *See Leahy,* 8 Cal.4th at 605, 34 Cal.Rptr.2d at 674, 882 P.2d at 332, which states:

"The horizontal gaze nystagmus (HGN) test has been in use for 30 years, *but it has not been widely applied in the United States until recently.* * * * [T]he HGN symptom was first recognized in the 1960s in connection with barbiturate use, but the earliest court decision cited by the annotation as addressing the admissibility of HGN test results was decided in California in 1984." (Emphasis in original; citations and internal quotation marks omitted.)

[12] In ***State** v. Clark,* 286 Or. 33, 39-40, 593 P.2d 123 (1979), this court took judicial notice of a list of 11 common physical manifestations of intoxication: "(1) Odor of the breath (2) Flushed appearance (3) Lack of muscular coordination (4) Speech difficulties (5) Disorderly or unusual conduct (6) Mental disturbance (7) *Visual disorders* (8) Sleepiness (9) Muscular tremors (10) Dizziness (11) Nausea." (Emphasis added.) In *Clark,* this court held that evidence of the absence of such manifestations is relevant to a charge of driving with a proscribed level of alcohol in the blood. *Id.* at 40, 593 P.2d 123. This court noted that the physical manifestations are not invariably exhibited by a person with the proscribed level of blood alcohol. *Id.* at 39, 593 P.2d 123.

[13] "All relevant evidence is admissible, except as otherwise provided by the Oregon Evidence Code, by the Constitutions of the United States and Oregon, or by Oregon statutory and decisional law. Evidence which is not relevant is not admissible." OEC 402.

[14] Relevance and probative value are not synonymous terms. OEC 401 defines relevancy in terms of the minimum relationship that must exist between the evidence offered and the proposition sought to be proved. *See **State** v. Hampton,* 317 Or. 251, 255, 855 P.2d 621 (1993) (discussing the concept of relevance set forth in OEC 401). Probative value inquires about the strength of that relationship. The inference from the evidence to the proposition may be strong or weak. Thus, probative value may be high or low. In this opinion, we use the words "probative value" and "persuasive force" interchangeably.

[15] In a footnote, *Brown* mentioned somewhat overlapping additional factors to consider:

"(1) The potential error rate in using the technique;

"(2) The existence and maintenance of standards governing its use;

"(3) Presence of safeguards in the characteristics of the technique;

"(4) Analogy to other scientific techniques whose results are admissible;

"(5) The extent to which the the [sic] technique has been accepted by scientists in the field involved;

"(6) The nature and breadth of the inference adduced;

"(7) The clarity and simplicity with which the technique can be described and its results explained;

"(8) The extent to which the basic data are verifiable by the court and jury;

"(9) The availability of other experts to test and evaluate the technique;

"(10) The probative significance of the evidence in the circumstances of the case; and

"(11) The care with which the technique was employed in this case." 297 Or. at 418-419 n. 5, 687 P.2d 751.

[16] *Frye v. United States,* 293 F. 1013, 1014 (D.C.Cir.1923), required that a foundation for the admission of scientific evidence include proof that the principle upon which it is based be sufficiently established to have gained general acceptance in the field to which it

belongs.

[17] OEC 702 is identical to FRE 702. OEC 401 is identical to FRE 401. OEC 402, which is derived from FRE 402, is substantially similar to FRE 402, but is modified to provide that the exceptions to admissibility are set forth in the Oregon Evidence Code, the Constitutions of the United States and Oregon, and in Oregon's statutory and decisional law. OEC 402 Commentary, *in* Laird C. Kirkpatrick, *Oregon Evidence* 121 (2d ed 1989). OEC 403, which is derived from FRE 403, differs slightly from FRE 403. FRE 403 includes "waste of time" as a reason for excluding relevant evidence; OEC 403 does not. OEC 403 Commentary, *in* Kirkpatrick, *Oregon Evidence* at 125.

[18] A trial court, acting as a gatekeeper, does not sit as a trier of fact to determine which side has presented the more credible (or more persuasive) expert or scientific evidence. Rather, a trial court, in an OEC 104(1) hearing to determine whether (or to what extent) any specific expert or scientific evidence will be admissible at trial, sits only as the trier of *preliminary facts—i.e.,* those facts that must be found, under the governing rules of evidence, *before* a witness is permitted to express an opinion. In other words, a trial court, acting as a gatekeeper, cannot resolve any *genuine* issue of *material* fact. "The line between *preliminary* factfinding and *ultimate* factfinding, prevents judges from usurping the constitutional function of juries." Marc S. Klein, *Cardozo Law Review's Special Issue: Scientific Evidence After the Death of Frye,* 2 Shepard's Expert & Sci Evidence Q 271, 272 (1994).

[19] The Supreme Court denominated scientific validity as the linchpin of admissibility because validity relates to whether the methods in question are capable of measuring what they purport to measure. *Daubert* recognized that reliability and validity differ as scientific measures. 509 U.S. at ___ n. 9, 113 S.Ct. at 2795 n. 9, 125 L.Ed.2d at 481 n. 9. Whereas validity describes how well the scientific method reasons to its conclusions, reliability describes the ability of the scientific method to produce consistent results when replicated. David H. Kaye & David A. Freedman, *Reference Guide on Statistics, in Reference Manual on Scientific Evidence* 331, 341-42 (Federal Judicial Ctr, ed 1994). "For example, a new test for blood alcohol level may be invalid in that it grossly underestimates the amount of alcohol in one's bloodstream, and yet be reliable in that it underestimates the blood alcohol level in one's bloodstream by the same amount every time." Developments in the Law, *Confronting the New Challenges of Scientific Evidence,* 108 Harv.L.Rev. 1481, 1534 (1995). *See also* Brown, 297 Or. at 427, 687 P.2d 751 ("Accuracy can be broken down into two categories: reliability and validity. The reliability of a test is the consistency with which the test measures whatever it is that it measures. * * * The validity of the test is the extent to which the test measures that which it claims to measure."); David L. Faigman, *To Have and Have Not: Assessing the Value of Social Science to the Law as Science and Policy,* 38 Emory L.J. 1005, 1010 n. 16 (1989) (defining reliability and validity and providing an example illustrating the difference). With little discussion, the Supreme Court concluded that the ultimate concern for a trial judge must be *evidentiary* reliability, that is trustworthiness, but stated that such reliability must be based on scientific validity. *Daubert,* 509 U.S. at ___ n. 9, 113 S.Ct. at 2795 n. 9, 125 L.Ed.2d at 481 n. 9.

[20] In performing its role as "gatekeeper," the trial court ensures that the trier of fact does not attach an undue aura of reliability to "scientific" evidence that is not scientifically valid. Evidence that purports to be based on science beyond the common knowledge of the average person that does not meet the judicial standard for scientific validity can mislead, confuse, and mystify the jury.

"There is a fifth dimension beyond that which is known to man. It is a dimension as vast as space and as timeless as infinity. It is the middle ground between light and shadow, between science and superstition. And it lies between the pit of man's fears and the summit of his knowledge. It is an area we call the Twilight Zone."

Rod Sterling opened each episode of his 1959 television series, The Twilight Zone, with those words. Gary Gerani & Paul H. Schulman, *Fantastic Television* 35 (1977).

In determining whether scientific evidence is admissible, the trial court is to make sure that the decision by the trier of fact is based on scientific facts, not science fiction.

[21] Novelty does not imply invalidity, because every scientific theory must at some point be "new." Perhaps the most famous example of a court rejecting a valid, yet novel, scientific theory is the trial of Galileo, where the scientist was convicted of heresy for asserting that the earth revolves around the sun. *See generally* Maurice A. Finocchiaro, *The Galileo Affair: A Documentary History* (The Notable Trials Library 1991).

[22] In *Daubert,* 509 U.S. at ___ n. 11, 113 S.Ct. at 2796 n. 11, 125 L.Ed.2d at 482 n. 11, the Court pointed out that, although the *Frye* decision was focused exclusively on novel techniques, the requirements of FRE 702 do not "apply specially or exclusively to unconventional evidence."

[23] Both FRE 104(a) and OEC 104(1) provide that, in making its determination, the court "is not bound by the rules of evidence except those with respect to privileges."

[24] The main premise of falsifiability is that a hypothesis that cannot be subject to the possibility of rejection by observation and experiment cannot be regarded as scientific. Developments in the Law, 108 Harv.L.Rev. at 1515 n. 45.

[25] According to one commentator:

"Peer review is of limited utility in eliminating mistakes or even fraud. Graduate students sometimes do the work; confirmation of experiments described is difficult and expensive; general impressions are relied upon; referees may want to enhance or retard careers; different sets of referees may be used after the first set disagrees; the authors may recommend referees; and so on. Given such a dubious process, it is apparent why the courts cannot rely on any single test of admissibility such as peer review." Jack B. Weinstein, *The Effect of Daubert on the Work of Federal Trial Judges,* 2 Shepard's Expert & Sci Evidence Q 1, 7 (1994).

[26] Thus, *Daubert* reduced *Frye's* status from a legal mandate to one of several discretionary considerations.

[27] The unofficial Commentary to the Oregon Evidence Code states: "The [Oregon] legislative assembly did not adopt Rule 706 of the Federal Rules of Evidence, relating to court appointment of experts, because it believes that the practice should be discouraged. * * * By not adopting Federal Rule 706, the Legislative Assembly does not intend to limit the inherent power of a trial court to appoint experts[,] * * * but only to discourage the practice." Commentary, *in* Kirkpatrick, *Oregon Evidence* at 475.

[28] In *United States v. Downing,* 753 F.2d 1224, 1238-41 (3d Cir.1985), on which *Daubert* draws in part, 509 U.S. at ___ n. 12, 113 S.Ct. at 2797 n. 12, 125 L.Ed.2d at 484 n. 12, the Third Circuit Court of Appeals listed factors not mentioned in either *Brown* or *Daubert,* such as the non-judicial uses and experience with the process or technique and the extent to which other courts have permitted expert testimony based on the process or technique. We agree with the *Downing* approach in this regard, and hold that the foregoing factors also may be considered in determining the admissibility of proffered expert scientific testimony.

[29] When proffered scientific evidence raises issues of scientific validity, those issues should be addressed by the trial court in a separate OEC 104(1) hearing, preferably in advance of trial. Under OEC 104(1), the trial court is not to decide merely that the proponent has offered enough evidence of validity to enable a reasonable person to conclude that the evidence is valid, but the court is to decide the validity issue. For a discussion of the role of the trial court in deciding OEC 104(1) questions, see *supra,* notes 18 and 23; ***State** v. Carlson,* 311 Or. 201, 208-09, 808 P.2d 1002 (1991). At an OEC 104(1) inquiry, the proponent must establish by a preponderance of the evidence that the proffered "scientific" evidence satisfies the admissibility standard.

[30] Although the **state** and defendant agree that, with the necessary foundation, HGN test evidence is admissible to help establish probable cause to arrest a motorist for DUII, that inquiry differs from the use of HGN test evidence in a prosecution for DUII as evidence of guilt or innocence.

[31] In the context of a DUII proceeding, Oregon **State** Bar Uniform Criminal Jury Instruction No. 2701 (1994) provides:

"`Under the influence of intoxicating liquor' means that [defendant's name]'s physical or mental faculties were adversely affected by the use of intoxicating liquor to a noticeable or perceptible degree.

"`Under the influence of intoxicating liquor' includes not only the well-known and easily recognized conditions and degrees of intoxication, but also any abnormal mental or physical condition that results from consuming intoxicating liquor and that deprives the person of that clearness of intellect or control that the person would otherwise possess." (Brackets in original).

We agree that those instructions correctly **state** the applicable law.

[32] Before the trial court and the Court of Appeals, the **state** argued that HGN test evidence is admissible at a DUII trial to prove that a defendant was driving a vehicle while under the influence of intoxicants and/or while his BAC was .08 percent or more.

[33] ORS 813.010 provides in part:

"(1) A person commits the offense of driving while under the influence of intoxicants if the person drives a vehicle while the person:

"(a) Has .08 percent or more by weight of alcohol in the blood of the person *as shown by chemical analysis of the breath or blood of the person made under ORS 813.100, 813.140 or 813.150;*

"(b) Is under the influence of intoxicating liquor or a controlled substance; or

"(c) Is under the influence of intoxicating liquor and a controlled substance." (Emphasis added).

[34] At the omnibus hearing in this case, the trial court received both scientific publications and reports of research done for the United States Department of Transportation. The trial court also heard the testimony of two witnesses called by the **state**: Dr. Robert Leslie Yolton, a professor of optometry, and Trooper Gregory, the arresting officer. In addition, the parties stipulated that the trial court could consider the testimony of witnesses (except Trooper Gregory) and evidence received at an earlier hearing held in a different case before the same trial court. That case was ***State** v. Barnes/Metully,* Benton County District Court Case No. TM88-2916/2406. At the

Barnes/Metully hearing, the **state** had called Dr. Marcelline Burns, a research psychologist, Sergeant Studdard of the Los Angeles Police Department, Dr. William J. Brady, a consulting pathologist, Lieutenant Hayes of the Oregon **State** Police, and Trooper Gregory. The defendant called Dr. Wolf, an ophthalmologist.

Because of the parties' stipulation, we do not refer to Trooper Gregory's testimony in the *Barnes/Metully* omnibus hearing.

[35] The validity of proffered scientific evidence, which is a question of law, typically is established through the introduction of evidence, including expert testimony. Trial courts also may consider numerous sources, such as offers of proof, affidavits, stipulations, and learned treatises. *See Downing,* 753 F.2d at 1241 (stating same).

When a court, in determining what the law— statutory, decisional, or constitutional—is or should be, takes judicial notice of certain facts, it is taking judicial notice of legislative facts. ***State** v. Clowes,* 310 Or. 686, 692 n. 7, 801 P.2d 789 (1990); *Brown,* 297 Or. at 420 n. 7, 687 P.2d 751. Judicial notice of legislative facts is not governed by the provisions of OEC 201, and the limitations and standards of OEC 201 do not control judicial notice of legislative facts. *Clowes,* 310 Or. at 692 n. 7, 801 P.2d 789.

[36] In this case, Dr. Yolton testified that, although "none of the field sobriety tests give perfectly accurate predictions of [BAC], * * * [the HGN] test ranges in accuracy and classification for drivers above .10 percent [BAC] from about 80 percent accurate to over 90 percent accurate. There are studies that span that range and I have seen studies that suggest higher rates, but I can't document them."

[37] *See **State** v. Witte,* 251 Kan. 313, 326-30, 836 P.2d 1110, 1119-21 (1992) (discussing various researchers' criticisms of the HGN test).

A false positive is a test result that indicates that a person is under the influence of alcohol when that person is not. Mark A. Rouleau, *Unreliability of the Horizontal Gaze Nystagmus Test,* 4 Am.Jur.Proof of Facts 3d 439, 473 (1989).

[38] In a subsequent case, ***State** ex rel. Hamilton,* 165 Ariz. at 519, 799 P.2d at 860, the Arizona Supreme Court reaffirmed its holding in ***State** v. Superior Court,* stating: "HGN test results may be admitted only for the purpose of permitting the officer to testify that, based on his training and experience, the results indicated possible neurological dysfunction, one cause of which could be alcohol ingestion."

[39] "[T]he director of alcohol countermeasures of the National Highway Traffic Safety Administration has said that [the] HGN test should not be used without the one-legged stand and the walk-and-turn tests." John P. Ludington, Annot., *Horizontal Gaze Nystagmus Test: Use in Impaired Driving Prosecution,* 60 ALR 4th 1129, 1132 (1988) (citing Los Angeles Times, February 17, 1985, Sunday Home Edition, Metro Part 2, Page 12, Column 1).

[40] Every witness in this case acknowledged that, in combination with other signs of impairment, such as poor performance of other field sobriety tests (*e.g.,* the walk-and-turn test and the one-leg-stand test), the HGN test is a reliable indicator of alcohol impairment.

In his petition for review to this court, defendant states:

"[Defendant] acknowledges that the HGN test is widely accepted as a field sobriety test, to be used by an officer in the field when making a determination whether a driver is impaired to the point that he or she should not be driving. And indeed, this is exactly what every witness testified: for this purpose, and in combination with other officer observations, the test is a reliable, if imprecise, indicator of the probability of impairment."

[41] Sergeant Studdard testified that officers in all 50 states are using the HGN test.

[42] Of course, if the examining officer in the administration of the HGN test finds the absence of nystagmus, that finding would be relevant, because it would tend to make less probable the existence of the consequential fact of being under the influence of intoxicating liquor.

[43] In ***State** v. Pinnell,* 311 Or. 98, 112-13, 806 P.2d 110 (1991), this court stated that OEC 403, like its federal counterpart, FRE 403,

"requires the judge to go through a conscious process of balancing the costs of the evidence against its benefits. Unless the judge concludes that the probative worth of the evidence is `substantially outweighed' by one or more of the countervailing factors, there is no discretion to exclude; the evidence must be admitted. * * * [T]he process of balancing is a prerequisite to the exercise of discretion. * * * [T]he rule presupposes a two-step process—balancing, then the discretionary judgment. * * * Discretion is an intuitive process not susceptible to the quantification presupposed by the metaphor of the scales." (Quoting Wright and Graham, 22 Federal Practice and Procedure § 5214, 263-64 (1978) (footnote omitted)).

[44] On review of preliminary fact determinations made under OEC 104(1), this court normally determines whether there was sufficient evidence to support the trial court's finding by a preponderance of the evidence. *See, e.g., **State** v. Cornell,* 314 Or. 673, 678, 842 P.2d 394 (1992); ***State** v. Langley,* 314 Or. 247, 264-65, 839 P.2d 692 (1992).

[45] Although this court typically is deferential to a trial court's findings of preliminary facts under OEC 104(1), *see* *Carlson,* 311 Or. at 214, 808 P.2d 1002, good reasons exist to modify this approach in the context of scientific evidence. Unlike almost all other preliminary fact questions made under OEC 104(1), a large component of the decision surrounding scientific evidence transcends individual cases. In the usual application of OEC 104(1), a trial court must make a context-specific factual determination. For example, a trial court must find by a preponderance of the evidence that a conspiracy existed before admitting evidence under the exemption from the ban on hearsay for statements made by a co-conspirator, OEC 801(4)(b)(E), *Cornell,* 314 Or. at 677, 842 P.2d 394, and the trial court must similarly find that a hearsay declarant is "unavailable" under OEC 804(1) for purposes of the statement against penal interest exception to the hearsay rule, OEC 804(3)(c), ***State** v. Thoma,* 313 Or. 268, 276, 834 P.2d 1020 (1992). Because those preliminary facts are specific to the case before the trial court and do not repeat themselves in the same form in other cases, substantial deference to the trial court as factfinder logically flows out of the trial court's close proximity to the matter. When the preliminary facts are not case-specific, little or no deference to the trial court's findings is appropriate. *See* David L. Faigman, *Mapping the Labyrinth of Scientific Evidence,* 46 Hastings L.J. 555, 573-77 (1995) (stating similar analysis in context of Federal Rules of Evidence). The validity of scientific knowledge does not change from court to court; assessment of that knowledge should not change from court to court.

Moreover, if evidentiary rulings as to the admissibility of scientific evidence are reviewed with deference to trial court discretion, inconsistent decisions concerning the admissibility of scientific evidence may go unchecked from one trial court to another. Such inconsistency may confound efforts to provide uniformity under the Oregon Evidence Code.

[46] For instance, through cross-examination and rebuttal evidence, opposing counsel can show that there are numerous causes of nystagmus other than the use of alcohol. As with other field sobriety tests, the results of the HGN test may be attributable to physical and/or mental conditions other than the ingestion of alcohol.

[47] Of course, negative HGN test results would be admissible to show lack of impairment from alcohol.