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## Receptacle delivery system


### Abstract

A receptacle delivery system for an instrument includes a carriage, a puck supported by the carriage, and a first shelf. The carriage is configured to move from a first location of the instrument to a second location of the instrument. The puck is configured to removably support a receptacle such that a longitudinal axis of the receptacle is substantially coincident with a vertical axis of the puck. The first shelf comprises (a) a base extending substantially transverse to the vertical axis of the puck and (b) a first opening defined by the base, and when the carriage is positioned at the second location, the longitudinal axis of a receptacle seated in the puck extends through the first opening.



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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation claiming the benefit under 35 U.S.C. § 120 of the filing date of U.S. application Ser. No. 17/608,745, now U.S. Pat. No. 12,210,028, filed Nov. 3, 2021, which is a national phase entry pursuant to 35 U.S.C. § 371 of International Application No. PCT/US2020/030481, filed Apr. 29, 2020, which claims the benefit under 35 U.S.C. § 119(c) of the filing date of U.S. Provisional Application No. 62/951,019, filed Dec. 20, 2019, and U.S. Provisional Application No. 62/842,585, filed May 3, 2019, the disclosures of which applications are hereby incorporated by reference.

TECHNICAL FIELD
(1) The present disclosure relates to receptacle transport systems for an analytical system and methods of using the disclosed receptacle transport systems.
BACKGROUND
(2) Laboratories today face increasing pressure to automate their operations to increase throughput and processing consistency, address a shortage of medical technologists, and decrease errors. In some laboratories, a sample transport system, such as a conveyor, may be used to connect instruments within the laboratory, thereby allowing samples provided to a single sample loading area to be automatically and sequentially delivered to multiple instruments without human intervention. Instruments connected in this manner may be used to perform the same or different types of tests.
SUMMARY
(3) In some embodiments, a receptacle delivery system for an instrument is disclosed. The system may include a puck configured to removably support a receptacle therein. The puck may include a plurality of fingers arranged about a vertical axis, one or more springs coupling the plurality of fingers and thereby biasing the plurality of fingers toward the vertical axis, a supporting disc, a synchronization disc, and a retaining ring. Each finger of the plurality of fingers may have a contact surface configured to be in contact with a receptacle seated in the puck. The supporting disc may include (i) a disc sidewall projecting from a base to define a pocket for seating a receptacle, (ii) a plurality of first cavities formed in the base and extending in a direction of the vertical axis, and (iii) a puck passageway extending through opposed portions of the disc sidewall in a direction transverse to and offset from the vertical axis. Each of the plurality of fingers may be rotatably coupled to the supporting disc at a corresponding first cavity of the plurality of first cavities. The synchronization disc may be positioned in the pocket of the supporting disc. Each of the plurality of fingers may be coupled to the synchronization disc such that the contact surfaces of the plurality of fingers move toward and away from the vertical axis in a synchronous manner. And the retaining ring may couple the plurality of fingers, the supporting disc, and the synchronization disc together.
(4) Various embodiments of the disclosed system may, additionally or alternatively, include one of more of the following features: the plurality of fingers may be arranged substantially symmetrically about the vertical axis; at least an upper portion of the contact surface of each finger of the plurality of fingers may be sloped; each finger of the plurality of fingers may include a first end and a second end extending substantially transverse to the first end, the first end may include the contact surface and the second end may include an inner cavity and an outer cavity, and the inner cavity may be positioned closer to the vertical axis than the outer cavity; the synchronization disc may include a plurality of radially extending slots, each finger of the plurality of fingers may be slidably

coupled to the synchronization disc by a first pin that extends through a slot of the plurality of radially extending slots and the inner cavity of the finger; each first cavity of the plurality of first cavities of the supporting disc may include a bearing positioned at least partly therein; each finger of the plurality of fingers may be rotatably coupled to the supporting disc by a second pin that extends through the bearing of a first cavity of the plurality of first cavities of the supporting disc and the outer cavity of the finger; one end of each second pin may extend through the bearing and an opposite end of the second pin may extend into a corresponding cavity in the retaining ring; the one or more springs coupling the plurality of fingers may be an O-ring; the O-ring may comprise an elastomeric material; the puck may further include a first bearing positioned on one side of the supporting disc and a second bearing positioned on an opposite side of the supporting disc; the system may further include a holder, the holder may have a central cavity defined by holder sidewalls and a holder passageway extending through the holder sidewalls, the holder passageway may extend in a direction transverse to and offset from the vertical axis, and the puck may be positioned in the central cavity and configured to rotate about the vertical axis relative to the holder; the holder sidewalls may include a first holder sidewall positioned on one side of the central cavity and a second holder sidewall positioned on an opposite side of the central cavity, and the holder passageway may include a first holder passageway portion extending though the first holder sidewall and a second holder passageway portion extending though the second holder sidewall; the system may further include a signal emitter and a signal detector, the signal emitter may be positioned at one end of the holder passageway and the signal detector may be positioned at an opposite end of the holder passageway; and the signal emitter may be coupled to the first holder sidewall and the signal detector may be coupled to the second holder sidewall.

(5) Various embodiments of the disclosed system may, additionally or alternatively, also include one of more of the following features: the puck may be configured to rotate about the vertical axis relative to the holder to bring the puck passageway into alignment with the holder passageway such that a signal from the signal emitter is received by the signal detector when a receptacle is not seated in the puck; the system may further include a first sensor coupled to the holder, the first sensor may be configured to detect when the puck has rotated to a predetermined position in the holder; the first sensor may be a Hall effect sensor; the system may further include an electric motor coupled to the supporting disc of the puck via a belt; the supporting disc of the puck may include a flange projecting from the base in a direction opposite the disc sidewall, and the belt may be engaged with the flange of the supporting disc; the system may further include a label reader configured to read data encoded in a machine-readable label on a receptacle seated in the puck; the label reader may be a barcode reader, and the machine-readable label may be a barcode; the system may further include a carriage configured to move from a first location to a second location of the instrument, and the holder may be coupled to the carriage; the disc sidewall of the puck may include multiple sidewall segments spaced apart from each other and arranged around the pocket, the multiple sidewall segments may include a first sidewall segment positioned on one side of the pocket and a second sidewall segment positioned on an opposite side of the pocket, and the puck passageway may include a first puck passageway portion extending through the first sidewall segment and a second puck passageway portion extending through the second sidewall segment; each first cavity of the plurality of first cavities of the puck may be positioned in a space formed between two adjacent sidewall segments of the multiple sidewall segments; when a receptacle is seated in the puck, the pocket of the supporting disc may receive a bottom portion of the receptacle; the plurality of fingers may consist of four fingers; each of the plurality of fingers may include anodized aluminum; each of the plurality of fingers may include anodized aluminum coated with polytetrafluoroethylene or a fluoropolymer; the one or more springs may couple the plurality of fingers together such that, when a receptacle is inserted in a space between the contact surfaces of the plurality of fingers, the one or more springs stretch to allow the contact surfaces to move away from the vertical axis and increase the space between the contact surfaces; a longitudinal axis of the

puck passageway may be offset from the vertical axis; and the longitudinal axis of the puck passageway may be offset from the vertical axis by a distance of from about 3 mm to about 6 mm.
(6) In some embodiments, a receptacle delivery system for an instrument is disclosed. The disclosed system may include a carriage supporting a puck. The carriage may be configured to move with the puck from a first location to a second location within an instrument of the plurality of instruments. The first location may be a location where a receptacle supported by the carrier is configured to be transferred to the puck supported by the carriage. And, the second location may be a location where fluid from the receptacle seated in the puck is configured to be drawn into a tip associated with a fluid extraction device of the instrument.
(7) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the puck may be configured to rotate relative to the carriage about a vertical axis of the puck; the system may further include a label reader configured to read information encoded in a machine-readable label on the receptacle seated in the puck when the carriage is positioned at the first location; the system may further include a sensing system coupled to the carriage, the sensing system may be configured to determine whether a receptacle is seated in the puck; the sensing system may be configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to a vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth; the puck may include a first passageway that extends transverse to and is offset from a vertical axis of the puck, and the carriage may include a second passageway that extends transverse to and is offset from the vertical axis of the puck; the sensing system may include a signal emitter and a signal detector, and when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways; the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; the system may further include a conveyor extending adjacent to each of a plurality of instruments; the system may further include a carrier configured to support a receptacle containing a fluid and move on the conveyor while the receptacle is supported by the carrier; the system may further include a pick and place device configured to transfer a receptacle from the carrier to the puck; the system may further include a rail, and the carriage may be configured to move on the rail from the first location to the second location; the system may further include a first electric motor operatively coupled to the carriage and configured to move the carriage from the first location to the second location; the fluid extraction device may be a pipettor; the carriage may further include a support mechanism configured to selectively apply a force on the receptacle when the carriage is positioned at the second location to prevent extraction of the receptacle from the puck, when the tip associated with the fluid extraction device is withdrawn from the receptacle; the puck may include a plurality of spring-loaded members configured to removably support the receptacle therebetween.
(8) In some embodiments, a method of delivering a receptacle to an instrument is disclosed. The method may include supporting a receptacle containing a fluid on a carrier, transporting the carrier supporting the receptacle on a conveyor extending adjacent to each of a plurality of instruments, transferring the receptacle from the carrier to a puck supported on a carriage when the carriage is positioned at a first location, moving the carriage with the receptacle seated in the puck from the first location to a second location within an instrument of the plurality of instruments, and drawing at least a portion of the fluid from the receptacle seated in the puck into a tip associated with a fluid extraction device of the instrument when the carriage is positioned at the second location.
(9) Various embodiments of the disclosed method may, additionally or alternatively, include one or more of the following features: rotating the puck relative to the carriage about a vertical axis of the puck; using a label reader to read information encoded in a machine-readable label on the receptacle seated in the puck when the carriage is positioned at the first location; determining if the receptacle is seated in the puck; if it is determined that the receptacle is seated in the puck, then using a sensing system to detect (a) whether a longitudinal axis of the receptacle seated in the puck

is inclined with respect to a vertical axis of the puck, and/or (b) whether the receptacle seated in the puck is inserted to a desired depth; the puck may include a first passageway that extends transverse to and is offset from a vertical axis of the puck, and the carriage may include a second passageway that extends transverse to and is offset from the vertical axis of the puck, and using the sensing system may include rotating the puck to align the first and second passageways; the sensing system may include a signal emitter and a signal detector, and when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck; the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; transferring the receptacle from the carrier to the puck may be performed with a pick and place device having a plurality of arms for releasably grasping the receptacle; moving the carriage may include operating an electric motor to move the carriage on a rail from the first location to the second location; the fluid extraction device may be a pipettor; the method may further include selectively applying a force on the receptacle when the carriage is positioned at the second location, and the force is not applied to the receptacle when the carriage is positioned at the first location; and transferring the receptacle from the carrier to the puck may include removably supporting the receptacle between a plurality of spring-loaded members of the puck.

(10) In some embodiments, a receptacle delivery system for an instrument is disclosed. The disclosed system may include a carriage configured to move from a first location to a second location, a puck coupled to the carriage, and a receptacle clamping mechanism. The puck may be configured to removably support a receptacle therein. The receptacle clamping mechanism may include a pair of opposed support pads configured to be (a) in contact with a receptacle seated in the puck when the carriage is positioned at the second location, and (b) separated from the receptacle when the carriage is positioned at the first location.

(11) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the pair of support pads may be configured to move toward each other as the carriage moves from the first location to the second location and move away from each other as the carriage moves from the second location to the first location; a pair of meshed gears coupled to the pair of support pads, wherein, when the carriage moves from the first location to the second location, the pair of meshed gears rotate in opposite directions relative to each other to move the pair of support pads toward each other; a pair of actuator arms, wherein each actuator arm of the pair of actuator arms may be coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears; a cam arm, wherein one end of the cam arm may be coupled to a gear of the pair of meshed gears and an opposite end of the cam arm may be configured to move on a downwardly inclined path when the carriage moves from the first location to the second location; the opposite end of the cam arm may include a roller configured to roll on the inclined path when the carriage moves from the first location to the second location; (a) a cam arm having a first end coupled to a first gear of the pair of meshed gears and a second end opposite the first end and (b) a ramp having an inclined surface extending substantially parallel to a path of the carriage from the first location to the second location, wherein when the carriage moves along the path between the first and second locations, the second end of the cam arm may move along the inclined surface to rotate the first gear; a cam arm configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location; and each support pad of the pair of support pads may include a contoured surface, and wherein the support pads face each other.

(12) Various embodiments of the disclosed system may, additionally or alternatively, also include one or more of the following features: each support pad of the pair of support pads may include a

substantially V-shaped groove, and wherein the support pads face each other; each support pad of the pair of support pads may include an elastomer; the elastomer may be selected from the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber; the receptacle clamping mechanism may further include one or more springs configured to bias the pair of support pads away from each other when the carriage is positioned at the first location; the pair of support pads may be configured to apply a clamping force to the receptacle when the carriage is positioned at the second location and not to apply a clamping force to the receptacle when the carriage is positioned at the first location; the pair of support pads may be configured to apply a clamping force of from about 10N to about 30N to the receptacle when the carriage is positioned at the second location; a first electric motor may be operatively coupled to the carriage and configured to move the carriage between the first location and the second location; a second electric motor may be operatively coupled to the puck and configured to rotate the puck in the carriage when the carriage is positioned at the first location; the carriage may further include a sensor configured to detect when the puck has rotated to a predetermined position in the carriage; the sensor may be a Hall effect sensor; a sensing system configured to detect whether a receptacle is seated in the puck; the puck may include a first passageway that extends transverse to and is offset from a vertical axis of the puck; a sensing system may be configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth in the puck; the puck may be rotatably supported in a housing of the carriage, and the housing may include a second passageway that extends transverse to and is offset from the vertical axis of the puck; and the sensing system may include a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck.

(13) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; when the first and second passageways are aligned, (a) the optical emitter may be configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector may be configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area is offset from a longitudinal axis of the receptacle; if a receptacle is properly seated in the puck, the incident area may be offset from the longitudinal axis of the receptacle by a distance from about 3 mm to about 6 mm; if a receptacle is properly seated in the puck, the incident area is offset from a base of the receptacle by a distance from about 3 mm to about 8 mm; the signal emitter and the signal detector may be coupled to the carriage; a first shelf may be attached to the carriage and a second shelf may be positioned at the second location, wherein when the carriage is positioned at the second location, the first shelf may be positioned below the second shelf; when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf may be from about 1 mm to about 6 mm; the second shelf may define a first opening, and wherein when the carriage is positioned at the second location, the first opening may be aligned with a receptacle seated in the puck, such that a tip associated with a fluid extraction device of the instrument is moveable through the first opening and into the receptacle; the first opening may be an inwardly extending recess defined by a side wall of the second shelf; a label reader configured to read information encoded in a machine-readable label on the receptacle when the carriage is positioned at the first location; a rail, wherein the carriage is configured to move on the rail between the first and second locations; a pick-and-place device configured to transfer a receptacle to the puck from a location outside the instrument; the pick-and-place device may be configured to transfer a receptacle to the puck from a receptacle carrier supported on a receptacle

delivery conveyor, wherein the receptacle delivery conveyor is configured to transport the receptacle carrier supporting the receptacle to locations adjacent multiple instruments; the puck may include a plurality of spring-loaded members configured to removably support a receptacle therebetween.

(14) In some embodiments, a method of delivering a receptacle to an instrument is disclosed. The method may include supporting a receptacle in a carriage, activating an electric motor to move the carriage between a first location and a second location of the instrument while the receptacle is supported by the carriage, applying a clamping force to the receptacle as the carriage moves from the first location to the second location, and releasing the clamping force from the receptacle as the carriage moves from the second location to the first location. In some embodiments, applying a clamping force to the receptacle as the carriage moves from the first location to the second location means that the clamping force is applied to receptacle when the carriage is in the process of moving from the first to second location. Similarly, in some embodiments, releasing the clamping force from the receptacle as the carriage moves from the second location to the first location means that the clamping force is released from the receptacle when the carriage is in the process of moving from the second to the first location.

(15) Various embodiments of the disclosed method may, additionally or alternatively, include one or more of the following features: applying the clamping force may include applying a force of from about 10N to about 30N to the receptacle; applying the clamping force to the receptacle may include moving a pair of support pads into contact with the receptacle as the carriage moves from the first location to the second location; releasing the clamping force may include moving the pair of contact pads away from the receptacle as the carriage moves from the second location to the first location; applying the clamping force and releasing the clamping force may each include rotating a pair of meshed gears coupled to the pair of support pads in opposite directions relative to each other as the carriage moves between the first and second locations; rotating the pair of meshed gears may include (a) rotating a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotating the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location; rotating the pair of meshed gears may include (a) moving a first end of a cam arm on a downwardly inclined path when the carriage moves from the first location to the second location and (b) moving the first end on an upwardly inclined surface when the carriage moves from the second location to the first location, wherein a second end of the cam arm is coupled to a gear of the pair of meshed gears; supporting the receptacle in the carriage may include removably supporting the receptacle in a rotatable puck positioned in the carriage; removably supporting the receptacle may include positioning the receptacle between a plurality of spring-loaded members of the puck, and the method may further include transferring the receptacle to the puck from a receptacle delivery system using a pick-and-place device; the electric motor may be a first electric motor, and the method may further include activating a second electric motor to rotate the puck in the carriage when the carriage is positioned at the first location; the method may further include using a sensor to detect when the puck has rotated to a predetermined position in the carriage; and using a label reader to read information encoded in a machine-readable label on the receptacle as the puck is rotating; using a sensing system associated with the carriage to detect (a) whether a longitudinal axis of the receptacle supported by the puck is inclined with respect to a vertical axis of the puck, and/or (b) whether the receptacle supported by the puck is inserted to a desired depth in the puck; the puck may be rotatably supported in a housing of the carriage, wherein the puck includes a first passageway that extends transverse to a vertical axis of the puck, and the housing includes a second passageway that extends transverse to the vertical axis of the puck.

(16) Various embodiments of the disclosed method may, additionally or alternatively, include one

or more of the following features: the sensing system may include a signal emitter and a signal detector, wherein when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck; the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal is an optical beam; using the sensing system may include directing the optical beam from the optical emitter toward the optical detector, wherein the receptacle seated in the puck is at least partially positioned between the optical emitter and the optical detector, and determining what portion of the optical beam, if any, is received by the optical detector; directing the optical beam may include directing at least a portion of the optical beam on an incident area of an external surface of the receptacle seated in the puck; when the receptacle is properly seated in the puck, the incident area may be offset from the vertical axis of the puck by a distance of from about 3 mm to about 6 mm; when the receptacle is properly seated in the puck, the incident area may be offset from the base of the receptacle by a distance of from about 3 mm to about 8 mm; activating the electric motor may include positioning the carriage at the second location such that a first shelf attached to the carriage is positioned below a second shelf coupled to the instrument and positioned at the second location; the second shelf may be removably coupled to the instrument at the second location; when the carriage is positioned at the second location, the first shelf may be vertically spaced apart from the second shelf by a distance from about 1 mm to about 6 mm; positioning the carriage at the second location may include positioning the carriage such that a first opening formed in the second shelf is positioned above, and aligned with, the receptacle, and the method may further include directing a tip associated with a fluid extraction device of the instrument through the first opening and into the receptacle, thereby contacting a fluid contained in the receptacle; and aspirating an aliquot of the fluid into the tip; after aspirating the aliquot of the fluid into the tip, removing the tip from the receptacle to a position above the first opening; the receptacle may include a pierceable cap that covers an opening of the receptacle, and wherein (i) directing the tip into the receptacle may include piercing the cap with the tip, and (ii) removing the tip from the receptacle may include moving the tip through the pierced cap.

(17) Various embodiments of the disclosed method may, additionally or alternatively, include one or more of the following features: after removing the tip from the receptacle, moving the tip to a position above a top surface of the second shelf; after moving the tip to the position above the top surface of the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm from the top surface of the shelf; after moving the tip to the position above the top surface of the second shelf, moving the tip to trace a predefined path along the surface of the second shelf after the lowering; moving the tip to trace the predefined path comprises moving the tip around an upwardly extending projection on the top surface of the second shelf; after moving the tip to trace the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf; removing the tip from above the top surface of the second shelf may include moving the tip through the second opening without changing a vertical position of the tip above the surface; a portion of the fluid is suspended from the tip when removing the tip from the receptacle, and wherein at least a portion of the fluid suspended from the tip is deposited onto the top surface of the second shelf while moving the tip to trace the path; after moving the tip to the position above the top surface of the second shelf, a portion of the fluid suspended from the tip when removing the tip from the receptacle is suspended from the second shelf beneath the first opening; activating the electric motor may further include moving the carriage from the second location to the first location after moving the tip to trace the predefined path, thereby cleaving at least a portion of the fluid suspended from the second shelf and depositing the cleaved fluid on a top surface of the first shelf; decoupling the second shelf from the instrument; removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument; coupling the second shelf to the instrument

after removing at least a portion of the fluid deposited on the top surface of the second shelf; and removing at least a portion of the fluid deposited on the top surface of the first shelf after moving the carriage from the second location to the first location.

(18) In some embodiments, a receptacle delivery system for an instrument is disclosed. The disclosed system may include a carriage, a puck rotatably supported by the carriage, a first electric motor configured to move the carriage between a first location and a second location of the instrument, and a second electric motor configured to rotate the puck about the vertical axis. The puck may include a plurality of spring-loaded fingers arranged around a vertical axis and configured to removably support a receptacle therebetween.

(19) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: an O-ring biases the plurality of fingers toward the vertical axis of the puck; the O-ring may be comprised of an elastomer; the elastomer may be selected from the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber; each finger of the plurality of fingers may include a top portion that is configured to contact the receptacle and a base portion that extends substantially transverse to the top portion, the base portion of each finger may be rotatably coupled to a supporting disc of the puck at a pivot point; the base portion of each finger of the plurality of fingers may be configured to rotate about the associated pivot point; the top portion of each finger of the plurality of fingers may include an inclined surface, and the inclined surfaces of the plurality of fingers may be arranged in a funnel-like configuration with respect to the vertical axis; the plurality of fingers may include four equally spaced-apart fingers; each of the plurality of fingers may include anodized aluminum at least partially coated with PTFE (polytetrafluoroethylene); a sensor configured to detect when the puck has rotated to a predetermined position in the carriage; the sensor may be a Hall effect sensor; a sensing system may be configured to detect whether a receptacle is seated in the puck; the puck may include a first passageway that extends transverse to and is offset from the vertical axis of the puck; a sensing system may be configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is insert to a desired depth in the puck; the puck may be rotatably supported in a housing of the carriage, and the housing may include a second passageway that extends transverse to and is offset from the vertical axis of the puck; the sensing system may include a signal emitter and a signal detector, and when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck; the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; and when the first and second passageways are aligned, (a) the optical emitter may be configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector may be configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area may be offset from a longitudinal axis of the receptacle; when a receptacle is properly seated in the puck, the incident area may be offset from the vertical axis of the puck by a distance from about 3 mm to about 6 mm; when a receptacle is properly seated in the puck, the incident area may be offset from a base of the receptacle by a distance from about 3 mm to about 8 mm; the signal emitter and the signal detector may be coupled to the carriage.

(20) In some embodiments, a receptacle delivery system for an instrument is disclosed. The disclosed system may include a carriage configured to move on a rail from a first location to a second location of the instrument. The carriage may include a bracket having opposed first and second sidewalls and a base extending between the first and second sidewalls. The carriage may be configured to support a receptacle. The carriage may also include a pair of opposed support pads and a pair of meshed cam gears rotatably coupled to the first sidewall. The pair of support pads may be configured to (a) move toward a receptacle supported by the carriage as the carriage moves

from the first location toward the second location, and (b) move away from a receptacle supported by the carriage as the carriage moves from the second location toward the first location. And, each cam gear of the pair of meshed cam gears may be coupled to a different support pad of the pair of support pads.

(21) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the bracket may be substantially U-shaped; the second sidewall of the bracket may include an elongated slot aligned with a receptacle supported by the carriage, and the carriage may include a label reader configured to read information encoded in a machine-readable label on the receptacle through the elongated slot when the carriage is positioned at the first location; the carriage may further include a rotatable puck comprising a plurality of spring-loaded fingers configured to support the receptacle therebetween, and the puck may be coupled to the bracket below the base such that the plurality of fingers extend into a space between the first and second sidewalls of the bracket through an opening in the base; a first electric motor may be operatively coupled to the puck and configured to rotate the puck in the carriage when the carriage is positioned at the first location; a sensor may be configured to detect when the puck has rotated to a predetermined position in the carriage; the sensor may be a Hall effect sensor; the carriage may further include a pair of actuator arms, and each actuator arm of the pair of actuator arms may be coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears; and the carriage may further include (a) a cam arm having a first end and a second end, and (b) a ramp having an inclined surface extending substantially parallel to the rail, wherein the first end of the cam arm is coupled to a gear of the pair of meshed gears and the second end of the cam arm is configured to move on the inclined surface of the ramp as the carriage moves between the first and second locations.

(22) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the second end of the cam arm may include a roller configured to roll on the inclined surface when the carriage moves between the first and second locations; the cam arm may be configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location; each support pad of the pair of support pads may include a contoured surface; each support pad of the pair of support pads may include a substantially V-shaped groove; each support pad of the pair of support pads may include an elastomer; the elastomer may be selected form the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber; one or more springs may be configured to bias the pair of support pads away from each other when the carriage is positioned at the first location; the pair of support pads may be configured to apply a clamping force of from about 10N to about 30N to a receptacle supported by the carriage when the carriage is positioned at the second location; a second electric motor may be operatively coupled to the carriage and configured to move the carriage between the first and second locations; the carriage may further include a sensing system configured to detect whether a receptacle is properly supported seated in the puck; the puck may include a first passageway that extends transverse to and is offset from a vertical axis of the puck; a sensing system may be configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth in the puck; the puck may be rotatably supported in a housing of the carriage, and the housing may include a second passageway that extends transverse to and is offset from the vertical axis of the puck; and the sensing system may include a signal emitter and a signal detector, and when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck.

(23) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; when the first and second passageways are aligned, (a) the optical emitter may be configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector may be configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area may be offset from a longitudinal axis of the receptacle; if a receptacle is properly seated in the puck, the incident area may be offset from the longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm; if a receptacle is properly seated in the puck, the incident area may be offset from a base of the receptacle by a distance of from about 3 mm to about 8 mm; the signal emitter and the signal detector may be coupled to the carriage; a first shelf may be attached to the carriage and a second shelf may be positioned at the second location, wherein when the carriage is positioned at the second location, the first shelf may be positioned below the second shelf; when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf may be from about 1 mm to about 6 mm; the second shelf may define a first opening, and wherein when the carriage is positioned at the second location, the first opening may be aligned with a receptacle supported by the carriage, such that a tip associated with a fluid extraction device of the instrument is moveable through the first opening and into the receptacle.
(24) In some embodiments, a receptacle delivery system for an instrument is disclosed. The disclosed system may include a carriage configured to move from a first location of the instrument to a second location of the instrument, a puck supported by the carriage, and a first shelf positioned at the second location of the instrument. The puck may be configured to removably support a receptacle such that a longitudinal axis of the receptacle is substantially coincident with a vertical axis of the puck. The shelf may include (a) a base extending substantially transverse to the vertical axis of the puck and (b) a first opening defined by the base. When the carriage is positioned at the second location, the longitudinal axis of a receptacle seated in the puck may extend through the first opening.
(25) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the shelf may be removably coupled to a housing of the instrument; the shelf may be removably coupled to the housing of the instrument using one or more magnets; the one or more magnets may include a pair of corresponding magnets, and wherein the shelf may include a first projection extending upward from the base, and the housing of the instrument may include a second projection, the first projection may contain a first magnet of the pair of magnets and the second projection may contain a second magnet of the pair of magnets; a top surface of the base may include a passageway defined by an interior projection extending upward from the top surface the base and a sidewall circumscribing the base; the sidewall may include a second opening, the second opening may be sized to permit the lateral passage of a distal end of a pipette tip; the shelf and the housing may include mated registration elements configured to correctly align the shelf on the instrument; the mated registration elements may include a third opening on the shelf and third projection coupled to the housing, wherein the third projection extends through the third opening when the second shelf is coupled to the housing; a shape of an outer surface of the third projection may generally conform to a shape of the third opening; the third projection of the housing may include a first recess located at an end of the third projection, and the shelf may include a fourth projection positioned proximate the third opening, and wherein when the second shelf is coupled to the housing, the fourth projection may be positioned in the first recess; the surface of the shelf may include a recessed thumb grip; the carriage may include a second shelf coupled to a top surface of the carriage; the second shelf may include a recessed region configured to contain a fluid; the second shelf may be removably coupled to the top surface of the carriage; and when the carriage is positioned at the second location, a vertical clearance between the first

shelf and the second shelf may be from about 1 mm to about 6 mm.

(26) In some embodiments, a receptacle clamping mechanism of an instrument is disclosed. The system may include a carriage configured to move between a first location and a second location of the instrument. The carriage may include (a) one or more support members configured to removably support a receptacle therebetween, and (b) a pair of opposed support pads configured to apply a clamping force to a receptacle supported by the carriage as the carriage moves from the first location to the second location and release the clamping force from the receptacle as the carriage moves from the second location to the first location. The system may also include a sensing system configured to determine whether a receptacle is properly supported by the carriage.

(27) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: the sensing system may be configured to determine (a) whether a longitudinal axis of a receptacle supported by the carriage is inclined with respect to a vertical axis, and/or (b) whether a receptacle supported by the carriage is inserted to a desired depth; the sensing system may include a signal emitter and a signal detector positioned at two ends of a linear axis, and wherein when a receptacle is properly supported by the carriage, the linear axis (a) passes through a sidewall of the receptacle and (b) is offset from the longitudinal axis of the receptacle; the signal emitter may be an optical emitter and the signal detector may be an optical detector; wherein (a) the optical emitter may be configured to direct an optical beam on an incident area on an external surface of a receptacle supported by the carriage and (b) the optical detector may be configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not supported by the carriage, wherein when a receptacle is properly supported by the carriage, the incident area is offset from a longitudinal axis of the receptacle; when a receptacle is properly supported by the carriage, the incident area may be offset from a longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm; when a receptacle is properly supported by the carriage, the incident area may be offset from a base of the receptacle by a distance of from about 3 mm to about 8 mm; the signal emitter and the signal detector may be coupled to the carriage; the pair of support pads may be configured to be (a) in contact with a receptacle supported by the one or more support members when the carriage is positioned at the second location, and (b) separated from the receptacle when the carriage is positioned at the first location; the pair of support pads may be configured to move toward each other as the carriage moves from the first location to the second location and move away from each other as the carriage moves from the second location to the first location; and a pair of meshed gears may be coupled to the pair of support pads, wherein when the carriage moves from the first location to the second location, the pair of meshed gears may rotate in opposite directions relative to each other to move the pair of support pads toward each other; further include a pair of actuator arms, wherein each actuator arm of the pair of actuator arms may be coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears.

(28) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: further include a cam arm, wherein one end of the cam arm may be coupled to a gear of the pair of meshed gears and an opposite end of the cam arm may be configured to move on a downwardly inclined path when the carriage moves from the first location to the second location; the opposite end of the cam arm may include a roller configured to roll on the inclined path when the carriage moves from the first location to the second location; the cam arm may be configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location; each support pad of the pair of support pads may include a contoured surface or a V-shaped groove; each support pad of the pair of support pads may include an elastomer; the elastomer may be selected from the group consisting of silicon, EPDM (ethylene

propylene diene monomer), and rubber; further include one or more springs configured to bias the pair of support pads away from each other when the carriage is positioned at the first location; the pair of support pads may be configured to apply a clamping force of from about 10N to about 30N to a receptacle supported by the one or more support members when the carriage is positioned at the second location.

(29) In some embodiments, a method of delivering a receptacle to an instrument is disclosed. The method includes supporting a receptacle in a carriage when the carriage is positioned at a first location of the instrument, activating a sensing system coupled to the carriage to confirm that the receptacle is supported by the carriage, moving the carriage and the receptacle supported therein to a second location of the instrument, applying a clamping force to the receptacle as the carriage moves from the first location to the second location, at the second location, extracting at least a portion of a fluid contained in the receptacle using a fluid extraction device of the instrument, moving the carriage and the receptacle supported therein from the second location to the first location, and releasing the clamping force from the receptacle as the carriage moves from the second location to the first location.

(30) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: further comprising using the sensing system to determine (a) whether a longitudinal axis of the receptacle supported by the carriage is inclined with respect to a vertical axis, and/or (b) whether the receptacle supported by the carriage is inserted to a predetermined depth; applying the clamping force may include applying a force of from about 10N to about 30N to the receptacle; applying the clamping force to the receptacle may include moving a pair of opposed support pads into contact with the receptacle as the carriage moves from the first location to the second location; releasing the clamping force may include moving the pair of support pads away from the receptacle as the carriage moves from the second location to the first location; applying the clamping force and releasing the clamping force may each include rotating a pair of meshed gears coupled to the pair of support pads in opposite directions relative to each other as the carriage moves between the first and second locations; rotating the pair of meshed gears may include (a) rotating a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotating the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location; rotating the pair of meshed gears may include (a) moving a first end of a cam arm on a downwardly inclined path when the carriage moves from the first location to the second location and (b) moving the first end of the cam arm on an upwardly inclined surface when the carriage moves from the second location to the first location, and wherein a second end of the cam arm is coupled to a gear of the pair of meshed gears; supporting the receptacle in the carriage may include removably supporting the receptacle in a rotatable puck positioned in the carriage; and removably supporting the receptacle may include positioning the receptacle between a plurality of spring-loaded members of the puck, and wherein the method may further include transferring the receptacle to the puck from a conveyor located outside of the instrument using a pick-and-place device.

(31) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: rotating the puck in the carriage when the carriage is positioned at the first location; using a sensor to detect when the puck has rotated to a predetermined position in the carriage; using a label reader to read information encoded in a machine-readable label on the receptacle as the puck is rotating; activating the sensing system may include directing a signal from a signal emitter toward a signal detector, wherein the receptacle supported by the carriage is positioned between the signal emitter and the signal detector, and determining what portion of the signal, if any, is received by the signal detector; directing the signal may include directing at least a portion of the signal on an incident area of an external surface of the receptacle supported by the

carriage; the signal emitter may be an optical emitter, the signal detector may be an optical detector, and the signal may be an optical beam; when the receptacle is properly supported by the carriage, the incident area may be offset from a longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm; when the receptacle is properly supported by the carriage, the incident area may be offset from the base of the receptacle by a distance of from about 3 mm to about 8 mm; moving the carriage, and the receptacle supported therein, to the second location may include positioning the carriage at the second location such that (a) at least a portion of the carriage is positioned below a second shelf of the instrument positioned at the second location and (b) the receptacle is positioned below a first opening defined by the second shelf; moving the carriage, and the receptacle supported therein, to the second location may include positioning the carriage at the second location such that (a) a first shelf coupled to the carriage is positioned below a second shelf removably coupled to the instrument at the second location and (b) the receptacle is aligned with a first opening defined by the second shelf; when the carriage is positioned at the second location, the first shelf may be vertically spaced apart from the second shelf by a distance of from about 1 mm to about 6 mm; extracting at least a portion of the fluid from the receptacle may include directing a tip associated with the fluid extraction device through the first opening and into the receptacle to contact the fluid contained in the receptacle; extracting at least a portion of the fluid from the receptacle may include drawing at least a portion of the fluid into the tip; after drawing at least a portion of the fluid into the tip, removing the tip from the receptacle to a position above the first opening; the receptacle may include a pierceable cap that covers an opening of the receptacle, and wherein (i) directing the tip into the receptacle may include piercing the cap with the tip, and (ii) removing the tip from the receptacle may include moving the tip through the pierced cap; after removing the tip from the receptacle, laterally moving the tip to a position above the second shelf; after laterally moving the tip to the position above the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm above a top surface of the second shelf; after laterally moving the tip to a position above the second shelf, moving the tip along a predefined path above the top surface of the second shelf; and moving the tip along the predefined path may include moving the tip around a projection extending upward from the top surface of the second shelf; after moving the tip along the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf.

(32) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: a portion of the fluid extracted from the receptacle is suspended from the tip prior to moving the tip along the predefined path, and wherein at least a portion of the fluid suspended from the tip is deposited on the top surface of the second shelf while moving the tip along the predefined path; at least a portion of the fluid suspended from the tip prior to moving the tip along the predefined path is suspended from the second shelf beneath the first opening after moving the tip along the predefined path; moving the carriage, and the receptacle supported therein, from the second location to the first location may include cleaving at least a portion of the fluid suspended from the second shelf directly beneath the first opening and depositing the cleaved fluid onto a top surface of a first shelf supported by the carriage as the carriage moves from the second location to the first location; decoupling the second shelf from the instrument; removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument; coupling the second shelf to the instrument after removing at least a portion of the fluid deposited on the top surface of the second shelf; removing at least a portion of the fluid deposited on the first shelf after moving the carriage to the first location; removing the receptacle from the carriage using a pick-and-place device after releasing the clamping force from the receptacle.

(33) In some embodiments, a method of delivering a receptacle to an instrument is disclosed. The method may include positioning a carriage at a first location of the instrument, wherein the carriage may include a rotatable puck and may be configured to move from the first location to a second

location of the instrument. The puck may be configured to seat a receptacle therein. The method may also include rotating the puck in the carriage about a vertical axis to position the puck in a desired rotational position, determining whether a receptacle is seated in the puck using a first sensor, and if it is determined that a receptacle is not seated in the puck, calibrating a sensing system. The sensing system may be configured to determine whether a receptacle is seated in the puck. The method may further include, after calibrating the sensing system, seating a receptacle in the puck, after seating the receptacle in the puck, using the sensing system to determine whether the receptacle is properly seated in the puck, and after determining that the receptacle is properly seated in the puck, moving the carriage from the first location to the second location.

(34) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: determining whether the receptacle is properly seated in the puck may include determining (a) whether a longitudinal axis of the receptacle seated in the puck is inclined with respect to the vertical axis, and/or (b) whether the receptacle seated in the puck is inserted to a desired depth; the puck may include a first passageway that extends transverse to and is offset from the vertical axis of the puck, and the carriage may include a second passageway that extends transverse to and is offset from the vertical axis of the puck, and calibrating the sensor assembly may include rotating the puck to align the first and second passageways; the sensing system may include a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector may be configured to receive a signal from the signal emitter through the aligned first and second passageways; the signal emitter may be an optical emitter, and the signal detector may be an optical detector, and the method may further include performing luminance calibration of an optical beam from the optical emitter after aligning the first and second passageways; the first sensor may be a label reader of the instrument, and determining whether a receptacle is seated in the puck may include using the label reader to detect a label on the carriage, the label may be positioned at a location that is not in a line of sight of the label reader if a receptacle is seated in the puck; rotating the puck to position the puck in a desired rotational position may include stopping rotation of puck when a Hall effect sensor indicates that the puck is at the desired rotational position; moving the carriage from the first location to the second location may include positioning the carriage at the second location such that a first shelf attached to the carriage is positioned below a second shelf positioned at the second location; positioning the carriage at the second location may include positioning the carriage at the second location such that the first shelf is vertically spaced apart from the second shelf by a distance of from about 1 mm to about 6 mm; positioning the carriage at the second location may include positioning the carriage such that the receptacle seated in the puck is positioned below and aligned with a first opening defined by the second shelf; directing a tip associated with a fluid extraction device of the instrument through the first opening and into the receptacle to contact a fluid contained in the receptacle; drawing at least a portion of the fluid into the tip; after drawing at least a portion of the fluid into the tip, removing the tip from the receptacle to a position above the first opening; and the receptacle may include a pierceable cap that covers an opening of the receptacle, and (i) directing the tip into the receptacle may include piercing the cap with the tip, and (ii) removing the tip from the receptacle may include moving the tip through the pierced cap.

(35) Various embodiments of the disclosed system may, additionally or alternatively, include one or more of the following features: after removing the tip from the receptacle, laterally moving the tip to a position above the second shelf; after laterally moving the tip to the position above the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm above a top surface of the shelf; after laterally moving the tip to a position above the second shelf, moving the tip along a predefined above the top surface of the second shelf; moving the tip along the predefined path may include moving the tip around a projection extending upward from the top surface of the second shelf; after moving the tip along the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf; a portion of

the fluid drawn from the receptacle may be suspended from the tip prior to moving along the predefined path, and at least a portion of the fluid suspended from the tip may be deposited on the top surface of the second shelf while moving the tip along the predefined path; at least a portion of the fluid suspended from the tip prior to moving the tip along the predefined path may be suspended from the second shelf directly beneath the first opening after moving the tip along the predefined path; moving the carriage from the second location to the first location after moving the tip along the predefined path; moving the carriage from the second location to the first location may include cleaving at least a portion of the fluid suspended from the second shelf beneath the first opening and depositing the cleaved fluid onto a top surface of the first shelf as the carriage moves from the second location to the first location; decoupling the second shelf from the instrument; removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument; coupling the second shelf to the instrument after removing at least a portion of the fluid deposited on the top surface of the second shelf; and removing at least a portion of the fluid deposited on the top surface of the first shelf after moving the carriage to the first location.

(36) In some embodiments, a method for providing a fluid to an instrument located adjacent a conveyor for transporting receptacles between a plurality of modules is disclosed. The method may include the steps of (a) supporting a sample receptacle in an upright orientation on a first carrier, (b) transporting the first carrier on a conveyor extending adjacent to each of a plurality of modules, at least one of the modules being an analytical instrument, (c) stopping the first carrier at a position adjacent the analytical instrument, (d) after step (c), and while the first carrier remains on the conveyor, removing the sample receptacle from the first carrier and transporting the sample receptacle to a pick-up position of the analytical instrument, (e) transporting the sample receptacle from the pick-up position to a pipetting station located within the analytical instrument, (f) at the pipetting station, aspirating a fluid contained within the sample receptacle and transferring the aspirated fluid to a reaction receptacle supported by the analytical instrument, (g) after aspirating the fluid from the sample receptacle, transporting the sample receptacle from the pipetting station to the pick-up position, (h) removing the sample receptacle from the pick-up position and transporting the sample receptacle to a second carrier located on the conveyor adjacent the analytical instrument, the second carrier supporting the sample receptacle in an upright orientation, (i) in the analytical instrument, performing an assay with the aspirated fluid, thereby determining the presence or absence of an analyte in the aspirated fluid, and (j) transporting the second carrier supporting the sample receptacle on the conveyor to one or more of the plurality of modules other than the analytical instrument.

(37) Various embodiments of the disclosed method may, additionally or alternatively, include one of more of the following aspects: the first carrier may be a puck having a cylindrically shaped base and a pocket formed in a top surface of the base for seating the sample receptacle; the puck may have a plurality of upwardly extending fingers for supporting the sample receptacle in the upright orientation; the conveyor may comprise a stationary track for supporting the first carrier during step (b); the first carrier may be propelled on the track by a magnetic attraction between the first carrier and the conveyor; the analytical instrument may be an instrument for performing nucleic acid-based amplification reactions; step (c) may be performed with a stop element operationally associated with the conveyor, and wherein the stop element may be actuated from an open position allowing passage of the first carrier on the conveyor to a closed position during step (c), the stop element immobilizing the first carrier in the closed position; the sample receptacle may be removed from the first carrier and transported to the pick-up position with a gripper apparatus; the method may also include the step of determining whether the height and orientation of the sample receptacle is acceptable; a receptacle holder supported by a carriage may receive the sample receptacle at the pick-up position in step (d); the pick-position may be located outside of a housing of the analytical instrument; the carriage may transport the sample receptacle from the pick-up

position and to the pipetting station in step (d); the method may further comprise the step of securing the sample receptacle in the carriage as the sample receptacle is transported from the pick-up position to the pipetting station, thereby impeding vertical movement of the sample receptacle; the first carrier and the second carrier may be the same carrier; the assay may comprise exposing the sample to reagents and conditions for performing a nucleic acid-based amplification reaction.

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## Description

DESCRIPTION OF THE DRAWINGS

(1) The accompanying drawings, which are incorporated herein and form part of the specification, illustrate various, non-limiting embodiments of the present disclosure. Where appropriate, reference numerals illustrating like structures, components, materials and/or elements in different drawings are labeled similarly. It should be understood that various combinations of the structures, components, and/or elements, other than those specifically shown in these drawings, are contemplated and are within the scope of the present disclosure.

(2) For simplicity and clarity of illustration, the drawings depict the general structure and/or manner of construction of the described embodiments, as well as associated methods of manufacture. Well-known features (e.g., fasteners, electrical connections, control systems, etc.) are not shown in these drawings (and are not described in the corresponding description for brevity) to avoid obscuring other features, since these features are well known to those of ordinary skill in the art. The features in the drawings are not necessarily drawn to scale. The dimensions of some features may be exaggerated relative to other features to improve understanding of the exemplary embodiments. Cross-sectional views are simplifications provided to help illustrate the relative positioning of various features. One skilled in the art would appreciate that the cross-sectional views are not drawn to scale and should not be viewed as representing proportional relationships between different features. It should be noted that, even if it is not specifically mentioned, aspects and features described with reference to one embodiment may also be applicable to, and may be used with, other embodiments.

(3) FIG. **1**A is a schematic illustration of an exemplary automated laboratory that includes a conveyor and shuttles.

(4) FIG. **1**B is an illustration of a portion of FIG. **1**A in more detail;

(5) FIG. **1**C illustrates a robotic arm of a pick-and-place device transferring a receptacle from the conveyor to the shuttle of FIG. **1**A, in an exemplary embodiment.

(6) FIGS. **2**A-**2**J illustrate different views of an exemplary conveyor of FIG. **1**A.

(7) FIGS. **3**A-**3**E illustrate different views of an exemplary shuttle of FIG. **1**A.

(8) FIGS. **4**A-**4**G illustrate different views of an exemplary carriage of the shuttle of FIGS. **3**A-**3**E.

(9) FIGS. **5**A-**5**K illustrate different views of an exemplary puck of the carriage of FIGS. **4**A-**4**E.

(10) FIGS. **6**A-**6**J illustrate optical sensors being used to detect proper seating of a receptacle in the carriage of FIGS. **4**A-**4**E, in an exemplary embodiment.

(11) FIGS. **7**A-**7**C illustrate an initialization procedure for the carriage of FIGS. **4**A-**4**E, in an exemplary embodiment.

(12) FIGS. **8**A-**8**B illustrate an exemplary receptacle clamping mechanism of the carriage of FIGS. **4**A-**4**E.

(13) FIG. **9**A illustrates the shuttle of FIGS. **3**A-**3**E with a primary mucoid shelf removed, in an exemplary embodiment.

(14) FIG. **9**B illustrates an exemplary primary mucoid shelf that may be attached to the shuttle of FIG. **9**A.

(15) FIGS. **10**A and **10**B illustrate a pipettor having an associated pipette tip, in an exemplary embodiment.

(16) FIG. **10**C illustrates the pipette tip of the pipettor of FIGS. **10**A-**10**B positioned in an exemplary capped receptacle.
(17) FIGS. **11**A-**11**D illustrate a pipette tip attached to a pipettor aspirating a fluid from a receptacle positioned in the carriage of FIGS. **4**A-**4**E, in an exemplary embodiment.
(18) FIG. **12** illustrates an exemplary secondary mucoid shelf that may be attached to the carriage of FIGS. **4**A-**4**E.
(19) FIG. **13**A illustrates an exemplary multi-receptacle unit (MRU) of an instrument of FIG. **1**A.
(20) FIG. **13**B illustrates an exemplary cap/vial assembly of an instrument of FIG. **1**A.

## DETAILED DESCRIPTION

(21) Unless defined otherwise, all terms of art, notations and other scientific terms or terminology used herein have the same meaning as is commonly understood by one of ordinary skill in the art to which this disclosure belongs. All patents, applications, published applications and other publications referred to herein are incorporated by reference in their entirety. If a definition set forth in this disclosure is contrary to, or otherwise inconsistent with, a definition in these references, the definition set forth in this disclosure prevails over the definitions that are incorporated herein by reference. None of the references described or referenced herein is admitted to be prior art to the current disclosure.
(22) References in the specification to “one embodiment,” “an embodiment,” a “further embodiment,” “an example embodiment,” “some aspects,” “a further aspect,” “aspects,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, such feature, structure, or characteristic is also a description in connection with other embodiments whether or not explicitly described. As used herein, “a” or “an” means “at least one” or “one or more.”
(23) As used herein, “sample” refers to any substance suspected of containing at least one analyte of interest. The analyte of interest may be, for example, a nucleic acid, a protein, a prion, a chemical, or the like. The substance may be derived from any source, including an animal, an industrial process, the environment, a water source, a food product, or a solid surface (e.g., surface in a medical facility). Substances obtained from animals may include, for example, blood or blood products, urine, mucous, sputum, saliva, semen, tears, pus, stool, nasopharyngeal or genitourinary specimen obtained with a swab or other collective device, and other bodily fluids or materials. The term “sample” will be understood to mean a specimen in its native form or to any stage of processing.
(24) As used herein, a “receptacle” refers to any type of fluid container, including, for example, a tube, vial, cuvette, cartridge, microtiter plate, etc., that is configured to contain a sample or another fluid (collectively referred to herein as fluid). Non-limiting examples of exemplary receptacles include, for example, Aptima® urine specimen transport tube, Aptima® specimen transfer tube, BD Vacutainer®, etc.
(25) As used herein, the term “instrument” refers to any apparatus that may be used with the disclosed shuttle. As used herein, an “instrument” includes, among others, analyzers capable of analyzing a sample. For example, an instrument may be an analyzer capable of performing a nucleic acid-based detection assay, a sequencing assay, an immunoassay, or chemistry assay on a sample. Non-limiting examples of such “instruments” include automated analyzers such as, for example, the Tigris®, Panther®, and Panther Fusion® systems sold by Hologic, Inc., Marlborough, Mass. As used herein, an “instrument” also includes an apparatus that is used to transfer sample material from one receptacle to another receptacle without processing or analyzing the sample. Non-limiting examples of such “instruments” include the Tomcat® instrument sold by Hologic, Inc., Marlborough, Mass.

(26) As used herein, the term “robotic arm” refers to an electromechanical device that translates a payload (such as a receptacle) in the X, Y, and/or Z directions. In an embodiment, a robotic arm includes a receptacle gripper (such as, for example, a pick-and-place claw) that can be used to pick and move a receptacle from one location to another.
(27) As used herein, the term “conveyor” refers to a mechanical apparatus for transporting articles (e.g., receptacles) from one location to another along a defined path. Non-limiting examples of exemplary conveyors include robots, belts (such as, for example, a moving belt, a shuttle/carriage moving on a track, rail, belt, etc.), magnetic devices, gear systems, cable systems, vacuum systems, automated cars with wheels, etc.
(28) As used herein, “assay” refers to a procedure for detecting and/or quantifying an analyte in a sample. A sample comprising or suspected of comprising the analyte is contacted with one or more reagents and subjected to conditions permissive for generating a detectable signal informative of whether the analyte is present or the amount (e.g., mass or concentration) of analyte in the sample.
(29) As used herein, the term “analytical instrument” refers to an automated instrument that is capable of performing one or more steps of an assay, including the step of determining the presence or absence of one or more analytes suspected of being present in a fluid sample.
(30) With reference to nucleic acids, the term “extraction” is used herein to refer to the recovery of a nucleic acid molecule (e.g., DNA or RNA of any form) from a sample comprising non-nucleic acid components, such as the native environment of the nucleic acid molecule, a partially purified sample, or a crude sample (i.e., a sample that is in substantially the same form as it was upon being obtained from its source). Extraction can result in substantially purified nucleic acid molecules or nucleic acid molecules that are in a more pure form than in the pre-extraction sample and can be used to obtain such molecules for use in analytical procedures from samples comprising biological material, such as cells (including cells isolated directly from a source or cultured), blood, urine, mucus, semen, saliva, or tissue (e.g., a biopsy). Many extraction methods are available. In various embodiments, extraction may comprise one or more of cell lysis, removal of insoluble material such as by centrifugation or filtration, chromatography, precipitation of nucleic acids, or capture of nucleic acids with capture probes.
(31) As used herein, “analyte” refers to a molecule present or suspected of being present in a sample and which is targeted for detection in an assay. Exemplary types of analytes include biological macromolecules such as nucleic acids, polypeptides, and prions.
(32) As used herein, “nucleic acid” and “polynucleotide” refer to a multimeric compound comprising nucleosides or nucleoside analogs which have nitrogenous heterocyclic bases or base analogs linked together to form a polynucleotide, including conventional RNA, DNA, mixed RNA-DNA, and polymers that are analogs thereof. A nucleic acid “backbone” can be made up of a variety of linkages, including one or more of sugar-phosphodiester linkages, peptide-nucleic acid bonds (“peptide nucleic acids” or PNA; International Publication No. WO 95/32305), phosphorothioate linkages, methylphosphonate linkages, or combinations thereof. Sugar moieties of a nucleic acid can be ribose, deoxyribose, or similar compounds with substitutions, e.g., 2′ methoxy or 2′ halide substitutions. Nitrogenous bases can be conventional bases (A, G, C, T, U), analogs thereof (e.g., inosine or others; see The Biochemistry of the Nucleic Acids 5-36, Adams et al., ed., 11th ed., 1992), derivatives of purines or pyrimidines (e.g., N4-methyl guanine, N6-methyladenine, deaza- or aza-purines, deaza- or aza-pyrimidines, pyrimidine bases with substituent groups at the 5 or 6 position (e.g., 5-methylcytosine), purine bases with a substituent at the 2, 6, or 8 positions, 2-amino-6-methylaminopurine, O6-methylguanine, 4-thio-pyrimidines, 4-amino-pyrimidines, 4-dimethylhydrazine-pyrimidines, and O4-alkyl-pyrimidines; U.S. Pat. No. 5,378,825 and International Publication No. WO 93/13121). Nucleic acids can include one or more “abasic” residues where the backbone includes no nitrogenous base for position(s) of the polymer (U.S. Pat. No. 5,585,481). A nucleic acid can comprise only conventional RNA or DNA sugars, bases and linkages, or can include both conventional components and substitutions (e.g., conventional bases

with 2′ methoxy linkages, or polymers containing both conventional bases and one or more base analogs). Nucleic acid includes "locked nucleic acid" (LNA), an analogue containing one or more LNA nucleotide monomers with a bicyclic furanose unit locked in an RNA mimicking sugar conformation, which enhance hybridization affinity toward complementary RNA and DNA sequences (Vester and Wengel, 2004, Biochemistry 43(42):13233-41). Embodiments of oligomers that can affect stability of a hybridization complex include PNA oligomers, oligomers that include 2′-methoxy or 2′-fluoro substituted RNA, or oligomers that affect the overall charge, charge density, or steric associations of a hybridization complex, including oligomers that contain charged linkages (e.g., phosphorothioates) or neutral groups (e.g., methylphosphonates). Methylated cytosines such as 5-methylcytosines can be used in conjunction with any of the foregoing backbones/sugars/linkages including RNA or DNA backbones (or mixtures thereof) unless otherwise indicated. RNA and DNA equivalents have different sugar moieties (i.e., ribose versus deoxyribose) and can differ by the presence of uracil in RNA and thymine in DNA. The differences between RNA and DNA equivalents do not contribute to differences in homology because the equivalents have the same degree of complementarity to a particular sequence. It is understood that when referring to ranges for the length of an oligonucleotide, amplicon, or other nucleic acid, that the range is inclusive of all whole numbers (e.g., 19-25 contiguous nucleotides in length includes 19, 20, 21, 22, 23, 24, and 25).
(33) As used herein, "nucleic acid amplification" or simply "amplification" refers to any in vitro procedure that produces multiple copies of a target nucleic acid sequence, or its complementary sequence, or fragments thereof (i.e., an amplified sequence containing less than the complete target nucleic acid). Amplification methods include, for example, replicase-mediated amplification, polymerase chain reaction (PCR), ligase chain reaction (LCR), strand-displacement amplification (SDA), helicase-dependent amplification (HDA), transcription-mediated amplification (TMA), and nucleic acid sequence-based amplification (NASBA). TMA and NASBA are both forms of transcription-based amplification. Replicase-mediated amplification uses self-replicating RNA molecules, and a replicase such as QB-replicase (see, e.g., U.S. Pat. No. 4,786,600). PCR uses a DNA polymerase, pairs of primers, and thermal cycling to synthesize multiple copies of two complementary strands of dsDNA or from a cDNA (see, e.g., U.S. Pat. Nos. 4,683,195, 4,683,202, and 4,800,159). LCR uses four or more different oligonucleotides to amplify a target and its complementary strand by using multiple cycles of hybridization, ligation, and denaturation (sec, e.g., U.S. Pat. Nos. 5,427,930 and 5,516,663). SDA uses a primer that contains a recognition site for a restriction endonuclease and an endonuclease that nicks one strand of a hemimodified DNA duplex that includes the target sequence, whereby amplification occurs in a series of primer extension and strand displacement steps (see, e.g., U.S. Pat. Nos. 5,422,252, 5,547,861, and 5,648,211). HDA uses a helicase to separate the two strands of a DNA duplex generating single-stranded templates, followed by hybridization of sequence-specific primers hybridize to the templates and extension by DNA polymerase to amplify the target sequence (see, e.g., U.S. Pat. No. 7,282,328). Transcription-based amplification uses a DNA polymerase, an RNA polymerase, deoxyribonucleoside triphosphates, ribonucleoside triphosphates, a promoter-containing oligonucleotide, and optionally can include other oligonucleotides, to ultimately produce multiple RNA transcripts from a nucleic acid template. Examples of transcription-based amplification are described in U.S. Pat. Nos. 4,868,105, 5,124,990, 5,130,238, 5,399,491, 5,409,818, and 5,554,516; and in International Publication Nos. WO 88/01302, WO 88/10315 and WO 95/03430. Amplification may be either linear or exponential.
(34) As used herein, "oligomer" or "oligonucleotide" refers to a nucleic acid of generally less than 1,000 nucleotides (nt), including those in a size range having a lower limit of about 2 to 5 nt and an upper limit of about 500 to 900 nt. Some particular embodiments are oligomers in a size range with a lower limit of about 5 to 15, 16, 17, 18, 19, or 20 nt and an upper limit of about 50 to 600 nt, and other particular embodiments are in a size range with a lower limit of about 10 to 20 nt and an

upper limit of about 22 to 100 nt. Oligomers can be purified from naturally occurring sources, but can be synthesized by using any well-known enzymatic or chemical method. Oligomers can be referred to by a functional name (e.g., capture probe, primer or promoter primer) but those skilled in the art will understand that such terms refer to oligomers. Oligomers can form secondary and tertiary structures by self-hybridizing or by hybridizing to other polynucleotides. Such structures can include, but are not limited to, duplexes, hairpins, cruciforms, bends, and triplexes. Oligomers may be generated in any manner, including chemical synthesis, DNA replication, reverse transcription, PCR, or a combination thereof. In some embodiments, oligomers that form invasive cleavage structures are generated in a reaction (e.g., by extension of a primer in an enzymatic extension reaction).

(35) As used herein, “amplicon” or “amplification product” refers to a nucleic acid molecule generated in a nucleic acid amplification reaction and which is derived from a target nucleic acid. An amplicon or amplification product contains a target nucleic acid sequence that can be of the same or opposite sense as the target nucleic acid. In some embodiments, an amplicon has a length of about 100-2000 nucleotides, about 100-1500 nucleotides, about 100-1000 nucleotides, about 100-800 nucleotides, about 100-700 nucleotides, about 100-600 nucleotides, or about 100-500 nucleotides.

(36) As used herein, “primer” refers to an oligomer that hybridizes to a template nucleic acid and has a 3′ end that is extended by polymerization. A primer can be optionally modified, e.g., by including a 5′ region that is non-complementary to the target sequence. Such modification can include functional additions, such as tags, promoters, or other sequences that may be used or useful for manipulating or amplifying the primer or target oligonucleotide. Examples of primers incorporating tags, or tags and promoter sequences, are described in U.S. Pat. No. 9,284,549. A primer modified with a 5′ promoter sequence can be referred to as a “promoter-primer.” A person of ordinary skill in the art of molecular biology or biochemistry will understand that an oligomer that can function as a primer can be modified to include a 5′ promoter sequence and then function as a promoter-primer, and, similarly, any promoter-primer can serve as a primer with or without its 5′ promoter sequence.

(37) As used herein, “detection oligomer” or “detection probe” refers to an oligomer that interacts with a target nucleic acid to form a detectable complex. A probe's target sequence generally refers to the specific sequence within a larger sequence (e.g., gene, amplicon, locus, etc.) to which the probe specifically hybridizes. A detection oligomer can include target-specific sequences and a non-target-complementary sequence. Such non-target-complementary sequences can include sequences which will confer a desired secondary or tertiary structure, such as a flap or hairpin structure, which can be used to facilitate detection and/or amplification (e.g., U.S. Pat. Nos. 5,118,801, 5,312,728, 6,835,542, 6,849,412, 5,846,717, 5,985,557, 5,994,069, 6,001,567, 6,913,881, 6,090,543, and 7,482,127; International Publication Nos. WO 97/27214 and WO 98/42873; Lyamichev et al., Nat. Biotech., 17:292 (1999); and Hall et al., PNAS, USA, 97:8272 (2000)). Probes of a defined sequence can be produced by techniques known to those of ordinary skill in the art, such as by chemical synthesis, and by in vitro or in vivo expression from recombinant nucleic acid molecules.

(38) As used herein, “label” or “detectable label” refers to a moiety or compound that is detected or leads to a detectable signal. The label may be joined directly or indirectly to a probe or it may be, for example, an intercalating dye (e.g., SYBR® Green). Direct joining can use covalent bonds or non-covalent interactions (e.g., hydrogen bonding, hydrophobic or ionic interactions, and chelate or coordination complex formation), whereas indirect joining can use a bridging moiety or linker (e.g., via an antibody or additional oligonucleotide(s). Any detectable moiety can be used, e.g., radionuclide, ligand such as biotin or avidin, enzyme, enzyme substrate, reactive group, chromophore such as a dye or particle (e.g., latex or metal bead) that imparts a detectable color, luminescent compound (e.g. bioluminescent, phosphorescent, or chemiluminescent compound),

and fluorescent compound (i.e., fluorophore). Embodiments of fluorophores include those that absorb light (e.g., have a peak absorption wavelength) in the range of 495 to 690 nm and emit light (e.g., have a peak emission wavelength) in the range of 520 to 710 nm, which include those known as FAM®, TET®, HEX®, CAL FLUOR® (Orange or Red), CY®, and QUASAR® compounds. Fluorophores can be used in combination with a quencher molecule that absorbs light when in close proximity to the fluorophore to diminish background fluorescence. Such quenchers are well known in the art and include, e.g., BLACK HOLE QUENCHER® (or BHQ®), Blackberry Quencher® (or BBQ-650®), Eclipse®, or TAMRA™ compounds. Particular embodiments include a "homogeneous detectable label" that is detectable in a homogeneous system in which bound labeled probe in a mixture exhibits a detectable change compared to unbound labeled probe, which allows the label to be detected without physically removing hybridized from unhybridized labeled probe (e.g., U.S. Pat. Nos. 5,283,174, 5,656,207, and 5,658,737). Exemplary homogeneous detectable labels include chemiluminescent compounds, including acridinium ester ("AE") compounds, such as standard AE or AE derivatives which are well known (U.S. Pat. Nos. 5,656,207, 5,658,737, and 5,639,604). Methods of synthesizing labels, attaching labels to nucleic acid, and detecting signals from labels are known (e.g., Sambrook et al., Molecular Cloning, A Laboratory Manual, 2nd ed. (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N Y, 1989) at Chapt. 10, and U.S. Pat. Nos. 5,658,737, 5,656,207, 5,547,842, 5,283,174, 5,585,481, 5,639,604, and 4,581,333, and European Patent No. 0 747 706). Other detectably labeled probes include FRET cassettes, TaqMan® probes, and probes that undergo a conformational change in the presence of a targeted nucleic acid, such as molecular torches and molecular beacons. FRET cassettes are described in U.S. Patent Application Publication No. 2005/0186588 and U.S. Pat. No. 9,096,893. TaqMan® probes include a donor and acceptor label wherein fluorescence is detected upon enzymatically degrading the probe during amplification in order to release the fluorophore from the presence of the quencher. Chemistries for performing TaqMan assays are described in PCT Application No. PCT/US2018/024021, filed Mar. 23, 2018, and U.S. Pat. No. 5,723,591. Molecular torches and beacons exist in open and closed configurations wherein the closed configuration quenches the fluorophore and the open position separates the fluorophore from the quencher to allow a change in detectable fluorescent signal. Hybridization to target opens the otherwise closed probes. Molecular torches are described in U.S. Pat. No. 6,361,945; and molecular beacons are described in U.S. Pat. No. 6,150,097.

(39) As used herein, "target capture" or "a target capture procedure" refers to a procedure for immobilizing a target analyte on a solid support and purifying the analyte by removing potential inhibitors of an amplification reaction (e.g., heparin, proteins, and heme).

(40) "Capture probe," "target capture probe," "capture oligonucleotide," "capture oligomer," "target capture oligomer," and "capture probe oligomer" are used interchangeably herein to refer to a nucleic acid oligomer that hybridizes to a target sequence in a target nucleic acid by standard base pairing and joins to a binding partner on an immobilized probe to capture the target nucleic acid to a support. In one embodiment, "target capture" refers to a process in which a target nucleic acid is purified or isolated by hybridization to a capture probe. In another embodiment, "target capture" refers to direct immobilization of a target nucleic acid on a solid support. One example of a capture probe includes two binding regions: a sequence-binding region (e.g., target-specific portion) and an immobilized probe-binding region, usually on the same oligomer, although the two regions may be present on two different oligomers joined together by one or more linkers. Another embodiment of a capture probe uses a target-sequence binding region that includes random or non-random poly-GU, poly-GT, or poly U sequences to bind non-specifically to a target nucleic acid and link it to an immobilized probe on a support.

(41) As used herein, "molecular assay" refers to a procedure for specifically detecting and/or quantifying a target molecule, such as a target nucleic acid. A sample comprising or suspected of comprising the target molecule is contacted with one or more reagents, including at least one

reagent specific for the target molecule, and subjected to conditions permissive for generating a detectable signal informative of whether the target molecule is present. For example, where the molecular assay is PCR, the reagents include primers specific for the target and the generation of a detectable signal can be accomplished at least in part by providing a labeled probe that hybridizes to the amplicon produced by the primers in the presence of the target. Alternatively, the reagents can include an intercalating dye for detecting the formation of double-stranded nucleic acids.

(42) As used herein, “reagent” refers to any substance or combination thereof that participates in a molecular assay, other than sample material and products of the assay. Exemplary reagents include nucleotides, enzymes, amplification oligomers, probes, and salts.

(43) This description may use relative spatial and/or orientation terms in describing the position and/or orientation of a component, apparatus, location, feature, or a portion thereof. Unless specifically stated, or otherwise dictated by the context of the description, such terms, including, without limitation, top, bottom, above, below, under, on top of, upper, lower, left of, right of, inside, outside, inner, outer, proximal, distal, in front of, behind, next to, adjacent, between, horizontal, vertical, diagonal, longitudinal, transverse, etc., are used for convenience in referring to such component, apparatus, location, feature, or a portion thereof in the drawings and are not intended to be limiting. Further, relative terms such as, for example, “about,” “substantially,” “approximately,” etc., are used to indicate a possible variation of ±10% in a stated numeric value or range.

(44) FIG. **1**A is a schematic illustration of an exemplary automated laboratory with a conveyor system **3000** configured to transport receptacles containing specimens or samples (e.g., fluids) to different instruments in the laboratory. Conveyor system **3000** includes a conveyor **300** that extends between (i.e., extends adjacent to) multiple instruments **1000**, **1010**, **1020**, etc. positioned in the laboratory. In some embodiments, as illustrated in FIG. **1**A, these multiple instruments may include analyzer modules or analytical instruments **1000**, a loading module **1010**, an unloading module **1020**, a capping module **1030**, a de-capping module **1040**, a receptacle storage module **1050**, and an aliquoting module **1060**. It should be noted that the specific instruments and the layout of conveyor **300** illustrated in FIG. **1**A are only exemplary. In general, any number and type of instruments may be arranged (e.g., adjacent to conveyor **300**) in the laboratory, and conveyor **300** may be arranged in any configuration adjacent to some or all of these instruments. Conveyor **300** is configured to transport receptacles **50** containing fluids (e.g., specimens, samples, etc.) to the multiple instruments **1000-1060** in the laboratory.

(45) The loading module **1010** serves as an input through which trays of receptacles **50** (e.g., 50 to 100 receptacles per each tray) containing fluids can be manually loaded by an operator through a loading bay of loading module **1010**. Once a tray of receptacles **50** has been provided to a loading bay of loading module **1010**, the receptacles **50** may be automatically transferred from loading module **1010** onto the automated conveyor **300** to be subsequently acted upon by the other instruments (e.g., some or all of instruments **1000**, **1020-1060**) in the laboratory in accordance with the workflows for the receptacles. The unloading module **1020** serves to receive capped receptacles **50** having contents that were extracted and processed by one or more of the analytical instruments **1000** (e.g., analyzer modules). The capped receptacles **50** can be transferred from conveyor **300** of the automated conveyor system **3000** to racks contained in a bay located within a housing of unloading module **1020**. After sufficiently filling the racks with capped receptacles **50**, an operator can manually remove the racks from the bay of unloading module **1020**. The de-capping module **1040** is configured for removing caps from closed, specimen-containing receptacles **50** prior to processing the specimens in one or more of the analytical instruments **1000**. The capping module **1030** is configured for coupling (e.g., inserting or attaching) caps **56** (see FIG. **5**C) (e.g., replacement caps or stoppers (e.g., plugs or septums)) to open-ended receptacles **50** after extracting specimen from the receptacles in one or more of the analytical instruments **1000** and, in many instances, prior to transferring the receptacles **50** to the receptacle storage module **1050** or the unloading module **1020**. Exemplary capping and de-capping modules **1030**, **1040** are described in

U.S. Pat. Nos. 6,321,619 and 7,152,504. The aliquoting module **1060** transfers one or more aliquots of the fluid contained in a parent receptacle **50** to a child receptacle **50** (possibly along with other child receptacles). An exemplary aliquoting module **1060** is the Tomcat® instrument sold by Hologic, Inc., Marlborough, Mass. An exemplary aliquoting module **1060** is described in U.S. Pat. No. 9,335,336. Each analyzer module or analytical instrument **1000** is configured for processing specimens contained in selected receptacles **50**, e.g., by performing analytical tests on the specimens. Such tests may include molecular tests (e.g., nucleic acid-based assays), sequencing assays, immunoassays, chemistry analyses, etc. Exemplary analytical instruments **1000** include automated analyzers such as, e.g., the Tigris®, Panther®, and Panther Fusion® systems sold by Hologic, Inc., Marlborough, Mass. The receptacle storage module **1050** is configured for storing receptacles **50**. In some cases, receptacle storage module **1050** may be configured for storing completed receptacles **50** (i.e., receptacles containing fluids or specimens for which the workflow has been completed) for subsequent manual removal from the receptacle storage module **1050** by an operator. In other cases, receptacle storage module **1050** may be configured for storing non-completed receptacles **50** (i.e., receptacles containing specimens for which the workflow has not been completed) in a controlled environment for subsequent processing by the other modules.

(46) With reference to FIG. **1**A, conveyor system **3000** may also include a work management system (WMS) software module **1070** configured for coordinating workflow and high-level receptacle traffic in conveyor **300**. WMS software module **1070** can be conceptualized as a minimum cloud database that maintains the status of all receptacles **50** and instruments **1000-1060** in the automated specimen processing system, and controls assay specific workflows for the receptacles. In particular, the WMS software module **1070** identifies assays to be run for the specimen in any particular receptacle **50** based on encoded information read by a barcode reader (not shown) of the loading module **1010**, and generates an assay specific work flow, including pre-analytical and post-analytical steps, such as, e.g., de-capping, aliquoting, capping, centrifuging, storage, repeat testing, reflex testing, additional testing, etc. Conveyor system **3000** may also include a conveyor controller **1080** configured for controlling the low-level functions of the automated conveyor system **3000**, such as transporting the receptacle carriers, along with the supporting specimen-containing receptacles (i.e., the occupied receptacle carriers), between the various instruments of laboratory. Thus, the conveyor controller **1080** controls which instruments **1000-1060** the occupied receptacle carriers will be diverted to and which instruments the occupied receptacle carriers will bypass. Conveyor controller **1080** may direct a receptacle carrier towards an instrument **1000-1060** by controlling the position of a gate **3010** on conveyor **300**. With reference to FIG. **1**B, when gate **3010** is positioned in a first position (the position shown in FIG. **1**B), carriers **400** moving on conveyor **300** will be diverted towards analytical instrument **1000**, and when gate **1010** is positioned in a second position (the position shown using dashed lines in FIG. **1**B), the carriers **400** moving on conveyor **300** will bypass analytical instrument **1000**. Conveyor controller **1080** may also be configured for controlling low-level error handling and basic display of information. The conveyor controller **1080** is also configured for managing communication between the various instruments of the automated specimen processing system and the WMS software module **1070**.

(47) In some embodiments, a receptacle **50** may be transported on conveyor **300** between the different instruments **1000-1060** supported in a carrier **400** (see, for example, FIG. **2**B). In some embodiments, each carrier **400** may support a single receptacle **50**. It is also contemplated that, in some embodiments, a single carrier may support multiple receptacles **50**. In general, carrier **400** may have any configuration. In some embodiments, carrier **400** may have a configuration/structure generally similar to puck **100** (e.g., see FIG. **5**A) discussed later. Exemplary carriers that may be used on conveyor **300** are described in U.S. Pat. Nos. 7,485,264, 8,147,778, and 10,041,965, and U.S. Patent Application Nos. 2006/0222573, 2017/0153262, 2017/0248623, and 2018/0052183.

(48) With reference to FIG. **1**B, some or all of the multiple instruments **1000-1060** (e.g., analytical

instrument **1000**) may include a shuttle **16** configured to transport a receptacle **50** from a location proximate conveyor **300** to a location within instrument **1000**. Shuttle **16** includes a carriage **20** that travels between a first location (e.g., a receptacle pick-up location or a first end **22**) positioned proximate conveyor **300** to a second location (e.g., a pipetting location or a second end **24**) located within instrument **1000** along a path. It should be noted that first end **22** may be a location within instrument **1000** or a location outside instrument **1000**. A pick-and-place device **600** may be configured to transfer receptacles **50** between carriage **20** of instrument **1000** and carrier **400** on conveyor **300**. With reference to FIGS. **1**B and **1**C, pick-and-place device **600** may have a robotic arm **660** with fingers or grasping members **662** configured to grasp and transfer a receptacle **50** from conveyor **300** to carriage **20** of shuttle **16** (and vice versa). Carriage **20** is configured to receive receptacle **50** from robotic arm **660** and transport receptacle **50** from first end **22** to second end **24**. When carriage **20** is positioned at second end **24** (see FIGS. **3**G and **10**A), a suitable fluid or sample extraction device (such as, for example, automated pipettor **150**) of instrument **1000**, removes at least an aliquot of the fluid from receptacle **50**. After a sufficient amount of the fluid is removed from receptacle **50**, carriage **20** transports receptacle **50** back to first end **22**. Grasping members **662** of robotic arm **660** may then pick receptacle **50** from carriage **20** and transfer receptacle **50** to a carrier (the same or a different carrier) positioned on conveyor **300**. Conveyor **300** may then transport the carrier with the transferred receptacle to another instrument or module **1000-1060** (e.g., receptacle storage module **1050** for temporarily holding receptacles **50** in a refrigerated state).

(49) It should be noted that although an exemplary embodiment where a robotic arm **660** having a two-fingered grasper with two grasping members **662**A and **662**B is illustrated in FIG. **1**C, this is not a requirement. In general, robotic arm **660** may include any number of grasping members of any suitable configuration. Additionally, although receptacle **50** is described as being physically transferred from conveyor **300** to shuttle **16**, this is not a requirement. In general, any type of pick-and-place device **600** having any suitable configuration of robotic arm **600** may be used to transfer receptacle **50** between conveyor **300** and shuttle **16**. In some embodiments, instead of physically transferring a receptacle **50** from conveyor **300** to shuttle **16**, fluid from a receptacle **50** supported by conveyor **300** (e.g., in a carrier **400**) may be transferred into a new receptacle supported by shuttle **16** (e.g., extracted from one receptacle and deposited into another receptacle by a sample or fluid extraction device). It should be noted that conveyor **300** described with reference to FIGS. **1**A-IC (and below with reference to FIGS. **2**A-**2**J) is only exemplary. In general, any suitable transport system configured to transport fluid containing receptacles between instruments in a laboratory may be used as conveyor **300**. Exemplary conveyor system **3000** and conveyors **300** that may be used include commercially available systems from FlexLink, Inpeco (Flexlab, FlexLab-HT, etc.), Integrated Drive Systems (e.g., IDS-CLAS-X1), Thermo Fisher Scientific, Hitachi, MagneMotion, GLP, etc.

(50) FIGS. **2**A-**2**J illustrate different views of an exemplary conveyor **300** extending adjacent to an instrument **1000** in an exemplary embodiment. With reference to FIG. **2**A, conveyor **300** extends by instrument **1000** such that, when carriage **20** of instrument **1000** is positioned at its first end **22**, carriage **20** is located proximate conveyor **300**. As explained previously, when carriage **20** is positioned at first end **22**, robotic arm **660** of pick-and-place device **600** can transfer a receptacle **50** from conveyor **300** to carriage **20**. FIG. **2**B illustrates multiple disc or puck-like carriers **400** approaching instrument **1000** on conveyor **300**. With reference to FIGS. **2**A and **2**B, conveyor **300** includes a track **310** that conveys (e.g., propels, moves, supports (as in the case of a self-propelled carrier), etc.) the multiple carriers **400** to and/or between different instruments **1000** in the laboratory. Carriers **400** transported on track **310** include carriers supporting receptacles **50** (e.g., carriers **400** with receptacles **50** containing fluids or samples, receptacles from which a portion of their samples have been removed for processing, and empty receptacles **50**) and carriers **400** that do not support receptacles **50** (e.g., carriers **400** from which receptacles **50** have been transferred to an

instrument **1000**). In general, conveyor **300** may propel or move the carriers **400** between modules along track **310** in any manner. In some embodiments, magnetic force may be used to move carriers **400** on track **310**. FIGS. **2**C and **2**D illustrate an exemplary embodiment of conveyor **300** that uses magnetic force to move carriers **400** thereon. FIG. **2**C illustrates a portion of conveyor **300** including track **310**, and FIG. **2**D illustrates the conveyor of FIG. **2**C with track **310** removed to show components positioned below track **310**. As best seen in FIG. **2**C, track **310** may be a substantially flat piece or strip of material supported, for example, by grooves formed on rails **312** positioned on either side of track **310**. Track **310** may be formed (in whole or in part) of any rigid material, such as, for example, metal (e.g., steel, aluminum, etc.), plastics (polyethylene, polypropylene, polyacetal, etc.), ceramics, rigid organic materials (e.g., wood, etc.), etc.

(51) As best seen in FIGS. **2**C and **2**D, carrier **400** may include a substantially cylindrical base **410** having a top surface **412** and a bottom surface **414**. Bottom surface **414** of base **410** may be supported on track **310** of conveyor **300**. Base **410** may also include a circumferential groove **416** positioned between its top and bottom surfaces **412**, **414**. Inwardly extending flanges **314** positioned on a top section of rails **312** may project into the circumferential groove **416** of base **410** to retain carrier **400** on conveyor **300** and, in some embodiments, prevent its accidental removal therefrom (e.g., when receptacle **50** is removed from carrier **400** by gripper **750** of pick-and-place device **600**). In some embodiments, bottom surface **414** of base **410** may rest on the top surface of track **310** when flanges **314** of rails **312** are positioned in groove **416** of base **410**. In some embodiments, bottom surface **414** of base **410** may not rest on, but may be positioned close to, the top surface of track **310** when flanges **314** are positioned in groove **416**. In the current disclosure, reference to base **410** being supported on track **310** (or carrier **400** supported on track **310**) is intended to refer to both an embodiment where bottom surface **414** of base **410** rests on (i.e., physically contacts) track **310** and an embodiment where bottom surface **414** of base **410** is suspended over and positioned in close proximity to the top surface of track **310**.

(52) Top surface **412** of base **410** includes a cavity or a pocket **430** configured to receive and support the base of a receptacle **50** therein. An annular flange **418** is attached to top surface **412** such that an inner opening of flange **418** aligns with pocket **430** of base **410**. A plurality of fingers **420** extend upward from flange **418**. The plurality of fingers **420** may be arranged, for example, in a circle around the inner opening of flange **418**. When the base of receptacle **50** is supported in pocket **430** of base **410**, the plurality of fingers **420** support receptacle **50** in an upright orientation on carrier **400** (sec FIGS. **2**B, **2**H). The plurality of fingers **420** are arranged to receive receptacle **50** in the space formed between them. When a receptacle **50** is inserted between fingers **420**, the fingers deflect radially outward to allow receptacle **50** to slide between fingers **420** and fit into pocket **430** of base **410**. The elastic restoring force of fingers **420** apply a radially inward force against the cylindrical wall of receptacle **50** and maintains receptacle **50** in an upright position between the plurality of fingers **420** (see FIGS. **2**B, **2**H). Fingers **420** may be made of any suitable material having elastic properties. It is also contemplated that, in some embodiments, fingers **420** of carrier **400** may be spring-loaded fingers similar to the fingers **102** of puck **100** that will be described later.

(53) A magnet (not shown) may be attached to, or embedded in, base **410** of carrier **400**. In some embodiments, the magnet may be attached to base **410** proximate its bottom surface **414**. Exemplary carriers that may be used on conveyor **300** are described in U.S. Provisional Application No. 62/891,728.

(54) Referring again to FIGS. **2**C and **2**D, conveyor **300** includes a cylindrical member **320** positioned below track **310** between rails **312**. As best seen in FIG. **2**D, cylindrical member **320** extends in the direction of travel of carrier **400** on conveyor **300**. During operation, a motor (not shown) rotates cylindrical member **320** via a gear **330** coupled to cylindrical member **320**. The cylindrical outer surface of cylindrical member **320** includes a ferromagnetic member **322** arranged helically around cylindrical member **320**. Ferromagnetic member **322** may be formed of any

ferromagnetic material and may be attached to cylindrical member **320** in any manner. In some embodiments a ferromagnetic material (e.g., iron) may be attached to a helical groove formed on the cylindrical outer surface of cylindrical member **320** to form ferromagnetic member **322**. In some embodiments, a strip of a ferromagnetic material may be attached to the cylindrical outer surface of cylindrical member **320** in a helical pattern to form ferromagnetic member **322**. When carrier **400** is supported on a top surface **310**A of track **410** (see FIG. **2**C), the magnet in base **410** of carrier **400** attracts the portion of ferromagnetic member **322** (on the cylindrical outer surface of cylindrical member **320**) that faces a bottom surface **310**B of track **310**. When cylindrical member **320** rotates, the portion of ferromagnetic member **322** that faces the bottom surface of track **310** appears to move in a linear direction along the length of track **310**, and the attractive force between the ferromagnetic member **322** and the magnet embedded in carrier **400** propels or moves the carrier along track **310**. Exemplary conveyors that may be used to propel carriers using magnetic attraction and carriers that may be used with such conveyors are described in U.S. Pat. Nos. 9,766,258 and 9,776,811.

(55) Conveyor **300** includes sensors configured to detect, among other things, a carrier **400** on track **310**. FIGS. **2**E and **2**F illustrate portions of conveyor **300** with exemplary sensors. These sensors may include, among others, one or more first sensors **710** (see first sensors **710**A, **710**B, **710**C in FIG. **2**E) and one or more second sensors **720** (see FIG. **2**F). Sensors **710** and **720** may include any type of sensor configured to detect a carrier **400** on track **310**. Although not a requirement, in some embodiments, one or both of first and second sensors **710**, **720** may be optical sensors. For example, with reference to FIG. **2**E, when a carrier **400** is positioned proximate to (e.g., at region of track **310** in front of) sensor **710**A, signal from this sensor may indicate (e.g., to conveyor controller **1080** (see FIG. **1**A) that controls the operation of conveyor **300**) the presence of carrier **400** at that location of track **310**. When carrier **400** moves on track **310** and is positioned proximate sensor **710**B, signals from sensor **710**B may indicate that carrier **400** is now proximate sensor **710**B. Thus, based on signals from sensors **710**A, **710**B, and **710**C, conveyor controller **1080** may identify the location of carriers **400** on conveyor **300**. In addition to detecting the presence of a carrier **400**, sensors positioned at some locations of conveyor **300** may also detect whether a receptacle **50** is supported on carrier **400**. For example, second sensor **720** (of FIG. **2**F) may include both a carrier sensor **720**A and a receptacle sensor **720**B. When a carrier **400** is positioned proximate sensor **720**, a signal from carrier sensor **720**A may indicate the presence of the carrier, and a signal from (or the lack of a signal from) receptacle sensor **720**B may indicate whether a receptacle **50** is supported on carrier **400**. Carrier sensor **720**A and receptacle sensor **720**B may include any type of sensor. In some embodiments, one or both of these sensors may be optical sensors, for example, substantially similar to first sensor **710**. In some embodiments, second sensor **720** may comprise a vertical post **722** with carrier sensor **720**A and receptacle sensor **720**B arranged at different heights thereon. Although not a requirement, in some embodiments, as illustrated in FIGS. **2**E and **2**F, first and second sensors **710**, **720** may be attached to rails **312** positioned alongside track **310**.

(56) As best seen in FIG. **2**E, track **310** may include a plurality of through-holes or cavities **350** (e.g., first cavity **350**A, second cavity **350**B, etc.). Stop elements **370** may be configured to selectively extend through respective cavities **350**. In some embodiments, conveyor controller **1080** may selectively activate a stop element **370** to extend through a selected cavity (e.g., second cavity **350**B) on track **310**. When activated, a stop element **370** protrudes out of second cavity **350**B such that a carrier **400** moving on track **310** is stopped, or blocked from further movement, by stop element **370**. And, when not activated, stop element **370** is positioned below the cavity on track **310** (see cavity **350**A). In some embodiments, as illustrated in FIGS. **2**E and **2**F, a sensor (e.g., first sensor **710**B of FIG. **2**E and second sensor **720** of FIG. **2**F) may be positioned proximate a cavity **350** such that, a carrier **400** stopped by a stop element **370** extending through the cavity is aligned with (e.g., positioned in a zone of detection of) the sensor. In some embodiments, when the sensor

is an optical sensor, the blocked carrier **400** may be positioned in a line-of-sight of the optical detectors of the optical sensor. With specific reference to FIG. **2**E, it should be noted that, because of the cylindrical shape of base **410** of carrier **400**, cavity **350**B may not be positioned directly in front of sensor **710**B. Instead, the horizontal spacing between sensor **710**B and cavity **350**B may be such that, when carrier **400** is stopped by a stop element **370** extending through cavity **350**B, carrier **400** (e.g., annular flange **418** of carrier **400**) is aligned with sensor **710**B. Similarly, with reference to FIGS. **2**F and **2**G, when carrier **400** is stopped proximate second sensor **720** by stop element **370** extending through cavity **350**, carrier sensor **720**A of second sensor **720** may be aligned with carrier **400** (e.g., annular flange **418** of carrier **400**), and receptacle sensor **720**B may be aligned with receptacle **50**, if any, supported by carrier **400**. In some embodiments, as illustrated in FIG. **2**G, when a carrier **400** is stopped by stop element **370**, the carriers moving on track **310** behind the stopped carrier **400** will collect behind and press against stopped carrier **400**. In some embodiments, with reference to FIG. **2**E, when a carrier **400** is stopped by a stop element **370** of cavity **350**B, the stop element of cavity **350**A may be activated to project out of cavity **350**A and block the carriers behind the stopped carrier **400**.

(57) As illustrated in FIG. **2**G, in some embodiments, conveyor **300** may include a gripper **750** positioned proximate a stop element **370**. Gripper **750** may include a grip head **752** that may be actuated by, for example, conveyor controller **1080**. For example, when a carrier **400** is stopped by stop element **370**, conveyor controller **1080** may activate gripper **750** to extend grip head **752** towards and apply a retention force on the stopped carrier **400** to restrain or immobilize the carrier **400**. In some embodiments, in its extended state, grip head **752** may press against and apply a retention force on annular flange **418** of carrier **400**. This retention force may immobilize the stopped carrier and aid in preventing vibrations. in the carrier **400** that can translate to the receptacle **50** supported thereby, especially when carriers **400** collect behind and, in some cases, press against the stopped carrier **400**. In some embodiments, the retention force applied by grip head **752** may also assist in retaining carrier **400** on track **310** when receptacle **50** is removed from carrier **400** by robotic arm **660** of pick-and-place device **600** (see FIG. **1**B). In some embodiments, grip head **752** may be made of an elastomeric or another relatively compliant material. In some embodiments, a front surface **754** of grip head **752** may be a curved surface (e.g., a concavely curved surface) to conform with the curved side surface of annular flange **418** that it presses against. Gripper **750** may be actuated by any suitable method (e.g., pneumatically, hydraulically, electrically, magnetically, electro-magnetically, etc.).

(58) In some embodiments, as illustrated in FIG. **2**G, gripper **750** may be positioned on a side of track **310** opposite to a sensor (e.g., second sensor **720** in FIG. **2**G). Although not a requirement, in some embodiments, second sensor **720** may be attached to a rail **312** on one side of track **310** and gripper **750** may be attached to rail **312** on the other side of track **310**. In some embodiments, stop element **370** (or cavity **350** from which stop element **370** extends), gripper **750**, and second sensor **720** may be positioned relative to each other such that, when carrier **400** is blocked by stop element **370**, grip head **752** contacts annular flange **418** (when actuated), and second sensor **720** is aligned with carrier **400** (e.g., carrier sensor **720**A is aligned with annular flange **418** of carrier **400** and receptacle sensor **720**B is aligned with receptacle **50** supported by carrier **400**).

(59) With reference to FIGS. **2**G and **2**H, in some embodiments, stop element **370**, second sensor **720**, and gripper **750** (see FIG. **2**G) may be positioned on a section of conveyor **300** located proximate to instrument **1000**. In some such embodiments, when a carrier **400** moving on track **310** is stopped by stop element **370**, immobilized by gripper **750**, and second sensor **720** detects that receptacle **50** is supported in carrier **400**, control unit **800** may direct robotic arm **660** of pick-and-place device **600** (see FIG. **2**A) to move to a position above receptacle **50** (see FIG. **2**H). With reference to FIG. **2**A, pick-and-place device **600** may be configured to move robotic arm **660** up and down (e.g., vertically in the Z direction) on a lead screw **670**, and side-to-side (e.g., horizontally in the X and/or Y directions) on a gantry (not shown). Grasping members **662**A, **662**B

of robotic arm **660** are also configured to move towards each other (e.g., to close the grasping members) to grasp a receptacle **50** between them, and to move away from each other (e.g., to open the grasping members) to release receptacle **50**. As is known in the art, in some embodiments, robotic arm **660** may be configured to monitor and/or control the amount of pressure applied by grasping-member **662**A, **662**B on receptacle **50**. In some embodiments, as best seen in FIGS. **2**A and **2**H, the surfaces of grasping members **662** that are configured to contact receptacle **50** may include a contact member **664** to reduce the likelihood of damage to receptacle **50**. In some embodiments, contact member **664** may include an elastomeric or other compliant material attached to grasping members **662**. An electric motor **680** may assist in the operations of robotic arm **660**. Since pick-and-place devices for grasping and moving receptacles, and their method of operation, are well known in the art, they are not described in detail herein.

(60) Referring to FIGS. **2**H-**2**J, with robotic arm **660** positioned above the restrained or immobilized carrier **400** on track **310** (see FIG. **2**H), electric motor **680** may operate to move robotic arm **660** downwards towards carrier **400** (e.g., in the −Z direction) and grasp receptacle **50** supported on carrier **400** with grasping members **662**. See FIG. **2**I. With receptacle **50** securely grasped by grasping members **662**, robotic arm **660** may move upwards (e.g., in the +Z direction) to lift receptacle **50** from between fingers **420** of carrier **400**. Sec FIG. **2**J. Robotic arm **660** may then move horizontally in the X and/or Y direction towards carriage **20** of instrument **1000** positioned at first end **22** of shuttle **16**. Robotic arm **660** may then move downwards towards carriage **20** to deposit receptacle **50** between the spring-loaded fingers **102** of puck **100** that is positioned on carriage **20** (as will be described in more detail below, for example, with reference to FIGS. **5**A-**5**D). Pick-and-place device **600** may also operate in a similar manner to transfer a receptacle **50** from carriage **20** of instrument **1000** back to a carrier **400** (the same or a different carrier) on conveyor **300**. For example, when carriage **20** with a receptacle **50** (e.g., a receptacle from which fluid or sample has been extracted by instrument **1000** for testing) is positioned at first end **22** of shuttle **16**, robotic arm **660** of pick-and-place device **600** may descend to grasp and pick up receptacle **50** from carriage **20** using its gasping-members **662**. With receptacle **50** secured between grasping members **662**, robotic arm **660** may move in the vertical (e.g., Z) and horizontal (e.g., X and/or Y) directions to transfer receptacle **50** to a carrier **400** positioned on conveyor **300**. In some embodiments, carrier **400** to which receptacle **50** is transferred to may also be secured by grip head **752** of gripper **750** as explained previously. Conveyor **300** may then transport carrier **400** with receptacle **50** to another instrument **1000** or module (e.g., a storage module, output module, capping module, etc.) in the laboratory (sec FIG. **1**A).

(61) FIGS. **3**A-**3**E illustrate different views of an exemplary shuttle **16** associated with an instrument **1000**. FIGS. **3**A-**3**C illustrate perspective views from different viewpoints, FIG. **3**D illustrates a top view, and FIG. **3**E illustrates a side view of shuttle **16**. It should be noted that some components of shuttle **16** are removed in some of these figures to show features that are hidden by these components. It should also be noted that some of the components in these figures are represented larger or smaller to highlight different aspects. In the description below, reference will be made to FIGS. **3**A-**3**E. As explained previously, shuttle **16** includes carriage **20** that supports receptacle **50** and travels between first and second ends **22**, **24** of shuttle **16**. In some embodiments, carriage **20** may travel (e.g., slide) between first and second ends **22**, **24** on a rail **30**. A belt **28** (best seen in FIG. **3**B) driven by an electric motor **26** may be coupled to carriage **20** to move carriage **20** between first and second ends **22**, **24**. Rotation of motor **26** in one direction moves carriage **20** from first end **22** to second end **24**, rotation of motor **26** in the opposite direction moves carriage **20** from second end **24** to first end **22**. Second end **24** includes a primary mucoid shelf **90** coupled to a housing **44** of shuttle **16**. A secondary mucoid shelf **60** is coupled to carriage **20**. When carriage **20** is positioned at second end **24**, secondary mucoid shelf **60** is positioned below primary mucoid shelf **90** (see, e.g., FIGS. **4**G and **11**A). The primary and secondary mucoid shelves **90**, **60** will be described in more detail later.

(62) FIGS. **4**A-**4**E illustrate different views of carriage **20** positioned at first end **22** of shuttle **16**, FIG. **4**G illustrates carriage **20** positioned at second end **24** of shuttle **16**, and FIG. **4**F illustrates carriage positioned at an intermediate location between first and second ends **24**. FIGS. **4**A, **4**B, and **4**C illustrate perspective views of carriage **20** from different viewpoints, FIG. **4**D illustrates an exploded view, and FIG. **4**E illustrates a top view. Some components of carriage **20** and shuttle **16** (and receptacle **50**) are removed in some of these figures to show features that are hidden by these components. As best seen in FIG. **4**D, carriage **20** includes bracket **38** having sidewalls **38**A, **38**B and a base **38**E. In some embodiments, bracket **38** may be substantially C-shaped or U-shaped. Sidewall **38**B of bracket **38** includes a vertically extending slot **38**D and base **38**E includes a substantially circular opening or cavity **38**C. Secondary mucoid shelf **60** is attached to the top surface of bracket **38** (see FIG. **4**A). It should be noted that although specific shapes or configurations of bracket **38**, slot **38**D and cavity **38**C are described herein, these are not requirements. In general, bracket **38**, slot **38**D and cavity **38**C may have any shape and configuration suitable for its function described below.
(63) Carriage **20** includes a puck **100** positioned in a holder **130** and attached below bracket **38**. See FIG. **5**C and FIG. **4**C (with holder **130** removed). FIGS. **5**A-**5**K illustrate different views of puck **100** (with some components removed, in some figures, for clarity). Puck **100** receives and supports receptacle **50** that is transferred to carriage **20** from conveyor **300** (see FIGS. **5**H, **5**I, **5**K). It should be noted that although a specific configuration of puck is described below, this is only exemplary. In general, any receptacle supporting device suitable for the functions described below may be used as puck **100**. Exemplary pucks that may be used (with modifications in some cases) in carriage **20** are described in U.S. Pat. No. 8,147,778 and U.S. Patent Application Publication No. 2017/0153262. When supported by puck **100** (or seated in puck **100**), receptacle **50** extends into the space between sidewalls **38**A and **38**B of bracket **38** through cavity **38**C (sec, FIGS. **5**H, **5**I). Puck **100** includes a plurality of spring-loaded fingers **102** that are arranged to receive receptacle **50** from robotic arm **660** (of pick-and-place device **600**) in the space formed between them (see FIGS. **5**A-**5**D). The plurality of fingers **102** are held or coupled together by one or more springs, such as by a resilient elastic O-ring **110** (best seen in FIGS. **5**D and **6**C). When robotic arm **660** inserts receptacle **50** between the plurality of fingers **102**, the compliant O-ring **110** stretches radially outward to increase the space enclosed by, or between, fingers **102** and allow receptacle **50** to slide into this space. The spring force of the stretched O-ring **110** presses the plurality of fingers **102** radially inward against the cylindrical wall of receptacle **50** and maintains receptacle **50** in an upright position between the plurality of fingers **102** (sec FIGS. **5**C, **5**K, **6**C). O-ring **110** may be made of any suitable material having spring-like properties. Although not a requirement, in some embodiments, O-ring **110** may be made of an elastomeric material such as, for example, silicone, EPDM (ethylene propylene diene monomer), rubber, etc. It should be noted that although the figures illustrate an embodiment of puck **100** having four fingers **102**, this is only exemplary. In general, puck **100** may include any number of fingers **102** (e.g., 3, 4, 5, 6, 7, 8, 9, 10, etc.) arranged to receive a receptacle therebetween. Although, in general, fingers **102** may be made of any suitable material, in some embodiments, fingers **102** may be made of a material having a low coefficient of friction. In some embodiments, fingers **102** may be made of anodized aluminum coated with PTFE (polytetrafluoroethylene) or other suitable fluoropolymer. Further, in some embodiments, in addition to or in place of O-ring **110**, another spring member (such as, for example, a metallic spring member, etc.) may be used to constrain the plurality of fingers **102** together.
(64) With reference to FIGS. 5D and 5E, each finger **102** includes a sloped first end **102**A that serves as a lead-in surface for a receptacle **50** into the space between the plurality of fingers **102**. When the plurality of fingers **102** are held together by O-ring **110**, the sloped first ends **102**A of fingers **102** collectively form a funnel-like feature that tolerates some amount of misalignment between receptacle **50** and puck **100** when robotic arm **14** places a receptacle **50** between the plurality of fingers **102**. Each finger **102** also includes a base or a second end **102**B arranged

substantially transverse to first end **102**A. The plurality of fingers **102** are attached to puck **100** at second end **102**B. Second end **102**B includes a pair of through-holes or cavities extending therethrough. As best seen in FIG. **5**E, these through-holes include an inner cavity **102**C and an outer cavity **102**D. With reference to FIG. **5**D, when fingers **102** are attached to puck **100**, outer cavities **102**D are located radially outwards of inner cavities **102**C. That is, inner cavity **102**C is positioned closer to axis **200** than outer cavity **102**D. With reference to FIG. **5**A, puck **100** also includes a synchronization disc **104** and a supporting disc **106** with a centrally positioned recess or pocket **106**A. Although not a requirement, in some embodiments synchronization disc **104** and retaining ring **112** may be made from a plastic (e.g., polyoxymethylene (POM)) and the supporting disc **106** (and, in some embodiments, bearings **114** and **108**) may be made from a metal (e.g., stainless steel, aluminum, etc.). As could be recognized by a person skilled in the art, POM is a plastic that has high mechanical strength and rigidity, as well as good sliding characteristics and wear resistance. Synchronization disc **104** allows the plurality of fingers **102** to move together (e.g., first end **102**A of each finger **102** moves toward and away from vertical axis **200**) in a synchronized manner and is positioned in pocket **106**A of supporting disc **106**. When puck **100** is assembled and a receptacle **50** is supported between the plurality of fingers **102** of puck **100**, pocket **106**A of supporting disc **106** receives the bottom portion of receptacle **50**.

(65) As best seen in FIGS. **5**A and **7**A, supporting disc **106** includes a rim **106**G in the form of a sidewall that projects from a base **106**J (of disc **106**) and defines pocket **106**A. Rim **106**G includes four sidewall segments arranged around pocket **106**A. A gap **106**H may be formed between each adjacent pair of segments of rim **106**G. The portion of base **106**J in the gaps **106**H between each pair of adjacent segments of rim **106**G include a cavity **106**D. Each cavity **106**D includes a bearing **107** (sec FIG. **5**B). As will be described later, the base of each finger **102** is rotatably coupled to disc **106** by a pin **103**D that extends through outer cavity **102**D of finger **102** and the bearing **107** in cavity **106**D of disc **106**. One or more openings or passageways **106**F extend through segments of rim **106**G located on opposite sides of pocket **106**A. Each passageway **106**F includes portions that extend through two oppositely positioned segments of rim **106**G (see FIG. **7**A). That is, with reference to FIG. **7**A, a first passageway **106**F′ extends through one segment of rim **106**G positioned on one side of pocket **106**A and a second passageway **106**F″ extends through another segment of rim **106**G positioned on the opposite side of pocket **106**A. The first and second passageways **106**F′ and **106**F″ are arranged on their respective segments of rim **106**G such that they are aligned with each other and have a common longitudinal axis **206**. In the discussion that follows, the first passageway **106**F′ and the second passageway **106**F″ may be collectively referred to as passageway **106**F (or puck passageway) having longitudinal axis **206**. As best seen in FIG. **7**A, passageways **106**F′ and **106**F″ extend through disc **106** such that the common longitudinal axis **206** of these passageways **106**F′ and **106**F″ is substantially perpendicular to and offset from a vertical axis extending through the center of disc **106** (e.g., axis **200**). Although not shown in FIG. **7**A, disc **106** may have multiple similar passageways **106**F (i.e., with a longitudinal axis extending substantially perpendicular to and offset from vertical axis **200**) arranged around disc **106** and extending through oppositely positioned segments of rim **106**G. In some embodiments, the amount of offset (distance “d” in FIG. **6**A) between axes **200** and **206** may be from about 2 mm to about 7 mm, or from about 3 mm to about 6 mm, or preferably from about 4 mm to about 5 mm. As will be described later, an optical beam from an optical emitter **116**A may be directed to an optical detector **116**B through passageways **106**F′ and **106**F″ and used to detect proper seating of receptacle **50** in puck **100**.

(66) As best seen in FIGS. **5**A, **5**B, and **5**D, a pin **103**C inserted through inner cavity **102**C of each finger **102** extends through a mated slot **104**C (a hole/opening that is elongated in the radial direction) in synchronization disc **104**. And, a pin **103**D inserted through outer cavity **102**D of each finger **102** extends through bearing **107** in cavity **106**D of supporting disc **106**. As best seen in FIG. **5**B, in an assembled puck **100**, the top end of pin **103**D is received in a cavity **112**A of a retaining

ring **112**, and the bottom end of pin **103**D is received in bearing **107**. Pin **103**D rotatably couples each finger **102** to disc **106**. With reference to FIGS. **5**A and **5**B, cavities **106**K are provided on base **106**J of supporting disc **106** corresponding to the location of inner cavities **102**C of fingers **102**. These cavities **106**K accommodate the movement of pins **103**C in slots **104**C of synchronization disc **104**. When a receptacle **50** is inserted between the plurality of fingers **102**, each finger **102** rotates about disc **106** to increase the space between the fingers **102**. As the fingers **102** spread apart from each other, pins **103**C slide radially outwards on slots **104**C of disc **104** and allow the fingers **102** to spread apart in a synchronized manner. As best seen in the perspective section view of FIG. **5**B, retaining ring **112** joins the plurality of fingers **102** and discs **104**, **106** together to form puck **100** with bearings **114** and **108** positioned on either side. With reference to FIG. **5**A, retaining ring **112** includes cavities **113**B that correspond in location with cavities **1061** of supporting disc **106**. Fasteners **113**A (e.g., screws, pins, etc.) engage with cavities **113**B (of retaining ring **112**) and cavities **1061** (of supporting disc **106**) to couple retaining ring **112** to supporting disc **106** with the plurality of fingers **102** and the synchronization disc **104** positioned in between. With reference to FIGS. **5**C and **6**A, puck **100** is then positioned in a cavity **132** of holder **130**, and the holder **130** is attached below bracket **38** (see FIG. **4**A and FIGS. **5**H-**5**J (shown with holder **130** removed)) such that the plurality of fingers **102** extend through cavity **38**C on base **38**E of bracket **38**. An electric motor **126** (see FIG. **4**C) is then coupled to a flange **106**E of supporting disc **106** (of puck **100**) using a belt **128** (see FIGS. **4**C, **5**I, **5**J). Rotation of electric motor **126** rotates puck **100** (and receptacle **50** positioned between its plurality of fingers **102**) within holder **130** about a vertical axis **200** of carriage **20**. Bearings **114** and **108** (see FIG. **5**B) assist in the rotation of puck **100** in holder **130**. As will be described later, rotation of puck **100** assists a label reader **42** of carriage **20** (see FIG. **4**B) to read the information encoded in a machine-readable label **52** of receptacle **50**.

(67) Carriage **20** includes multiple sensors configured to detect different parameters related to its operation. As best seen in FIG. **6**A, in some embodiments, carriage **20** may include a home sensor **120** (see also FIGS. **4**A, **5**C, **5**F, **5**G) used to detect that puck **100** is rotating during the label reading operation. Home sensor **120** may be attached to holder **130** of puck **100**. Home sensor **120** may be a Hall effect sensor that detects a magnet (not shown) on puck **100**. When puck **100** makes a complete rotation (i.e., 360°) within holder **130**, and the magnet on the rotating puck **100** aligns with home sensor **120** attached to the stationary holder **130**, home sensor **120** may output a signal (e.g., to a controller) to indicate that puck **100** has made one complete rotation. A missing signal from home sensor **120** may indicate that puck **100** is not rotating properly (as result of a fault in motor **126**, rupture of belt **128**, etc.). Home sensor **120** may also be used as a reference position for a receptacle-present sensing system of carriage **20**, as discussed below.

(68) The receptacle-present sensing system may include one or more sensors configured to determine whether a receptacle **50** is present and seated properly in puck **100** of carriage **20**. As explained previously, grasping member **662** of robotic arm **660** of pick-and-place device **600** grasps and transfers a receptacle **50** from carrier **400** on conveyor **300** to carriage **20**. In some embodiments, the receptacle-present sensing system may be used to confirm that receptacle **50** is stably supported, or seated, in puck **100** before it is released by grasping members **662** of robotic arm **660**. As would be recognized by a person skilled in the art, if receptacle **50** is not seated in puck **100** when carriage **20** transports the puck **100** to the second end **24**, receptacle **50** could be displaced from puck **100** and spill its contents (i.e., the fluid contained in the receptacle), which may result in contamination of instrument **1000**. Therefore, in some embodiments, it is preferable to confirm that receptacle **50** is seated in puck **100** before it is released by grasping members **662** of robotic arm **660**. Further, as will be described in more detail infra, when carriage **20** is positioned at second end **24**, a pipette tip **152** attached to a mounting end **156** of a pipettor **150** of instrument **1000** is configured to enter receptacle **50** seated in puck **100** and to aspirate a fluid (e.g., sample) contained in receptacle **50** (sec, e.g., FIGS. **4**G and **11**A). Using the receptacle-present sensing

system of carriage **20** to confirm that receptacle **50** is seated in puck **100** (or supported by carriage **20**) ensures that the fluid contained in receptacle **50** can be accessed, without interference, by pipette tip **152** associated with pipettor **150**. In some embodiments, the receptacle-present sensing system may determine that a receptacle is seated in puck **50** if (a) the receptacle **50** has limited tilt with respect to the vertical axis (e.g., the angle between the longitudinal axis **204** of receptacle **50** (see FIGS. **6**E and **6**F) and the vertical axis **200** that extends centrally between the plurality of fingers **102** of puck **100** (see FIGS. **6**E and **6**F) is less than or equal to a predetermined value), and/or (b) if receptacle **50** is inserted to an appropriate depth in puck **100** (e.g., if the distance of a base **55** of the receptacle **50** from the base **106**J of supporting disc **106** of puck **100** (see FIG. **6**J) is less than or equal to a predetermined value). In some embodiments, by determining that base **55** of receptacle **50** is within a certain distance of base **106**J of puck **100** (or carriage **20**), the receptacle-present sensing system can ensure that there will be no unintended interference between receptacle **50** and some structure of instrument **1000**, such as with primary mucoid shelf **90**, when carriage **20** moves from first end **22** to second end **24**. While the allowable tilt of the receptacle with respect to the vertical axis and the allowable gap between the receptacle base **55** and base **106**J may depend upon the application, in some embodiments the sensing system may be configured to detect that a receptacle **50** is seated in puck **100** if (a) base **55** of receptacle **50** is not more than about 5 mm from base **106**J of supporting disc **106** and/or (b) if an angle of the longitudinal axis **204** (see FIGS. **5**E and **5**F) of receptacle **50** relative to the vertical axis **200** of puck **100** (see FIGS. **5**E and **5**F) is not more than about 30°. It should be noted that the above-described values are intended to be exemplary only. For example, in some embodiments, based on the application, the allowable distance described in (a) above may be less than or equal to any integer between 1 mm and 15 mm (i.e., ≤2 mm, ≤10 mm, etc.), and the allowable angle described in (b) above may be less than or equal to any integer between 10° and 30° (i.e., ≤15°, ≤10°, etc.). While the receptacle-present sensing system may include any sensor capable of determining whether a receptacle **50** is seated in puck **100** (or supported by carriage **20**), the sensor of some embodiments may include a signal emitter and a signal detector pair, such as an optical emitter **116**A and an optical detector **116**B pair, as shown in FIGS. **5**C, **5**F, **5**G, **6**A. In one embodiment an infrared LED emitter and a silicon phototransistor sensor, such as optical emitter OPB100EZ and optical detector OPB100SZ (from Optek Technology Inc., Carrollton, TX), may be used as optical emitter **116**A and optical detector **116**B, respectively.

(69) Optical emitter **116**A and optical detector **116**B are attached to the stationary holder **130** of puck **100**. As best seen in FIGS. **5**F, **6**A, and **7**A, optical emitter **116**A is attached to a first sidewall **131**A and optical detector **116**B is attached to a second sidewall **131**B of holder **130**. Sidewalls **131**A and **131**B are located on opposite sides of central cavity **132** of holder **130**, which receives puck **100**. As best seen in FIG. **7**A, in holder **130**, a passageway **136**A extends through first sidewall **131**A and a passageway **136**B extends through second sidewall **131**B, such that these passageways **136**A and **136**B are aligned with each other and have a common longitudinal axis **202**. Passageways **136**A and **136**B are arranged on holder **130** such their common longitudinal axis **202** is substantially perpendicular to and offset from (i.e. spaced apart) from vertical axis **200** (see FIGS. **5**F and **7**A). In the discussion that follows, passageways **136**A and **136**B of holder **130** may be collectively referred to as the holder passageway. Although not a requirement, in some embodiments, the amount of offset (distance “d” in FIG. **7**A) may be from about 2 mm to about 7 mm, or from about 3 mm to about 6 mm, or preferably from about 4 mm to about 5 mm. Although not a requirement, in some embodiments, optical emitter and detector **116**A, **116**B are attached to first and second sidewalls **131**A, **131**B of holder **130** such that a light-emitting element **116**A′ of emitter **116**A is positioned in passageway **136**A and a light-detecting element **116**B′ of detector **116**B are positioned in passageway **136**B (see FIG. **6**A). When puck **100** is not present in holder **130**, an optical beam **500** emitted by optical emitter **116**A is transmitted to optical detector **116**B via the aligned passageways **136**A, **136**B. When puck **100** is positioned in holder **130** and aligned

such that passageways **106**F′ and **106**F″ of supporting disc **106** (of puck **100**) is aligned with passageways **136**A, **136**B of holder **130**, optical beam **500** from emitter **116**A is transmitted to detector **116**B via the aligned passageways **136**A, **106**F′, **106**F″, and **136**B (see FIGS. **5**F, **7**A). Although not a requirement, in some embodiments, as illustrated in FIG. **7**A, when puck **100** is positioned in holder **130** such that passageways **106**F′ and **106**F″ of puck **100** (i.e., the puck passageway) are aligned with passageways **136**A and **136**B of holder **130** (i.e., the holder passageway), longitudinal axis **202** (of passageways **136**A, **136**B) and longitudinal axis **206** (of passageway **106**F) may be coincident. With reference to FIGS. **5**G and **6**C-**6**E, when a receptacle **50** is positioned in puck **100** (and passageways **106**F′, **106**F″ of puck **100** are aligned with passageways **136**A, **136**B of holder **130**), optical beam **500** from emitter **116**A passes through passageways **136**A, **106**F′ and impinges on the curved sidewall of receptacle **50** at a location proximate its base.

(70) As explained previously, the common longitudinal axis **202** of passageways **136**A, **136**B (of holder **130**) is offset from vertical axis **200** of carriage **20** (see FIGS. **5**F and **7**A). That is, the common longitudinal axis **202** of passageways **136**A, **136**B does not extend through a diameter of receptacle **50** seated in puck **100**. Therefore, as best seen in FIGS. **6**D and **6**E, optical beam **500** that impinges on the curved sidewall of the receptacle **500** is also offset from vertical axis **200**. Passageways **136**A and **136**B of holder **130** are arranged such that, when receptacles **50** of different sizes (e.g., diameters) are supported on puck **100**, optical beam **500** passes through a side of receptacle **50** offset from vertical axis **200**. FIG. **6**F is a schematic illustration of the base of a 16 mm diameter receptacle **50**A (i.e., largest diameter of receptacle **50**A is 16 mm) showing the outline of optical beam **500** impinging on the external curved surface of receptacle **50**A. The diameter “a” of optical beam **500** depends on the size of the emitter **116**A and passageways **136**A, **106**F. In some embodiments, diameter “a” may be from about 1 mm to about 3 mm, or about 2 mm. As explained previously, receptacles **50** of different sizes (e.g., diameters, heights) may be supported in puck **100**. The profile of a 12 mm diameter receptacle **50**B is also shown in FIG. **5**F using dashed lines. With reference to FIG. **6**F, the common longitudinal axis **202** of passageways **136**A, **136**B (and passageway **106**F of puck **100**) may be offset from vertical axis **200** by a distance “A.” In general, distance A may depend on the size of the receptacles that are intended to be supported in puck **100** and the size of the emitter **116**A used. In some embodiments, distance A may be from about 3 mm to about 6 mm, or preferably from about 4 mm to about 5 mm, or more preferably about 4.5 mm. The common longitudinal axis **202** may also be offset from the base of a properly seated receptacle **50** by a distance “B.” As best seen in FIG. **6**F, in some embodiments, the distance B may be selected such that optical beam **500** impinges on the hemispherical base of a curved bottom receptacle. Typically, distance B may vary from about 3 mm to about 8 mm, or preferably from about 4 mm to about 7 mm, or more preferably from about 5 mm to about 6 mm. Although the values of distances A and B may depend upon the application (e.g., type and size of receptacle), in general, these distances are selected such that the optical beam **500** falls within the profile of a receptacle **50** seated in puck **100** without passing through the diameter of the receptacle **50**.

(71) FIGS. **6**G-**6**J schematically illustrate the interaction between an optical beam **500** passing from emitter **116**A to detector **116**B (not shown) and a receptacle **50** seated in puck **100**. As illustrated in FIG. **6**G, when a receptacle **50** is not present in puck **100**, the entire optical beam **500**, or substantially the entire optical beam **500** may be received and detected by detector **116**B. Note that although a receptacle is not present in puck **100** in FIG. **6**G, the outline of a receptacle is shown using dotted lines for reference. Detector **116**B may be configured to send a signal (e.g., voltage) indicative of the intensity (or another parameter) of the received optical beam **500** to a control unit **250** (sec FIG. **6**C) operatively coupled thereto. As illustrated in FIG. **6**H, when a receptacle **50** is seated (or properly seated in some embodiments) in puck **100**, the curved side wall of receptacle **50** in the path of optical beam **500** blocks, deflects and/or refracts at least a portion of the optical beam

**500** passing from emitter **116** to detector **116**B. Consequently, a smaller portion, if any, of optical beam **500** from emitter **116**A is received by detector **116**B as compared to when no receptacle is present in puck **100**. Thus, when a receptacle **50** is seated (or properly seated in some embodiments) in puck **100**, detector **116**B detects no more than a portion of the optical beam **500** emitted by the emitter **116**A. FIGS. **61** and **6**J are schematic illustrations of a receptacle **50** that may not be properly oriented or seated in puck **100**. FIG. **6**I illustrates a receptacle **50** positioned in puck **100** with its longitudinal axis **204** inclined at an angle θ with respect to vertical axis **200** (angle θ may be such that a side wall **57** of receptacle **50** blocks or interferes with pipettor **150** or an associated pipette tip **152** attempting to access the contents of receptacle **50**). FIG. **6**J illustrates a receptacle **50** positioned on puck **100** such that base **55** of receptacle **50** is spaced apart from base **106**J of supporting disc **106** (not shown). As a consequence, the distance “C” between base **55** of receptacle **50** and the common longitudinal axis **202** of passageways **136**A, **136**B is less than that of distance “B” of FIG. **6**H, which represents a receptacle **50** in contact with base **106**J of supporting disc **106** (not shown). As such, the distance “B-C” represents the distance that the base **55** of a receptacle **50** seated in puck **100** (or carriage **20**) is removed from base **106**J of puck **100** (or a base of carriage **20**). In both FIGS. **61** and **6**J, the shape/curvature of the receptacle sidewall **57** surface upon which optical beam **500** impinges, or is incident upon, will be different as compared to when receptacle **50** is properly seated in puck **100** (FIG. **6**H). Because of this difference in curvature of the incident surface, a different (more or less) amount of the optical beam **500** may be blocked/deflected/refracted by the receptacle sidewall. Consequently, when receptacle **50** is not properly seated in puck **100**, detector **116**B will detect a different (more or less) amount of optical beam **500** as compared to when receptacle **50** is properly seated (FIG. **6**H).

(72) The amount of receptacle misalignment (i.e., angle θ in FIG. **6**I and distance B-C (compare FIGS. **6**I and **6**J)) tolerated by instrument **1000** may depend upon the application. For example, in some embodiments, a tilt angle θ of up to about 10° and/or a seating deviation (i.e., distance B-C) of up to about 5 mm may have no adverse effect on performance. By “no adverse effect” is meant that pipettor **150** (or an associated pipette tip **152**) is able to access contents of receptacle **50** without interference from receptacle **50** at second end **24**, and that no structure of instrument **1000** is capable of interfering with movement of receptacle **50** between first and second ends **22**, **24** or positioning of receptacle **50** for pipetting at second end **24**. By “interference” is meant that receptacle **50** blocks or otherwise inhibits pipettor **150** (or an associated pipette tip **152**) from accessing or aspirating a desired volume of the contents of receptacle **50**.

(73) In some embodiments, puck **100** may be configured to receive a receptacle having a curved base (e.g., a hemispherical base as illustrated in FIGS. **6**A-**6**G) and a receptacle having a flat base. As best seen in FIG. **6**E, when a receptacle **50** with a curved or hemispherical base is seated in puck **100**, the sidewall surface of the receptacle that optical beam **500** (from emitter **116**A) is incident on is curved about both axes **200** and **202** (i.e., a vertical and a horizontal axis). And, in embodiments where puck **100** receives a receptacle with a flat base, the surface of the receptacle that the optical beam is incident on is only curved about vertical axis **200**. It should be noted that in embodiments, if the common longitudinal axis **202** of passageways **136**A, **136**B (and passageway **106**F) passes through the diameter of the receptacle (i.e., is not offset from vertical axis **200**), a sufficient portion of the optical beam **500** may not be blocked/deflected/refracted by the receptacle side wall for the sensing system to determine that a receptacle is seated in puck **100**. With reference to FIG. **6**F, in some embodiments when a receptacle with a flat base is used, the optical beam **500** may be focused lower on the receptacle (i.e., distance B may be smaller) than when a receptacle with a hemispherical base is used (e.g., because of their differences in profile). In some embodiments, control unit **250** may be calibrated to detect the presence of (or proper seating of, in some embodiments) both a receptacle with a curved base and a receptacle with a flat base. During use, based on signals from detector **116**B, control unit **250** (see FIG. **6**C) may detect whether receptacle **50** is properly seated in puck **100**. In some embodiments, control unit **250** may signal to

a user that receptacle **50** is properly or improperly seated in puck **100** using indicators (activating lights, sounds, icons, etc.). It should be noted that although a signal emitter and signal detector pair is described as being used as a sensor of the receptacle-present sensing system, this is only exemplary. In general, any suitable sensor (e.g., optical emitter and optical detector, contact switch, reflective sensor, ultrasonic camera, resistive film sensor, etc.) may be used.

(74) The signal from detector **116**B may be calibrated to distinguish between a properly seated and an improperly seated receptacle **50**. As would be recognized by a person skilled in the art, calibration of the detector signals to detect proper seating of receptacle **50** in puck **100** may be performed in any manner. In some embodiments, experiments may be performed to determine the emitter signals (voltage indicative of the intensity of detected light, etc.) for different configurations (diameters, types, base curvatures, etc.) and/or positioning (e.g., different angles θ and distances B-C) of receptacles **50** in puck **100**. And, based on these results and prior experience threshold values (or ranges) of emitter signals that indicate proper receptacle seating may be selected. The above-described calibration method is only exemplary.

(75) Receptacle **50** may include a machine-readable label **52** (see FIGS. **4**B, **5**H, **5**I) with encoded details (type of sample, collection date, type of test(s), patient information (age, address, sex, etc.), etc.) about the fluid contained in receptacle **50**. In general, machine-readable label **52** may include any form of encoded data. In some embodiments, machine-readable label **52** may include marks or lines (e.g., 1D or 2D barcodes, etc.) formed (e.g., printed) directly on the sidewall of receptacle **50**. In some embodiments, label **52** may be a tag or sticker with a pattern of marks formed thereon. Carriage **20** includes a label reader **42** (e.g., a barcode reader) (see FIG. **4**B) configured to read the information encoded in machine-readable label **52** (e.g., barcode) on receptacle **50**. In some embodiments, the information read by label reader **42** may be used to associate the fluid in receptacle **50** with a particular patient sample and/or an assay protocol(s). In some embodiments, label reader **42** may be positioned within a housing **40** (see FIGS. **3**A and **4**B) of shuttle **16**. With reference to FIG. **4**B, label reader **42** may be positioned such that, the sidewall of a receptacle **50** seated in puck **100** may be in a line of sight of label reader **42** through a slot **38**D (on sidewall **38**B) of bracket **38**. If receptacle **50** is oriented such that machine-readable label **52** (the sidewall of receptacle **50**) is visible to label reader **42**, when activated, label reader **42** may readily read label **52**. However, in some embodiments, receptacle **50** may be oriented such that machine-readable label **52** is not in the line of sight of label reader **42**. Therefore, in some embodiments, when label reader **42** is activated, puck **100**, along with receptacle **50**, may be rotated (within bracket **38**) about vertical axis **200** by activating electric motor **126**. Rotating receptacle **50** enables label reader **42** to read machine-readable label **52** even if label **52** was initially oriented away from label reader **42**. In general, electric motor **126** may rotate receptacle **50** by any amount (i.e., any angle about axis **200**). In some embodiments, electric motor **126** may rotate receptacle **50** in the same direction (i.e., clockwise or counterclockwise) for one or more cycles. In some embodiments, electric motor **126** may rotate receptacle **50** back-and-forth for one or more cycles. One cycle of back-and-forth rotation includes rotating receptacle **50** first in one direction (i.e., clockwise or counterclockwise) by any amount (e.g., from about 15° to about 360°) and then in the opposite direction. In general, receptacle **50** may be rotated back-and-forth, or rotated in the same direction, for any number of cycles (e.g., 1-10). In some embodiments, one cycle of back-and-forth rotation may include rotating receptacle **50** by about 360° in one direction and then by about 360° in the opposite direction. In some embodiments, receptacle **50** may be rotated (in the same direction or back-and-forth) until label reader **42** reads machine-readable label **52**. That is, a control unit (e.g., control unit **250** of FIG. **6**C) may deactivate electric motor **126** in response to a signal indicative of label reader **42** reading machine-readable label **52**. It should be noted that, in some embodiments, other techniques (e.g., RFID tags and RFI reader, etc.) may be used to read information about the fluid contained in receptacle **50**.

(76) Typically, prior to placing a receptacle in carriage **20**, an initialization routine may be

performed on carriage **20**. In some embodiments, the initialization routine may include the steps of (a) positioning puck **100** in its home position (or homing the puck **100**), (b) confirming that carriage **20** is not supporting a receptacle, (c) aligning the passageways that direct optical beam **500** from emitter **116**A to detector **116**B, and (d) luminance calibration of optical beam **500**. Positioning puck **100** in the home position may include activating electric motor **126** to rotate puck **100** until home sensor **120** attached to holder **130** (see FIG. **6**A) is aligned with the magnet (not shown) attached to puck **100**. After homing the puck **100**, label reader **42** is used to confirm that carriage **20** is not supporting a receptacle. For example, with reference to FIG. **4**B, sidewall **38**A of bracket **38** opposite slot **38**D may include a barcode (not shown) or another machine-readable indicator (e.g., encoded with, for example, the letter “Z”). If a receptacle is seated in puck **100**, label reader **42** will not be able to read the barcode on sidewall **38**A because the receptacle will be located between slot **38**D and the barcode. If label reader **42** reads the barcode on sidewall **38**A (i.e., the letter Z), it confirms that a receptacle is not supported by carriage **20**. After confirming that puck **100** does not include a receptacle, puck **100** is rotated to align passageways **106**F′, **106**F″ of puck **100** (i.e., collectively a puck passageway) with passageways **136**A, **136**B of the stationary holder **130** (i.e., collectively a holder passageway). When the puck passageway is aligned with the holder passageway, the longitudinal axis of the puck passageway may be parallel to, or coincident with, the longitudinal axis of the holder passageway. Aligning these passageways ensures that detector **116**B receives the maximum amount of optical beam **500** emitted by optical emitter **116**A when a receptacle **50** is not supported in puck **100** (see FIG. **6**G).

(77) FIGS. **7**A and **7**B are simplified schematic illustrations that depict aligning the optical beam passageways of the puck **100** (i.e., passageways **106**F′, **106**F″) and holder **130** (i.e., passageways **136**A, **136**B). FIG. **7**A is a simplified plan view of supporting disc **106** positioned in holder **130**. To align the passageways, puck **100** is rotated while monitoring the signal from optical detector **116**B. FIG. **7**B is a graphical illustration of the signal **118**A (e.g., indicative of intensity) from optical emitter **116**A as puck **100** is rotated. The outlines of the holder passageways **136**A, **136**B (marked **130**′) and the disc passageways **106**F′, **106**F″ (marked **106**) at different points during the rotation of puck **100** are also illustrated in FIG. **7**B. When the puck passageways **106**F′, **106**F″ is not aligned with the holder passageways **136**A, **136**B (i.e., when outlines **130**′ and **106**′ are not superimposed), only a portion of (or none of) optical beam **500** from emitter **116**A is received by detector **116**B. When these passageways are aligned (i.e., when outlines **130**′ and **106**′ are superimposed), detector **116**B receives the maximum amount of optical beam **500**, and therefore measures the maximum intensity. To align the passageways **106**F′, **106**F″ of puck **100** with the passageways **136**A, **136**B of holder **130**, rotation of puck **100** is stopped when detector **116**B detects the maximum intensity of light (i.e., at rotational position “X” in FIG. **7**B). After aligning the holder and the puck passageways, optical beam **500** is calibrated for luminance. FIG. **7**C is a graphical illustration of luminance calibration. As illustrated in FIG. **7**C, the power input to optical emitter **116**A is adjusted (increased, decreased, etc.) until the intensity of the light detected by optical detector **116**B (the measured luminance **118**B) reaches a predetermined target luminance value **118**C. Over time, aging of sensors and/or particulate buildup in the passageways **136**A, **136**B, **106**F′, **106**F″ may decrease the amount of optical beam **500** from emitter **116**A that is received/detected by detector **116**B. In some embodiments, the initialization routine may be performed periodically (e.g., weekly, monthly, before analyzing a set number or a batch of samples, etc.). Periodically aligning the optical passageways in the holder and puck and performing luminance calibration may enable the receptacle-present sensing system to accurately detect whether a receptacle is present in, and/or properly seated in, puck **100** under different practical conditions (e.g., account for sensor aging and/or particulate buildup in the optical passageways over time.

(78) After initializing carriage **20** as described above, a receptacle **50** may be placed in puck **100** (e.g., by robotic arm **660** of FIG. **2**J). As explained previously, receptacle **50** is supported on puck **100** by the plurality of fingers **102** (see FIGS. **5**H, **5**I, **5**K, and **6**A-**6**D). Carriage **20** also includes an

additional receptacle clamping mechanism **70** adapted to selectively clamp (e.g., restrict the movement of) receptacle **50** when carriage **20** is positioned at second end **24** of shuttle **16**. FIGS. **8**A and **8**B illustrate an exemplary receptacle clamping mechanism **70** of carriage **20**. Clamping mechanism **70** includes a cam arm **72** having a roller **74** rotatably coupled at one end. The opposite end of cam arm **72** is attached to a cam gear **76**A rotatably coupled to sidewall **38**A of bracket **38** (see FIGS. **4**B, **4**D). Cam gear **76**A is meshed with another cam gear **76**B, which is also rotatably coupled to sidewall **38**A. An actuator arm **78**A is coupled to cam gear **76**A such that actuator arm **78**A rotates along with cam gear **76**A (i.e., there is no relative motion between cam gear **76**A and actuator arm **78**A). And an actuator arm **78**B is coupled to cam gear **76**B such that actuator arm **78**B rotates with cam gear **76**B. As best seen in FIG. **8**B, actuator arms **78**A, **78**B have a substantially L-shape and may be attached to the respective cam gear **76**A, **76**B such that the free ends of both actuator arms **78**A, **78**B face receptacle **50** seated on puck **100**. The free end of actuator arm **78**A that faces receptacle **50** includes a support pad **80**A, and the free end of actuator arm **78**B that faces receptacle **50** includes a support pad **80**B. The surfaces of pads **80**A, **80**B that faces receptacle **50** may be contoured or include a groove (e.g., substantially V-shaped groove, substantially U-shaped groove, etc.). The shape of the contour or groove of pads **80**A and **80**B may be selected to fit on, and clamp, the sidewalls of receptacles of a range of diameters (e.g., from about 12 mm to about 16 mm) that are intended to be supported in puck **100**. When carriage **20** is positioned at first end **22**, a spring **82**A may bias actuator arm **78**A and pad **80**A away from receptacle **50**, and a spring **82**B may bias actuator arm **78**B and pad **80**B away from receptacle **50**. That is, when carriage **20** is positioned at first end **22**, the pads **80**A and **80**B do not apply a clamping force on the receptacle **50**. In general, the clamping force exerted by the pads **80**A, **80**B on receptacle **50** depends on the size and material of the pads and their coefficients of friction. Although not a requirement, in some embodiments, pads **80**A and **80**B may be configured to prevent upward movement of a receptacle clamped by the pads when a vertical or upward force of from about 10N to about 30N is applied to receptacle **50**. As will be explained later, in some embodiments, a receptacle seated in puck **100** may experience an upward force of a similar magnitude when a pipette tip is withdrawn from receptacle after aspirating fluid from the receptacle. Pads **80**A, **80**B may, in general, made of any suitable material (e.g., a relatively compliant material). In some embodiments, pads **80**A, **80**B may be made of silicone, EPDM (ethylene propylene diene monomer rubber), other rubbers, elastomeric material, etc.

(79) With reference to FIGS. **3**A-**3**C, shuttle **16** includes a ramp **34** attached to housing **44**. A top surface of ramp **34** is inclined to form an inclined surface **36** that extends parallel to rail **30** (see FIGS. **3**A, **3**B). Inclined surface **36** is a surface that inclines downwards from its top end **36**A located closer to first end **22** to its bottom end **36**B located between first end **22** and second end **24**. When carriage **20** is positioned at first end **22**, roller **74** of cam arm **72** rests at the top end **36**A of inclined surface **36**. When electric motor **26** is activated and carriage **20** moves from first end **22** to second end **24** on rail **30**, roller **74** rolls down inclined surface **36** of ramp **34**, and cam arm **72** rotates in one direction (clockwise or downward when viewed from the side of receptacle **50**, see FIG. **8**B). And when carriage **20** moves from second end **24** to first end **22**, cam arm **72** moves up inclined surface **36** and rotates in the opposite direction (counterclockwise in FIG. **8**B). With reference to FIG. **8**B, when cam arm **72** rotates in a clockwise direction, cam gear **76**A also rotates in a clockwise direction, and cam gear **76**B rotates in a counterclockwise direction. When cam gear **76**A rotates in a clockwise direction, actuator arm **78**A also rotates in a clockwise direction and pad **80**A moves toward receptacle **50**. Similarly, when cam gear **76**B rotates in a counterclockwise direction, actuator arm **78**B also rotates in a counterclockwise direction and pad **80**B moves toward receptacle **50**. When cam arm **72** reaches the bottom end **36**B of inclined surface **36**, pads **80**A and **80**B press against and secures or locks receptacle **50** in puck **100**. In a similar manner, when carriage **20** travels from second end **24** to first end **22**, cam gears **76**A and **76**B rotate in counterclockwise and clockwise directions, respectively, and cause pads **80**A, **80**B to move away

from and release receptacle **50**. When carriage **20** reaches first end **22**, receptacle **50** is not constrained, or clamped, by pads **80**A, **80**B. That is, as carriage **20** moves from first end **22** towards second end **24**, pads **80**A and **80**B make contact with and apply a clamping force on receptacle **50**, and as carriage **20** moves from the second end **24** towards first end **22**, pads **80**A and **80**B move away from receptacle **50** and release the clamping force (provided to receptacle **50** by pads **80**A, **80**B). Thus, clamping mechanism **70** selectively applies a clamping force to receptacle **50** only when carriage **20** is positioned at second end **24**.

(80) As best seen in FIG. **4**G, second end **24** of instrument **1000** includes an automated pipettor **150** that may be used to aspirate a fluid (e.g., sample) contained in receptacle **50** supported in carriage **20**. FIGS. **10**A and **10**B illustrate an exemplary pipettor **150** of instrument **1000**. With reference to FIGS. **4**G, **10**A and **10**B, pipettor **150** includes a disposable pipette tip **152** that may be removably attached to a mounting end **156** (e.g., bottom) of pipettor **150**. A slidable sleeve **154** is associated with the pipettor **150** which can be activated to move in a downward direction, thereby ejecting pipette tips **152** from the mounting end **156** after use. When carriage **20** is positioned at second end **24** (see FIG. **4**G), pipette tip **152** enters receptacle **50** and aspirates fluid **160** from receptacle **50**. FIG. **10**C illustrates pipette tip **152** of pipettor **150** aspirating fluid **160** from receptacle **50**. In some embodiments, as shown in FIG. **10**C, receptacle **50** may have a top opening **54** closed by a cap **56**. Cap **56** may be configured to be penetrated (e.g., top opening **54** may be covered with a metallic foil or another pierceable material **58**) by pipette tip **152** as it enters receptacle **50**. In general, cap **56** may have any configuration. Exemplary receptacles closed with a penetrable cap are disclosed in U.S. Pat. Nos. 8,052,944, and 8,206,662. As pipette tip **152** is withdrawn from receptacle **50** after fluid aspiration, the interaction (e.g., friction) between receptacle cap **56** and pipette tip **152** may result in a retention force being applied to receptacle **50**, such that pipettor **150** may tend to lift receptacle **50** and extract it from between the plurality of fingers **102** of puck **100**. In some cases, this upward force on receptacle **50** may exceed 10N (or may be from about 10N to about 30N). Clamping receptacle **50** using pads **80**A, **80**B of clamping mechanism **70** may prevent receptacle **50** from being pulled out of puck **100** when pipette tip **152** is withdrawn from receptacle **50**. In contrast, at first end **22**, robotic arm **660** picks up receptacle **50** from carriage **20** and transfers it back to carrier **400** of conveyor **300** (sec FIG. **2**I). Releasing the clamping force (to receptacle **50**) provided by pads **80**A, **80**B at first end **22** enables receptacle **50** to be easily removed from puck **100** by robotic arm **660**. It should be noted that the configuration of cap **56** illustrated in FIG. **10**C is only exemplary.

(81) With reference to FIG. **3**A, at second end **24** of shuttle **16**, primary mucoid shelf **90** is removably attached to housing **44**. FIG. **9**A illustrates second end **24** of shuttle **16** with primary mucoid shelf **90** removed, and FIG. **9**B illustrates an embodiment of the removed primary mucoid shelf **90**. In the description that follows, reference will be made to FIGS. **3**A, **9**A, and **9**B. Primary mucoid shelf **90** may be a plate-like structure arranged substantially horizontally over rail **30**. The top surface of primary mucoid shelf **90** includes a recessed pathway or a labyrinth **95** arranged around a first projection **94**. As illustrated in FIG. **9**B, labyrinth **95** may be bounded by sidewall **97**. A first opening **92** (e.g., a hole, recess, cut-out, aperture, etc.) may be formed in or defined by the base **91** of labyrinth **95**, and a second opening **93** may be formed in or defined by sidewall **97**. In some embodiments, as illustrated in FIG. **9**B, first opening **92** may be a recess defined by sidewall **97** extending inward into the base **91** of labyrinth **95** and second opening **93** may be a downwardly extending recess formed in sidewall **97**. As will be described in more detail below, pipette tip **152** of pipettor **150** may navigate through labyrinth **95** after aspirating fluid from receptacle **50**. The configuration of labyrinth **95** illustrated in FIG. **9**B is only exemplary. In general, labyrinth **95** may have any configuration (e.g., a zig-zag path, etc.). With respect to first opening **92**, it should be noted that the term “opening” is intended to cover embodiments where the opening is fully defined by base **91** of shelf **90** (e.g., fully contained within the base **91**, as in the case of a hole) and embodiments where the opening is only partially defined by the base **91** of shelf **90** (e.g., a recess

formed in the base **91** of the shelf, such as, for example, first opening **92** illustrated in the embodiment of FIG. **9**B). Second opening **93**, when present, is configured to permit lateral passage of pipette tip **152** through second opening **93** without adjusting the height of pipettor **150**.

(82) In some embodiments, primary mucoid shelf **90** is removably attached to housing **44** using magnets. Primary mucoid shelf **90** and housing **44** may include mating features that are adapted to align primary mucoid shelf **90** correctly on housing **44** when primary mucoid shelf **90** is attached to housing **44**. In some embodiments, as illustrated in FIGS. **9**A and **9**B, these alignment features include a cavity **96** on primary mucoid shelf **90** and a corresponding projection **46** on housing **44**. Cavity **96** and projection **46** may have shape and configuration that will allow projection **46** to fit through cavity **96** only when primary mucoid shelf **90** is aligned on housing **44** in a desired manner. Primary mucoid shelf **90** may also include a projection **96**A located proximate cavity **96**. This projection may fit into a recess **46**A located at the base of projection **46** of housing **44** when primary mucoid shelf **90** is attached to housing **44** and assist in maintaining the height of labyrinth **95** with respect to a datum. A first magnet **98**A is provided on primary mucoid shelf **90** and a second magnet **48**A (having the opposite polarity as magnet **98**A) is provided on housing **44** to removably attach primary mucoid shelf **90** to housing **44**. In some embodiments, one of first magnet **98**A or second magnet **98**B may be a magnet and the other may be a ferromagnetic material. In some embodiments, as illustrated in FIGS. **9**A and **9**B, first magnet **98**A is housed or encased within a feature **98** (e.g., a projecting post) of shelf **90** and second magnet **48**A is housed within a feature **48** (e.g., a projecting post) attached to housing **44**. When primary mucoid shelf **90** is positioned on housing **44** with projection **46** extending through cavity **96**, first and second magnets **98**A and **48**A attract each other and correctly align primary mucoid shelf **90** on housing **44**. A thumb grip **99** may be provided on primary mucoid shelf **90** for the user to securely grasp the primary mucoid shelf **90** while attaching and/or removing it from housing **44**. It should be noted that although primary mucoid shelf **90** is described as being removably attached to housing **44** using magnets, this is only exemplary. In some embodiments, tabs or other known alignment features and attachment mechanisms may be used to removably attach shelf **90** to housing **44**.

(83) FIGS. **11**A-**11**C illustrate pipette tip **152** attached to the mounting end **156** of pipettor **150** aspirating fluid **160** from receptacle **50** when carriage **20** is positioned at second end **24** of shuttle **16**. When carriage **20** is located at second end **24**, the top opening **54** of receptacle **50** (or cap **56** of receptacle **50** in embodiments where opening **54** of receptacle **50** is covered by a cap **56**) is positioned below, and aligned with, first opening **92** of primary mucoid shelf **90**. That is, a vertical axis passing through first opening **92** also passes through top opening **54** (or cap **56**) of receptacle **50**. In this configuration, secondary mucoid shelf **60** is positioned below primary mucoid shelf **90** (see FIGS. **11**A and **4**G). In some embodiments, the clearance between the primary mucoid shelf **90** and secondary mucoid shelf **60** may be from about 1 mm to about 6 mm, or preferably from about 2 mm to about 4 mm. The clearance or gap between the bottom surface of primary mucoid shelf **90** and the top of receptacle **50** may vary based on the height of receptacle **50**. For example, when a 100 mm tall receptacle is used, the clearance between the receptacle and primary mucoid shelf **90** may be from about 5 mm to about 10 mm, or preferably from about 6 mm to about 8 mm. When receptacle **50** is positioned below first opening **92**, pipette tip **152** attached the mounting end **156** of pipettor **150** (of instrument **1000**) descends into receptacle **50** through first opening **92** and aspirates fluid **160** contained in receptacle **50** (see FIG. **11**A). In embodiments where receptacle **50** is a capped receptacle as described with reference to FIG. **10**C, pipette tip **152** pierces the cap **56** as it enters receptacle **50**. After a sufficient quantity of fluid **160** is aspirated from receptacle **50**, pipette tip **152** is raised and removed from receptacle **50** through first opening **92** of primary mucoid shelf **90** (see FIGS. **11**B and **9**B).

(84) In some cases, fluid **160** in receptacle **50** may be a viscous fluid, such as, for example, a mucus (e.g., vaginal mucus) In some such cases, a strand of the viscous fluid (referred to herein as mucoid strand **170**) may extend from pipette tip **152** to receptacle **50** as pipette tip **152** is removed

from receptacle **50** (see FIG. **11**B). As would be recognized by a person skilled in the art, this mucoid strand **170** may become dislodged from pipette tip **152** or transported over portions of instrument **1000** (e.g., as pipettor **150** moves) before pipette tip **152** is ejected into a waste container, thus posing a contamination risk. Therefore, it is desirable to remove this mucoid strand **170** from pipette tip **152** after pipettor **150** aspirates fluid **160** from receptacle **50**.

(85) Primary mucoid shelf **90** and secondary mucoid shelf **60** assist in removing mucoid strand **170** from pipette tip **152**. With reference to FIGS. **9**B and **11**B, after pipettor **150** is moved in a vertical direction to lift its associated pipette tip **152** above primary mucoid shelf **90** through first opening **92**, pipettor **150** is moved horizontally (i.e., sideways) to trace a path defined by labyrinth **95**. In some embodiments, before pipettor **150** is moved horizontally along the path, it may be lowered such that the gap between pipette tip **152** and the base **91** of labyrinth **95** is relatively small (e.g., from about 1 mm to about 5 mm). As pipettor **150** moves along this path, mucoid strand **170** suspended from pipette tip **152** is drawn through labyrinth **95**. In some embodiments, pipettor **150** may be moved horizontally such that pipette tip **152** traces the dashed-line path identified as “P” in FIG. **9**B. That is, pipettor **150** may be moved such that its pipette tip **152**, along with mucoid strand **170** suspended therefrom, traverses through labyrinth **95** around projection **94** and is then removed via second opening **93** defined by sidewall **97** of primary mucoid shelf **90**. Mucoid strand **170** may break as it is drawn through labyrinth **95**, thereby separating it from pipette tip **152**. The separated mucoid strand **170** is deposited on labyrinth **95**. Labyrinth **95** may have a recessed or reservoir-like configuration that is adapted to collect the mucoid strand **170** deposited thereon. In some cases, as illustrated in FIG. **11**C, a portion of mucoid strand **170** may be suspended from primary mucoid shelf **90** and extend toward receptacle **50** through first opening **92**. Secondary mucoid shelf **60** may assist in separating and removing the suspended mucoid strand **170** from primary mucoid shelf **90**.

(86) As carriage **20** moves from second end **24** back to first end **22**, the portion of mucoid strand **170** suspended from mucoid shelf **90** (through first opening **92**) is deposited on secondary mucoid shelf **60** (sec FIG. **11**D). As carriage **20** moves further toward first end **22**, the suspended mucoid strand **170** is cleaved by a back wall **62** (of secondary mucoid shelf **60**) and deposited on secondary mucoid shelf **60**. FIG. **12** illustrates an exemplary secondary mucoid shelf **60** separated from carriage **20**. As seen in FIG. **12**, secondary mucoid shelf **60** includes side walls **66** and a front wall **68** that, together with back wall **62** and a base **61**, define a reservoir **64** or a recessed shape adapted to contain mucoid material deposited thereon. The mucoid material collected on primary and secondary mucoid shelves **90**, **60** (i.e., mucoid strand **170** deposited on shelves **60**, **90**) may then be removed and primary and secondary mucoid shelves **90**, **60** cleaned. Removably coupling primary mucoid shelf **90** to housing **44** using self-aligning features **46**, **96** and magnets **48**A, **98**A (see FIGS. **9**A, **9**B) enables primary mucoid shelf **90** to be easily removed for cleaning and reattached after cleaning. The mucoid collected in secondary mucoid shelf **60** may be cleaned (e.g., manually) when carriage **20** is positioned at first end **22**. In some embodiments, secondary mucoid shelf **60** may also be removably coupled to carriage **20** (e.g., using magnets or other suitable mechanisms) for removing secondary mucoid shelf **60** from carriage **20** (for example, for cleaning).

(87) In some embodiments, instrument **1000** may be configured to perform a molecular assay with fluid **160** (e.g., sample) aspirated by pipettor **150** from receptacle **50**. In some embodiments, the molecular assay may include one or more reactions and/or treatments tailored to detect and/or quantify a target molecule (e.g., a target nucleic acid) present in the aspirated fluid **160**. In some embodiments, the assay may include mixing an aliquot of the aspirated fluid **160**, or a processed form of the aspirated fluid, with one or more reagents (e.g., at least one of the reagents being specific for the target molecule), and subjecting the mixture to conditions (thermal cycling, etc.) facilitating the generation of a detectable signal indicative of the presence of the target molecule in the fluid. The signal may provide a qualitative result, or it may be used to approximate the total amount of target molecule present in fluid **160**. As would be recognized by a person skilled in the art, in some embodiments, prior to subjecting a sample to conditions for amplification and

detection of a targeted molecule, the targeted molecule may be subjected to a procedure (e.g., target capture procedure) for isolating and purifying the targeted molecule, provided it is present in the fluid sample. The selected procedure may remove inhibitors of amplification and detection (e.g., heme). In some embodiments, after isolating and purifying a target molecule, the purified molecule may be further processed in the same receptacle or it may be transferred to a separate receptacle for performing the steps of amplification and detection. Exemplary processes, instrument components, and consumables that may be used in a molecular assay are described in U.S. Pat. Nos. 9,011,771, 6,605,213, 5,234,809, 6,534,273, 6,517,783, 9,162,228, 9,732,374, 9,465,161, and 10,494,668, and in International Publication No. WO 2019/014239 A1. When the molecular assay is a PCR (polymerase chain reaction) assay, the reagents used may be specific for the target molecule and the generation of a detectable signal may be accomplished, at least in part, by providing a labeled probe that hybridizes to the amplicon produced by the associated primers in the presence of the target molecule. Since molecular assays are well known to the skilled person and extensively described elsewhere, they are only generally described above. Exemplary assays are described in more detail in PCT/US2018/041472 and the associated references that are incorporated by reference therein.

(88) In some embodiments, after pipette tip **152** of pipettor **150** is removed from labyrinth **95** of primary mucoid shelf **90** via the second opening **93** (see FIG. **9**B), an aliquot of fluid **160** may be transferred from the pipette tip **152** to a receptacle (e.g., to one or more receptacles **902** of a multi-receptacle unit (MRU) **900** illustrated in FIG. **13**A) contained in instrument **1000**. A target capture reagent (e.g., a reagent containing a magnetically-responsive solid support capable of immobilizing the target molecule) may be added to receptacle **902**, and the contents of the receptacle **902** may be incubated for a prescribed period(s) at a prescribed temperature(s). The contents of the receptacle **902** may then be subjected to a magnetic wash procedure, whereby non-targeted, potentially inhibitory components of the fluid sample are removed from the receptacle **902**. Following target capture, an elution buffer may be provided to receptacle **902**, and the receptacle **902** may then be subjected to a magnetic process to separate the eluted nucleic acid material from the magnetically-responsive solid support (e.g., magnetic or silica magnetic particles or beads). The eluted material, along with other reagents, may then be combined in a vial **922** by means of a pipettor, and the vial may then be sealed with a cap **910** to form a cap/vial assembly **920**. The contents of the cap/vial assembly **920** may then subjected to a thermal cycling protocol in a thermal cycler of instrument **1000** for amplification of any targeted molecules that may be present in the eluate (e.g., PCR amplification) and for fluorometric detection of the resulting amplicon, if any.

EMBODIMENTS

(89) Embodiment 1. A receptacle delivery system for an instrument, comprising: a puck configured to removably support a receptacle therein, wherein the puck comprises: a plurality of fingers arranged about a vertical axis, each finger of the plurality of fingers having a contact surface configured to be in contact with a receptacle seated in the puck; one or more springs coupling the plurality of fingers, thereby biasing the plurality of fingers toward the vertical axis; a supporting disc comprising (i) a disc sidewall projecting from a base to define a pocket for seating a receptacle, (ii) a plurality of first cavities formed in the base and extending in a direction of the vertical axis, and (iii) a puck passageway extending through opposed portions of the disc sidewall in a direction transverse to and offset from the vertical axis, wherein each of the plurality of fingers is rotatably coupled to the supporting disc at a corresponding first cavity of the plurality of first cavities; a synchronization disc positioned in the pocket of the supporting disc, wherein each of the plurality of fingers is coupled to the synchronization disc such that the contact surfaces of the plurality of fingers move toward and away from the vertical axis in a synchronous manner; and a retaining ring coupling the plurality of fingers, the supporting disc, and the synchronization disc together. Embodiment 2. The system of embodiment 1, wherein the plurality of fingers are arranged substantially symmetrically about the vertical axis. Embodiment 3. The system of

embodiment 1 or 2, wherein at least an upper portion of the contact surface of each finger of the plurality of fingers is sloped. Embodiment 4. The system of any one of embodiments 1 to 3, wherein each finger of the plurality of fingers comprises a first end and a second end extending substantially transverse to the first end, the first end including the contact surface and the second end including an inner cavity and an outer cavity, the inner cavity being positioned closer to the vertical axis than the outer cavity. Embodiment 5. The system of embodiment 4, wherein the synchronization disc includes a plurality of radially extending slots, each finger of the plurality of fingers being slidably coupled to the synchronization disc by a first pin that extends through a slot of the plurality of radially extending slots and the inner cavity of the finger. Embodiment 6. The system of any one of embodiments 1 to 5, wherein each first cavity of the plurality of first cavities of the supporting disc includes a bearing positioned at least partly therein. Embodiment 7. The system of embodiment 6, wherein each finger of the plurality of fingers is rotatably coupled to the supporting disc by a second pin that extends through the bearing of a first cavity of the plurality of first cavities of the supporting disc and the outer cavity of the finger. Embodiment 8. The system of embodiment 7, wherein one end of each second pin extends through the bearing and an opposite end of the second pin extends into a corresponding cavity in the retaining ring. Embodiment 9. The system of any one of embodiments 1 to 8, wherein the one or more springs coupling the plurality of fingers is an O-ring. Embodiment 10. The system of embodiment 9, wherein the O-ring comprises an elastomeric material. Embodiment 11. The system of any one of embodiments 1 to 9, wherein the puck further comprises a first bearing positioned on one side of the supporting disc and a second bearing positioned on an opposite side of the supporting disc. Embodiment 12. The system of any one of embodiments 1 to 11, further comprising a holder, the holder having a central cavity defined by holder sidewalls and a holder passageway extending through the holder sidewalls, wherein the holder passageway extends in a direction transverse to and offset from the vertical axis, and wherein the puck is positioned in the central cavity and configured to rotate about the vertical axis relative to the holder. Embodiment 13. The system of embodiment 12, wherein the holder sidewalls comprise a first holder sidewall positioned on one side of the central cavity and a second holder sidewall positioned on an opposite side of the central cavity, and the holder passageway comprises a first holder passageway portion extending though the first holder sidewall and a second holder passageway portion extending though the second holder sidewall. Embodiment 14. The system of embodiment 12 or 13, further comprising a signal emitter and a signal detector, wherein the signal emitter is positioned at one end of the holder passageway and the signal detector is positioned at an opposite end of the holder passageway. Embodiment 15. The system of embodiment 14, wherein the signal emitter is coupled to the first holder sidewall and the signal detector is coupled to the second holder sidewall. Embodiment 16. The system of embodiment 14 or 15, wherein the puck is configured to rotate about the vertical axis relative to the holder to bring the puck passageway into alignment with the holder passageway such that a signal from the signal emitter is received by the signal detector when a receptacle is not seated in the puck. Embodiment 17. The system of any one of embodiments 12 to 16, further including a first sensor coupled to the holder, the first sensor being configured to detect when the puck has rotated to a predetermined position in the holder. Embodiment 18. The system of embodiment 17, wherein the first sensor is a Hall effect sensor. Embodiment 19. The system of any one of embodiments 1 to 18, further comprising an electric motor coupled to the supporting disc of the puck via a belt. Embodiment 20. The system of embodiment 19, wherein the supporting disc of the puck includes a flange projecting from the base in a direction opposite the disc sidewall, and wherein the belt is engaged with the flange of the supporting disc. Embodiment 21. The system of any one of embodiments 1 to 20, further including a label reader configured to read data encoded in a machine-readable label on a receptacle seated in the puck. Embodiment 22. The system of embodiment 21, wherein the label reader is a barcode reader, and the machine-readable label is a barcode. Embodiment 23. The system of any one of embodiments 12 to 22, further comprising a carriage configured to move from a first location to a second location of the instrument, wherein the holder is coupled to the carriage. Embodiment 24. The system of any one of embodiments 1 to 23, wherein the disc sidewall of the puck comprises multiple sidewall segments spaced apart from each other and arranged around the pocket, the multiple sidewall segments comprising a first sidewall segment positioned on one side of the pocket and a second sidewall segment positioned on an opposite side of the pocket, and wherein the puck passageway comprises a first puck passageway portion extending through the first sidewall segment and a second puck passageway portion extending through the second sidewall segment. Embodiment 25. The system of embodiment 24, wherein each first cavity of the plurality of first cavities of the puck is positioned in a space formed between two adjacent sidewall segments of the multiple sidewall segments. Embodiment 26. The system of any one of embodiments 1 to 25, wherein, when a receptacle is seated in the puck, the pocket of the supporting disc receives a bottom portion of the receptacle. Embodiment 27. The system of any one of embodiments 1 to 26, wherein the plurality of fingers consists of four fingers. Embodiment 28. The system of any one of embodiments 1 to 27, wherein each of the plurality of fingers comprises anodized aluminum. Embodiment 29. The system of embodiment 28, wherein each of the plurality of fingers comprises anodized aluminum coated with polytetrafluoroethylene or a fluoropolymer. Embodiment 30. The system of any one of embodiments 1 to 29, wherein the one or more springs couple the plurality of fingers together such that, when a receptacle is inserted in a space between the contact surfaces of the plurality of fingers, the one or more springs stretch to allow the contact surfaces to move away from the vertical axis and increase the space between the contact surfaces. Embodiment 31. The system of any one of embodiments 1 to 30, wherein a longitudinal axis of the puck passageway is offset from the vertical axis. Embodiment 32. The system of embodiment 31, wherein the longitudinal axis of the puck passageway is offset from the vertical axis by a distance of from about 3 mm to about 6 mm. Embodiment 33. A receptacle delivery system for an instrument, comprising a carriage supporting a puck, wherein the carriage is configured to move with the puck from a first location to a second location within an instrument of the plurality of instruments, the first location being a location where a receptacle supported by the carrier is configured to be transferred to the puck supported by the carriage, and the second location being a location where fluid from the receptacle seated in the puck is configured to be drawn into a tip associated with a fluid extraction device of the instrument. Embodiment 34. The system of embodiment 33, wherein the puck is configured to rotate relative to the carriage about a vertical axis of the puck. Embodiment 35. The system of embodiment 33 or 34, further comprising a label reader configured to read information encoded in a machine-readable label on the receptacle seated in the puck when the carriage is positioned at the first location. Embodiment 36. The system of any one of embodiment 33 to 35, further comprising a sensing system coupled to the carriage, wherein the sensing system is configured to determine whether a receptacle is seated in the puck. Embodiment 37. The system of embodiment 36, wherein the sensing system is configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to a vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth. Embodiment 38. The system of embodiment 37, wherein the puck comprises a first passageway that extends transverse to and is offset from a vertical axis of the puck, and the carriage comprises a second passageway that extends transverse to and is offset from the vertical axis of the puck. Embodiment 39. The system of embodiment 38, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways. Embodiment 40. The system of embodiment 39, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 41. The system of any one of embodiments 33 to 40, further comprising a conveyor extending adjacent to each of a plurality of instruments. Embodiment 42. The system of embodiment 41, further comprising a carrier configured to support a receptacle containing a fluid and move on the conveyor while the receptacle is supported by the carrier. Embodiment 43. The system of embodiment 42, further comprising a pick and place device configured to transfer a receptacle from the carrier to the puck. Embodiment 44. The system of any one of embodiments 33 to 43, further comprising a rail, wherein the carriage is configured to move on the rail from the first location to the second location. Embodiment 45. The system of any one of embodiments 33 to 44, further comprising a first electric motor operatively coupled to the carriage and configured to move the carriage from the first location to the second location. Embodiment 46. The system of any one of embodiments 33 to 45, wherein the fluid extraction device is a pipettor. Embodiment 47. The system of any one of embodiments 33 to 46, wherein the carriage further comprises a support mechanism configured to selectively apply a force on the receptacle when the carriage is positioned at the second location to prevent extraction of the receptacle from the puck, when the tip associated with the fluid extraction device is withdrawn from the receptacle. Embodiment 48. The system of any one of embodiments 33 to 47, wherein the puck comprises a plurality of spring-loaded members configured to removably support the receptacle therebetween. Embodiment 49. A method of delivering a receptacle to an instrument, comprising: supporting a receptacle containing a fluid on a carrier; transporting the carrier supporting the receptacle on a conveyor extending adjacent to each of a plurality of instruments; transferring the receptacle from the carrier to a puck supported on a carriage when the carriage is positioned at a first location; moving the carriage with the receptacle seated in the puck from the first location to a second location within an instrument of the plurality of instruments; and drawing at least a portion of the fluid from the receptacle seated in the puck into a tip associated with a fluid extraction device of the instrument when the carriage is positioned at the second location. Embodiment 50. The method of embodiment 49, further comprising rotating the puck relative to the carriage about a vertical axis of the puck. Embodiment 51. The method of embodiment 49 or 50, further comprising using a label reader to read information encoded in a machine-readable label on the receptacle seated in the puck when the carriage is positioned at the first location. Embodiment 52. The method of any one of embodiments 49 to 51, further comprising determining if the receptacle is seated in the puck. Embodiment 53. The method of embodiment 52, wherein if it is determined that the receptacle is seated in the puck, then further comprising using a sensing system to detect (a) whether a longitudinal axis of the receptacle seated in the puck is inclined with respect to a vertical axis of the puck, and/or (b) whether the receptacle seated in the puck is inserted to a desired depth. Embodiment 54. The method of embodiment 52 or 53, wherein the puck comprises a first passageway that extends transverse to and is offset from a vertical axis of the puck, and the carriage comprises a second passageway that extends transverse to and is offset from the vertical axis of the puck, and wherein using the sensing system includes rotating the puck to align the first and second passageways. Embodiment 55. The method of embodiment 54, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck. Embodiment 56. The method of embodiment 55, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 57. The method of any one of embodiments 49 to 56, wherein transferring the receptacle from the carrier to the puck is performed with a pick and place device having a plurality of arms for releasably grasping the receptacle. Embodiment 58. The method of any one of embodiments 49 to 57, wherein moving the carriage comprises operating an electric motor to move the carriage on a rail from the first location to the second location. Embodiment 59. The method of any one of embodiments 49 to 58, wherein the fluid extraction device is a pipettor. Embodiment 60. The method of any one of embodiments 49 to 59, further comprising selectively applying a force on the receptacle when the carriage is positioned at the second location, wherein the force is not applied to the receptacle when the carriage is positioned at the first location. Embodiment 61. The method of any one of embodiments

49 to 60, wherein transferring the receptacle from the carrier to the puck comprises removably supporting the receptacle between a plurality of spring-loaded members of the puck. Embodiment 62. A receptacle delivery system for an instrument, comprising: a carriage configured to move from a first location to a second location; a puck coupled to the carriage, wherein the puck is configured to removably support a receptacle therein; and a receptacle clamping mechanism, wherein the receptacle clamping mechanism comprises a pair of opposed support pads configured to be (a) in contact with a receptacle seated in the puck when the carriage is positioned at the second location, and (b) separated from the receptacle when the carriage is positioned at the first location. Embodiment 63. The system of embodiment 62, wherein the pair of support pads are configured to move toward each other as the carriage moves from the first location to the second location and move away from each other as the carriage moves from the second location to the first location. Embodiment 64. The system of embodiment 62 or 63, further comprising a pair of meshed gears coupled to the pair of support pads, wherein, when the carriage moves from the first location to the second location, the pair of meshed gears rotate in opposite directions relative to each other to move the pair of support pads toward each other. Embodiment 65. The system of embodiment 64, further comprising a pair of actuator arms, wherein each actuator arm of the pair of actuator arms is coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears. Embodiment 66. The system of embodiment 64 or 65, further comprising a cam arm, wherein one end of the cam arm is coupled to a gear of the pair of meshed gears and an opposite end of the cam arm is configured to move on a downwardly inclined path when the carriage moves from the first location to the second location. Embodiment 67. The system of embodiment 66, wherein the opposite end of the cam arm comprises a roller configured to roll on the inclined path when the carriage moves from the first location to the second location. Embodiment 68. The system of embodiment 64 or 65, further comprising (a) a cam arm having a first end coupled to a first gear of the pair of meshed gears and a second end opposite the first end and (b) a ramp having an inclined surface extending substantially parallel to a path of the carriage from the first location to the second location, wherein when the carriage moves along the path between the first and second locations, the second end of the cam arm moves along the inclined surface to rotate the first gear. Embodiment 69. The system of embodiment 64 or 65, further comprising a cam arm configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location. Embodiment 70. The system of any one of embodiments 62 to 69, wherein each support pad of the pair of support pads comprises a contoured surface, and wherein the support pads face each other. Embodiment 71. The system of any one of embodiments 62 to 69, wherein each support pad of the pair of support pads comprises a substantially V-shaped groove, and wherein the support pads face each other. Embodiment 72. The system of any one of embodiments 62 to 71, wherein each support pad of the pair of support pads comprises an elastomer. Embodiment 73. The system of embodiment 72, wherein the elastomer is selected from the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber. Embodiment 74. The system of any one of embodiments 62 to 73, wherein the receptacle clamping mechanism further comprises one or more springs configured to bias the pair of support pads away from each other when the carriage is positioned at the first location. Embodiment 75. The system of any one of embodiments 62 to 74, wherein the pair of support pads are configured to apply a clamping force to the receptacle when the carriage is positioned at the second location and not to apply a clamping force to the receptacle when the carriage is positioned at the first location. Embodiment 76. The system of embodiment 75, wherein the pair of support pads are configured to apply a clamping force of from about 10N to about 30N to the receptacle when the carriage is positioned at the second location. Embodiment 77. The system of any one of embodiments 62 to

76, further comprising a first electric motor operatively coupled to the carriage and configured to move the carriage between the first location and the second location. Embodiment 78. The system of any one of embodiments 62 to 77, further comprising a second electric motor operatively coupled to the puck and configured to rotate the puck in the carriage when the carriage is positioned at the first location. Embodiment 79. The system of embodiment 78, wherein the carriage further comprises a sensor configured to detect when the puck has rotated to a predetermined position in the carriage. Embodiment 80. The system of embodiment 79, wherein the sensor is a Hall effect sensor. Embodiment 81. The system of any one of embodiments 62 to 80, further comprising a sensing system configured to detect whether a receptacle is seated in the puck. Embodiment 82. The system of any one of embodiments 62 to 80, wherein the puck comprises a first passageway that extends transverse to and is offset from a vertical axis of the puck. Embodiment 83. The system of embodiment 82, further comprising a sensing system configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth in the puck. Embodiment 84. The system of embodiment 83, wherein the puck is rotatably supported in a housing of the carriage, and wherein the housing comprises a second passageway that extends transverse to and is offset from the vertical axis of the puck. Embodiment 85. The system of embodiment 84, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck. Embodiment 86. The system of embodiment 85, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 87. The system of embodiment 86, wherein when the first and second passageways are aligned, (a) the optical emitter is configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector is configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area is offset from a longitudinal axis of the receptacle. Embodiment 88. The system of embodiment 87, wherein if a receptacle is properly seated in the puck, the incident area is offset from the longitudinal axis of the receptacle by a distance from about 3 mm to about 6 mm. Embodiment 89. The system of embodiment 87 or 88, wherein if a receptacle is properly seated in the puck, the incident area is offset from a base of the receptacle by a distance from about 3 mm to about 8 mm. Embodiment 90. The system of any one of embodiments 85 to 89, wherein the signal emitter and the signal detector are coupled to the carriage. Embodiment 91. The system of any one of embodiments 62 to 90, further comprising a first shelf attached to the carriage and a second shelf positioned at the second location, wherein when the carriage is positioned at the second location, the first shelf is positioned below the second shelf. Embodiment 92. The system of embodiment 91, wherein when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf is from about 1 mm to about 6 mm. Embodiment 93. The system of embodiment 91 or 92, wherein the second shelf defines a first opening, and wherein when the carriage is positioned at the second location, the first opening is aligned with a receptacle seated in the puck, such that a tip associated with a fluid extraction device of the instrument is moveable through the first opening and into the receptacle. Embodiment 94. The system of embodiment 93, wherein the first opening is an inwardly extending recess defined by a side wall of the second shelf. Embodiment 95. The system of any one of embodiments 62 to 94, further comprising a label reader configured to read information encoded in a machine-readable label on the receptacle when the carriage is positioned at the first location. Embodiment 96. The system of any one of embodiments 62 to 95, further comprising a rail, wherein the carriage is configured to move on the rail between the first and second locations. Embodiment 97. The system of any one of embodiments 62 to 96, further comprising a pick-and-place device configured to transfer a receptacle to the puck from a location outside the instrument. Embodiment 98. The system of embodiment 97, wherein the pick-and-place device is configured to transfer a receptacle to the puck from a receptacle carrier supported on a receptacle delivery conveyor, wherein the receptacle delivery conveyor is configured to transport the receptacle carrier supporting the receptacle to locations adjacent multiple instruments. Embodiment 99. The system of any one of embodiments 62 to 98, wherein the puck comprises a plurality of spring-loaded members configured to removably support a receptacle therebetween. Embodiment 100. A method of delivering a receptacle to an instrument, comprising: supporting a receptacle in a carriage; activating an electric motor to move the carriage between a first location and a second location of the instrument while the receptacle is supported by the carriage; applying a clamping force to the receptacle as the carriage moves from the first location to the second location; and releasing the clamping force from the receptacle as the carriage moves from the second location to the first location. Embodiment 101. The method of embodiment 100, wherein applying the clamping force comprises applying a force of from about 10N to about 30N to the receptacle. Embodiment 102. The method of embodiment 100 or 101, wherein applying the clamping force to the receptacle comprises moving a pair of support pads into contact with the receptacle as the carriage moves from the first location to the second location. Embodiment 103. The method of any one of embodiments 100 to 102, wherein releasing the clamping force comprises moving the pair of contact pads away from the receptacle as the carriage moves from the second location to the first location. Embodiment 104. The method of embodiment 102 or 103, wherein applying the clamping force and releasing the clamping force each comprises rotating a pair of meshed gears coupled to the pair of support pads in opposite directions relative to each other as the carriage moves between the first and second locations. Embodiment 105. The method of embodiment 104, wherein rotating the pair of meshed gears comprises (a) rotating a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotating the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location. Embodiment 106. The method of embodiment 104 or 105, wherein rotating the pair of meshed gears comprises (a) moving a first end of a cam arm on a downwardly inclined path when the carriage moves from the first location to the second location and (b) moving the first end on an upwardly inclined surface when the carriage moves from the second location to the first location, wherein a second end of the cam arm is coupled to a gear of the pair of meshed gears. Embodiment 107. The method of any one of embodiments 100 to 106, wherein supporting the receptacle in the carriage comprises removably supporting the receptacle in a rotatable puck positioned in the carriage. Embodiment 108. The method of embodiment 107, wherein removably supporting the receptacle comprises positioning the receptacle between a plurality of spring-loaded members of the puck, and the method further comprises transferring the receptacle to the puck from a receptacle delivery system using a pick-and-place device. Embodiment 109. The method of embodiment 107 or 108, wherein the electric motor is a first electric motor, and the method further comprises activating a second electric motor to rotate the puck in the carriage when the carriage is positioned at the first location. Embodiment 110. The method of embodiment 109, further comprising using a sensor to detect when the puck has rotated to a predetermined position in the carriage. Embodiment 111. The method of embodiment 109 or 110, further comprising using a label reader to read information encoded in a machine-readable label on the receptacle as the puck is rotating. Embodiment 112. The method of any one of embodiments 107 to 111, further comprising using a sensing system associated with the carriage to detect (a) whether a longitudinal axis of the receptacle supported by the puck is inclined with respect to a vertical axis of the puck, and/or (b) whether the receptacle supported by the puck is inserted to a desired depth in the puck. Embodiment 113. The method of embodiment 112, wherein the puck is rotatably supported in a housing of the carriage, and wherein the puck comprises a first passageway that extends transverse to a vertical axis of the puck, and the housing comprises a second passageway that extends transverse to the vertical axis of the puck. Embodiment 114. The method of embodiment 113, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck. Embodiment 115. The method of embodiment 114, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 116. The method of embodiment 115, wherein using the sensing system comprises: directing the optical beam from the optical emitter toward the optical detector, wherein the receptacle seated in the puck is at least partially positioned between the optical emitter and the optical detector; and determining what portion of the optical beam, if any, is received by the optical detector. Embodiment 117. The method of embodiment 116, wherein directing the optical beam comprises directing at least a portion of the optical beam on an incident area of an external surface of the receptacle seated in the puck. Embodiment 118. The method of embodiment 117, wherein when the receptacle is properly seated in the puck, the incident area is offset from the vertical axis of the puck by a distance of from about 3 mm to about 6 mm. Embodiment 119. The method of embodiment 117 or 118, wherein when the receptacle is properly seated in the puck, the incident area is offset from the base of the receptacle by a distance of from about 3 mm to about 8 mm. Embodiment 120. The method of any one of embodiments 100 to 119, wherein activating the electric motor comprises positioning the carriage at the second location such that a first shelf attached to the carriage is positioned below a second shelf coupled to the instrument and positioned at the second location. Embodiment 121. The method of embodiment 120, wherein the second shelf is removably coupled to the instrument at the second location. Embodiment 122. The method of embodiment 120 or 121, wherein when the carriage is positioned at the second location, the first shelf is vertically spaced apart from the second shelf by a distance from about 1 mm to about 6 mm. Embodiment 123. The method of any one of embodiments 120 to 122, wherein positioning the carriage at the second location comprises positioning the carriage such that a first opening formed in the second shelf is positioned above, and aligned with, the receptacle, and the method further comprises directing a tip associated with a fluid extraction device of the instrument through the first opening and into the receptacle, thereby contacting a fluid contained in the receptacle. Embodiment 124. The method of embodiment 123, further comprising aspirating an aliquot of the fluid into the tip. Embodiment 125. The method of embodiment 124, further comprising, after aspirating the aliquot of the fluid into the tip, removing the tip from the receptacle to a position above the first opening. Embodiment 126. The method of any one of embodiments 123 to 125, wherein the receptacle comprises a pierceable cap that covers an opening of the receptacle, and wherein (i) directing the tip into the receptacle comprises piercing the cap with the tip, and (ii) removing the tip from the receptacle comprises moving the tip through the pierced cap. Embodiment 127. The method of embodiment 125 or 126, further comprising, after removing the tip from the receptacle, moving the tip to a position above a top surface of the second shelf. Embodiment 128. The method of embodiment 127, further comprising, after moving the tip to the position above the top surface of the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm from the top surface of the shelf. Embodiment 129. The method of embodiment 127 or 128, further comprising, after moving the tip to the position above the top surface of the second shelf, moving the tip to trace a predefined path along the surface of the second shelf after the lowering. Embodiment 130. The method of embodiment 129, wherein moving the tip to trace the predefined path comprises moving the tip around an upwardly extending projection on the top surface of the second shelf. Embodiment 131. The method of embodiment 129 or 130, further comprising, after moving the tip to trace the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf. Embodiment 132. The method of embodiment 131, wherein removing the tip from above the top surface of the second shelf comprises moving the tip through the second opening without changing a vertical position of the tip above the surface. Embodiment 133. The method of any one of embodiments 129 to 132, wherein a portion of the fluid is suspended from the tip when removing the tip from the receptacle, and wherein at least a portion of the fluid suspended from the tip is deposited onto the top surface of the second shelf while moving the tip to trace the path. Embodiment 134. The method of embodiment 133, wherein, after moving the tip to the position above the top surface of the second shelf, a portion of the fluid suspended from the tip when removing the tip from the receptacle is suspended from the second shelf beneath the first opening. Embodiment 135. The method of any one of embodiments 131 to 134, wherein activating the electric motor further comprises moving the carriage from the second location to the first location after moving the tip to trace the predefined path, thereby cleaving at least a portion of the fluid suspended from the second shelf and depositing the cleaved fluid on a top surface of the first shelf. Embodiment 136. The method of any one of embodiments 133 to 135, further comprising decoupling the second shelf from the instrument. Embodiment 137. The method of embodiment 136, further comprising removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument. Embodiment 138. The method of embodiment 137, further comprising coupling the second shelf to the instrument after removing at least a portion of the fluid deposited on the top surface of the second shelf. Embodiment 139. The method of any one of embodiments 135 to 138, further comprising removing at least a portion of the fluid deposited on the top surface of the first shelf after moving the carriage from the second location to the first location. Embodiment 140. A receptacle delivery system for an instrument, comprising: a carriage; a puck rotatably supported by the carriage, wherein the puck comprises a plurality of spring-loaded fingers arranged around a vertical axis and configured to removably support a receptacle therebetween; a first electric motor configured to move the carriage between a first location and a second location of the instrument; and a second electric motor configured to rotate the puck about the vertical axis. Embodiment 141. The system of embodiment 140, wherein an O-ring biases the plurality of fingers toward the vertical axis of the puck. Embodiment 142. The system of embodiment 141, wherein the O-ring is comprised of an elastomer. Embodiment 143. The system of embodiment 142, wherein the elastomer is selected from the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber. Embodiment 144. The system of any one of embodiments 140 to 143, wherein each finger of the plurality of fingers comprises a top portion that is configured to contact the receptacle and a base portion that extends substantially transverse to the top portion, wherein the base portion of each finger is rotatably coupled to a supporting disc of the puck at a pivot point. Embodiment 145. The system of embodiment 144, wherein the base portion of each finger of the plurality of fingers is configured to rotate about the associated pivot point. Embodiment 146. The system of embodiment 144 or 145, wherein the top portion of each finger of the plurality of fingers comprises an inclined surface, and wherein the inclined surfaces of the plurality of fingers are arranged in a funnel-like configuration with respect to the vertical axis. Embodiment 147. The system of any one of embodiments 140 to 146, wherein the plurality of fingers comprises four equally spaced-apart fingers. Embodiment 148. The system of any one of embodiments 140 to 147, wherein each of the plurality of fingers comprises anodized aluminum at least partially coated with PTFE (polytetrafluoroethylene). Embodiment 149. The system of any one of embodiments 140 to 148, further comprising a sensor configured to detect when the puck has rotated to a predetermined position in the carriage. Embodiment 150. The system of embodiment 149, wherein the sensor is a Hall effect sensor. Embodiment 151. The system of any one of embodiments 140 to 150, further comprising a sensing system configured to detect whether a receptacle is seated in the puck. Embodiment 152. The system of any one of embodiments 140 to 150, wherein the puck comprises a first passageway that extends transverse to and is offset from the vertical axis of the puck. Embodiment 153. The system of embodiment 152, further comprising a sensing system configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is insert to a desired depth in the puck. Embodiment 154. The system of embodiment 153, wherein the puck is rotatably supported in a housing of the carriage, and wherein the housing comprises a second passageway that extends transverse to and is offset from the vertical axis of the puck. Embodiment 155. The system of embodiment 154, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck. Embodiment 156. The system of embodiment 155, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 157. The system of embodiment 156, wherein when the first and second passageways are aligned, (a) the optical emitter is configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector is configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area is offset from a longitudinal axis of the receptacle. Embodiment 158. The system of embodiment 157, wherein, when a receptacle is properly seated in the puck, the incident area is offset from the vertical axis of the puck by a distance from about 3 mm to about 6 mm. Embodiment 159. The system of embodiment 157 or 158, wherein, when a receptacle is properly seated in the puck, the incident area is offset from a base of the receptacle by a distance from about 3 mm to about 8 mm. Embodiment 160. The system of any one of embodiments 155 to 159, wherein the signal emitter and the signal detector are coupled to the carriage. Embodiment 161. A receptacle delivery system for an instrument, comprising: a carriage configured to move on a rail from a first location to a second location of the instrument, the carriage comprising: a bracket having opposed first and second sidewalls and a base extending between the first and second sidewalls, wherein the carriage is configured to support a receptacle; a pair of opposed support pads, wherein the pair of support pads are configured to (a) move toward a receptacle supported by the carriage as the carriage moves from the first location toward the second location, and (b) move away from a receptacle supported by the carriage as the carriage moves from the second location toward the first location; and a pair of meshed cam gears rotatably coupled to the first sidewall, wherein each cam gear of the pair of meshed cam gears is coupled to a different support pad of the pair of support pads. Embodiment 162. The system of embodiment 161, wherein the bracket is substantially U-shaped. Embodiment 163. The system of embodiment 161 or 162, wherein the second sidewall of the bracket comprises an elongated slot aligned with a receptacle supported by the carriage, and wherein the carriage comprises a label reader configured to read information encoded in a machine-readable label on the receptacle through the elongated slot when the carriage is positioned at the first location. Embodiment 164. The system of any one of embodiments 161 to 163, wherein the carriage further comprises a rotatable puck comprising a plurality of spring-loaded fingers configured to support the receptacle therebetween, and wherein the puck is coupled to the bracket below the base such that the plurality of fingers extend into a space between the first and second sidewalls of the bracket through an opening in the base. Embodiment 165. The system of embodiment 164, further comprising a first electric motor operatively coupled to the puck and configured to rotate the puck in the carriage when the carriage is positioned at the first location. Embodiment 166. The system of embodiment 165, wherein the carriage further comprises a sensor configured to detect when the puck has rotated to a predetermined position in the carriage. Embodiment 167. The system of embodiment 166, wherein the sensor is a Hall effect sensor. Embodiment 168. The system of any one of embodiment 161 to 167, wherein the carriage further comprises a pair of actuator arms, wherein each actuator arm of the pair of actuator arms is coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears. Embodiment 169. The system of any one of embodiments 161 to 168, further comprising (a) a cam arm having a first end and a second end, and (b) a ramp having an inclined surface extending substantially parallel to the rail, wherein the first end of the cam arm is coupled to a gear of the pair of meshed gears and the second end of the cam arm is configured to move on the inclined surface of the ramp as the carriage moves between the first and second locations. Embodiment 170. The system of embodiment 169, wherein the second end of the cam arm includes a roller configured to roll on the inclined surface when the carriage moves between the first and second locations. Embodiment 171. The system of embodiment 169 or 170, wherein the cam arm is configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location. Embodiment 172. The system of any one of embodiments 161 to 171, wherein each support pad of the pair of support pads comprises a contoured surface. Embodiment 173. The system of any one of embodiments 161 to 172, wherein each support pad of the pair of support pads comprises a substantially V-shaped groove. Embodiment 174. The system of any one of embodiments 161 to 173, wherein each support pad of the pair of support pads comprises an elastomer. Embodiment 175. The system of embodiment 174, wherein the elastomer is selected form the group consisting of silicone, EPDM (ethylene propylene diene monomer), and rubber. Embodiment 176. The system of any one of embodiments 161 to 174, further comprising one or more springs configured to bias the pair of support pads away from each other when the carriage is positioned at the first location. Embodiment 177. The system of any one of embodiments 161 to 176, wherein the pair of support pads are configured to apply a clamping force of from about 10N to about 30N to a receptacle supported by the carriage when the carriage is positioned at the second location. Embodiment 178. The system of any one of embodiments 161 to 177, further comprising a second electric motor operatively coupled to the carriage and configured to move the carriage between the first and second locations. Embodiment 179. The system of any one of embodiments 164 to 178, wherein the carriage further comprises a sensing system configured to detect whether a receptacle is seated in the puck. Embodiment 180. The system of any one of embodiments 164 to 179, wherein the puck includes a first passageway that extends transverse to and is offset from a vertical axis of the puck. Embodiment 181. The system of embodiment 180, further comprising a sensing system configured to detect (a) whether a longitudinal axis of a receptacle seated in the puck is inclined with respect to the vertical axis of the puck, and/or (b) whether a receptacle seated in the puck is inserted to a desired depth in the puck. Embodiment 182. The system of embodiment 181, wherein the puck is rotatably supported in a housing of the carriage, and wherein the housing includes a second passageway that extends transverse to and is offset from the vertical axis of the puck. Embodiment 183. The system of embodiment 182, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways when a receptacle is not seated in the puck. Embodiment 184. The system of embodiment 183, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 185. The system of embodiment 184, wherein when the first and second passageways are aligned, (a) the optical emitter is configured to direct the optical beam on an incident area on an external surface of a receptacle seated in the puck and (b) the optical detector is configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not seated in the puck, wherein if the receptacle is properly seated in the puck, the incident area is offset from a longitudinal axis of the receptacle. Embodiment 186. The system of embodiment 185, wherein if a receptacle is properly seated in the puck, the incident area is offset from the longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm. Embodiment 187. The system of embodiment 185 or 186, wherein if a receptacle is properly seated in the puck, the incident area is offset from a base of the receptacle by a distance of from about 3 mm to about 8 mm. Embodiment 188. The system of any one of embodiments 183 to 187, wherein the signal emitter and the signal detector are coupled to the carriage. Embodiment 189. The system of any one of embodiments 161 to 188, further comprising a first shelf attached to the carriage and a second shelf positioned at the second location, wherein when the carriage is positioned at the second location, the first shelf is positioned below the second shelf. Embodiment 190. The system of embodiment 189, wherein when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf is from about 1 mm to about 6 mm. Embodiment 191. The system of embodiment 189 or 190, wherein the second shelf defines an first opening, and wherein when the carriage is positioned at the second location, the first opening is aligned with a receptacle supported by the carriage, such that a tip associated with a fluid extraction device of the instrument is moveable through the first opening and into the receptacle. Embodiment 192. A receptacle delivery system for an instrument, comprising: a carriage configured to move from a first location of the instrument to a second location of the instrument; a puck supported by the carriage, wherein the puck is configured to removably support a receptacle such that a longitudinal axis of the receptacle is substantially coincident with a vertical axis of the puck; and a first shelf positioned at the second location of the instrument, wherein the shelf comprises (a) a base extending substantially transverse to the vertical axis of the puck and (b) a first opening defined by the base, and wherein when the carriage is positioned at the second location, the longitudinal axis of a receptacle seated in the puck extends through the first opening. Embodiment 193. The system of embodiment 192, wherein the shelf is removably coupled to a housing of the instrument. Embodiment 194. The system of embodiment 193, wherein shelf is removably coupled to the housing of the instrument using one or more magnets. Embodiment 195. The system of embodiment 194, wherein the one or more magnets comprises a pair of corresponding magnets, and wherein the shelf comprises a first projection extending upward from the base, and the housing of the instrument comprises a second projection, the first projection containing a first magnet of the pair of magnets and the second projection containing a second magnet of the pair of magnets. Embodiment 196. The system of any one of embodiments 192 to 195, wherein a top surface of the base comprises a passageway defined by an interior projection extending upward from the top surface the base and a sidewall circumscribing the base. Embodiment 197. The system of embodiment 196, wherein the sidewall comprises a second opening, the second opening being sized to permit the lateral passage of a distal end of a pipette tip. Embodiment 198. The system of any one of embodiments 193 to 197, wherein the shelf and the housing include mated registration elements configured to correctly align the shelf on the instrument. Embodiment 199. The system of embodiment 198, wherein the mated registration elements include a third opening on the shelf and third projection coupled to the housing, and wherein the third projection extends through the third opening when the second shelf is coupled to the housing. Embodiment 200. The system of embodiment 199, wherein a shape of an outer surface of the third projection generally conforms to a shape of the third opening. Embodiment 201. The system of embodiment 199 or 200, wherein the third projection of the housing comprises a first recess located at an end of the third projection, and the shelf comprises a fourth projection positioned proximate the third opening, and wherein when the second shelf is coupled to the housing, the fourth projection is positioned in the first recess. Embodiment 202. The system of any one of embodiments 192 to 201, wherein the surface of the shelf comprises a recessed thumb grip. Embodiment 203. The system of any one of embodiments 192 to 202, wherein the carriage comprises a second shelf coupled to a top surface of the carriage. Embodiment 204. The system of embodiment 203, wherein the second shelf comprises a recessed region configured to contain a fluid. Embodiment 205. The system of embodiment 203 or 204, wherein the second shelf is removably coupled to the top surface of the carriage. Embodiment 206. The system of any one of embodiments 203 to 205, wherein when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf is from about 1 mm to about 6 mm. Embodiment 207. A receptacle clamping mechanism of an instrument, comprising: a carriage configured to move between a first location and a second location of the instrument, wherein the carriage comprises (a) one or more support members configured to removably support a receptacle therebetween, and (b) a pair of opposed support pads configured to apply a clamping force to a receptacle supported by the carriage as the carriage moves from the first location to the second location and release the clamping force from the receptacle as the carriage moves from the second location to the first location; and a sensing system configured to determine whether a receptacle is supported by the carriage. Embodiment 208. The mechanism of embodiment 207, wherein the sensing system is configured to determine (a) whether a longitudinal axis of a receptacle supported by the carriage is inclined with respect to a vertical axis, and/or (b) whether a receptacle supported by the carriage is inserted to a desired depth. Embodiment 209. The mechanism of embodiment 207 or 208, wherein the sensing system comprises a signal emitter and a signal detector positioned at two ends of a linear axis, and wherein when a receptacle is properly supported by the carriage, the linear axis (a) passes through a sidewall of the receptacle and (b) is offset from the longitudinal axis of the receptacle. Embodiment 210. The mechanism of embodiment 209, wherein the signal emitter is an optical emitter and the signal detector is an optical detector. Embodiment 211. The mechanism of embodiment 210, wherein (a) the optical emitter configured to direct an optical beam on an incident area on an external surface of a receptacle supported by the carriage and (b) the optical detector configured to receive at least a portion of the optical beam from the optical emitter if a receptacle is not supported by the carriage, wherein when a receptacle is properly supported by the carriage, the incident area is offset from a longitudinal axis of the receptacle. Embodiment 212. The mechanism of embodiment 211, wherein when a receptacle is properly supported by the carriage, the incident area is offset from a longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm. Embodiment 213. The mechanism of embodiment 211 or 212, wherein when a receptacle is properly supported by the carriage, the incident area is offset from a base of the receptacle by a distance of from about 3 mm to about 8 mm. Embodiment 214. The mechanism of any one of embodiments 209 to 213, wherein the signal emitter and the signal detector are coupled to the carriage. Embodiment 215. The mechanism of any one of embodiments 207 to 214, wherein the pair of support pads are configured to be (a) in contact with a receptacle supported by the one or more support members when the carriage is positioned at the second location, and (b) separated from the receptacle when the carriage is positioned at the first location. Embodiment 216. The mechanism of any one of embodiments 207 to 215, wherein the pair of support pads are configured to move toward each other as the carriage moves from the first location to the second location and move away from each other as the carriage moves from the second location to the first location. Embodiment 217. The mechanism of any one of embodiments 207 to 216, further comprising a pair of meshed gears coupled to the pair of support pads, wherein when the carriage moves from the first location to the second location, the pair of meshed gears rotate in opposite directions relative to each other to move the pair of support pads toward each other. Embodiment 218. The mechanism of embodiment 217, further comprising a pair of actuator arms, wherein each actuator arm of the pair of actuator arms is coupled at one end to a different support pad of the pair of support pads and coupled at an opposite end to a different gear of the pair of meshed gears. Embodiment 219. The mechanism of embodiment 217 or 218, further comprising a cam arm, wherein one end of the cam arm is coupled to a gear of the pair of meshed gears and an opposite end of the cam arm is configured to move on a downwardly inclined path when the carriage moves from the first location to the second location. Embodiment 220. The mechanism of embodiment 219, wherein the opposite end of the cam arm comprises a roller configured to roll on the inclined path when the carriage moves from the first location to the second location. Embodiment 221. The mechanism of embodiment 219 or 220, wherein the cam arm is configured to (a) rotate a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotate the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location. Embodiment 222. The mechanism of any one of embodiments 207 to 221, wherein each support pad of the pair of support pads comprises a contoured surface or a V-shaped groove. Embodiment 223. The mechanism of any one of embodiments 207 to 222, wherein each support pad of the pair of support pads comprises an elastomer. Embodiment 224. The mechanism of embodiment 223, wherein the elastomer is selected from the group consisting of silicon, EPDM (ethylene propylene diene monomer), and rubber. Embodiment 225. The mechanism of any one of embodiments 207 to 224, further comprising one or more springs configured to bias the pair of support pads away from each other when the carriage is positioned at the first location. Embodiment 226. The mechanism of any one of embodiments 207 to 225, wherein the pair of support pads are configured to apply a clamping force of from about 10N to about 30N to a receptacle supported by the one or more support members when the carriage is positioned at the second location. Embodiment 227. A method of delivering a receptacle to an instrument, comprising: supporting a receptacle in a carriage when the carriage is positioned at a first location of the instrument; activating a sensing system coupled to the carriage to confirm that the receptacle is supported by the carriage; moving the carriage, and the receptacle supported therein, to a second location of the instrument; applying a clamping force to the receptacle as the carriage moves from the first location to the second location; at the second location, extracting at least a portion of a fluid contained in the receptacle using a fluid extraction device of the instrument; moving the carriage, and the receptacle supported therein, from the second location to the first location; and releasing the clamping force from the receptacle as the carriage moves from the second location to the first location. Embodiment 228. The method of embodiment 227, further comprising using the sensing system to determine (a) whether a longitudinal axis of the receptacle supported by the carriage is inclined with respect to a vertical axis, and/or (b) whether the receptacle supported by the carriage is inserted to a predetermined depth. Embodiment 229. The method of embodiment 227 or 228, wherein applying the clamping force comprises applying a force of from about 10N to about 30N to the receptacle. Embodiment 230. The method of any one of embodiments 227 to 229, wherein applying the clamping force to the receptacle comprises moving a pair of opposed support pads into contact with the receptacle as the carriage moves from the first location to the second location. Embodiment 231. The method of embodiment 230, wherein releasing the clamping force comprises moving the pair of support pads away from the receptacle as the carriage moves from the second location to the first location. Embodiment 232. The method of embodiment 230 or 231, wherein applying the clamping force and releasing the clamping force each comprise rotating a pair of meshed gears coupled to the pair of support pads in opposite directions relative to each other as the carriage moves between the first and second locations. Embodiment 233. The method of embodiment 232, wherein rotating the pair of meshed gears comprises (a) rotating a first gear of the pair of meshed gears in a first direction and a second gear of the pair of meshed gears in a second direction opposite the first direction when the carriage moves from the first location to the second location, and (b) rotating the first gear in the second direction and the second gear in the first direction when the carriage moves from the second location to the first location. Embodiment 234. The method of embodiment 232 or 233, wherein rotating the pair of meshed gears comprises (a) moving a first end of a cam arm on a downwardly inclined path when the carriage moves from the first location to the second location and (b) moving the first end of the cam arm on an upwardly inclined surface when the carriage moves from the second location to the first location, and wherein a second end of the cam arm is coupled to a gear of the pair of meshed gears. Embodiment 235. The method of any one of embodiments 227 to 234, wherein supporting the receptacle in the carriage comprises removably supporting the receptacle in a rotatable puck positioned in the carriage. Embodiment 236. The method of embodiment 235, wherein removably supporting the receptacle comprises positioning the receptacle between a plurality of spring-loaded members of the puck, and wherein the method further comprises transferring the receptacle to the puck from a conveyor located outside of the instrument using a pick-and-place device. Embodiment 237. The method of embodiment 235 or 236, further comprising rotating the puck in the carriage when the carriage is positioned at the first location. Embodiment 238. The method of embodiment 237, further comprising using a sensor to detect when the puck has rotated to a predetermined position in the carriage. Embodiment 239. The method of embodiment 237 or 238, further comprising using a label reader to read information encoded in a machine-readable label on the receptacle as the puck is rotating. Embodiment 240. The method of any one of embodiments 227 to 239, wherein activating the sensing system comprises: directing a signal from a signal emitter toward a signal detector, wherein the receptacle supported by the carriage is positioned between the signal emitter and the signal detector; and determining what portion of the signal, if any, is received by the signal detector. Embodiment 241. The method of embodiment 240, wherein directing the signal comprises directing at least a portion of the signal on an incident area of an external surface of the receptacle supported by the carriage. Embodiment 242. The method of embodiment 240 or 241, wherein the signal emitter is an optical emitter, the signal detector is an optical detector, and the signal is an optical beam. Embodiment 243. The method of embodiment 241 or 242, wherein when the receptacle is properly supported by the carriage, the incident area is offset from a longitudinal axis of the receptacle by a distance of from about 3 mm to about 6 mm. Embodiment 244. The method of any one of embodiments 241 to 243, wherein when the receptacle is properly supported by the carriage, the incident area is offset from the base of the receptacle by a distance of from about 3 mm to about 8 mm. Embodiment 245. The method of any one of embodiments 227 to 244, wherein moving the carriage, and the receptacle supported therein, to the second location comprises positioning the carriage at the second location such that (a) at least a portion of the carriage is positioned below a second shelf of the instrument positioned at the second location and (b) the receptacle is positioned below a first opening defined by the second shelf. Embodiment 246. The method of any one of embodiments 227 to 244, wherein moving the carriage, and the receptacle supported therein, to the second location comprises positioning the carriage at the second location such that (a) a first shelf coupled to the carriage is positioned below a second shelf removably coupled to the instrument at the second location and (b) the receptacle is aligned with a first opening defined by the second shelf. Embodiment 247. The method of embodiment 246, wherein when the carriage is positioned at the second location, the first shelf is vertically spaced apart from the second shelf by a distance of from about 1 mm to about 6 mm. Embodiment 248. The method of any one of embodiments 245 to 247, wherein extracting at least a portion of the fluid from the receptacle comprises directing a tip associated with the fluid extraction device through the first opening and into the receptacle to contact the fluid contained in the receptacle. Embodiment 249. The method of embodiment 248, wherein extracting at least a portion of the fluid from the receptacle comprises drawing at least a portion of the fluid into the tip. Embodiment 250. The method of embodiment 249, further comprising, after drawing at least a portion of the fluid into the tip, removing the tip from the receptacle to a position above the first opening. Embodiment 251. The method of any one of embodiments 248 to 250, wherein the receptacle comprises a pierceable cap that covers an opening of the receptacle, and wherein (i) directing the tip into the receptacle comprises piercing the cap with the tip, and (ii) removing the tip from the receptacle comprises moving the tip through the pierced cap. Embodiment 252. The method of embodiment 250 or 251, further comprising, after removing the tip from the receptacle, laterally moving the tip to a position above the second shelf. Embodiment 253. The method of embodiment 252, further comprising, after laterally moving the tip to the position above the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm above a top surface of the second shelf. Embodiment 254. The method of embodiment 252 or 253, further comprising, after laterally moving the tip to a position above the second shelf, moving the tip along a predefined path above the top surface of the second shelf. Embodiment 255.

The method of embodiment 254, wherein moving the tip along the predefined path comprises moving the tip around a projection extending upward from the top surface of the second shelf. Embodiment 256. The method of embodiment 254 or 255, further comprising, after moving the tip along the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf. Embodiment 257. The method of any one of embodiments 254 to 256, wherein a portion of the fluid extracted from the receptacle is suspended from the tip prior to moving the tip along the predefined path, and wherein at least a portion of the fluid suspended from the tip is deposited on the top surface of the second shelf while moving the tip along the predefined path. Embodiment 258. The method of embodiment 257, wherein at least a portion of the fluid suspended from the tip prior to moving the tip along the predefined path is suspended from the second shelf beneath the first opening after moving the tip along the predefined path. Embodiment 259. The method of embodiment 258, wherein moving the carriage, and the receptacle supported therein, from the second location to the first location comprises cleaving at least a portion of the fluid suspended from the second shelf directly beneath the first opening and depositing the cleaved fluid onto a top surface of a first shelf supported by the carriage as the carriage moves from the second location to the first location. Embodiment 260. The method of any one of embodiments 257 to 259, further comprising decoupling the second shelf from the instrument. Embodiment 261. The method of embodiment 260, further comprising removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument. Embodiment 262. The method of embodiment 261, further comprising coupling the second shelf to the instrument after removing at least a portion of the fluid deposited on the top surface of the second shelf. Embodiment 263. The method of any one of embodiments 259 to 262, further comprising removing at least a portion of the fluid deposited on the first shelf after moving the carriage to the first location. Embodiment 264. The method of any one of embodiments 227 to 263, further comprising removing the receptacle from the carriage using a pick-and-place device after releasing the clamping force from the receptacle. Embodiment 265. A method of delivering a receptacle to an instrument, comprising: positioning a carriage at a first location of the instrument, wherein the carriage comprises a rotatable puck and is configured to move from the first location to a second location of the instrument, and wherein the puck is configured to seat a receptacle therein; rotating the puck in the carriage about a vertical axis to position the puck in a desired rotational position; determining whether a receptacle is seated in the puck using a first sensor; if it is determined that a receptacle is not seated in the puck, calibrating a sensing system, the sensing system being configured to determine whether a receptacle is seated in the puck; after calibrating the sensing system, seating a receptacle in the puck; after seating the receptacle in the puck, using the sensing system to determine whether the receptacle is properly seated in the puck; and after determining that the receptacle is properly seated in the puck, moving the carriage from the first location to the second location. Embodiment 266. The method of embodiment 265, wherein determining whether the receptacle is properly seated in the puck comprises determining (a) whether a longitudinal axis of the receptacle seated in the puck is inclined with respect to the vertical axis, and/or (b) whether the receptacle seated in the puck is inserted to a desired depth. Embodiment 267. The method of embodiment 265 or 266, wherein the puck comprises a first passageway that extends transverse to and is offset from the vertical axis of the puck, wherein the carriage comprises a second passageway that extends transverse to and is offset from the vertical axis of the puck, and wherein calibrating the sensor assembly includes rotating the puck to align the first and second passageways. Embodiment 268. The method of embodiment 267, wherein the sensing system comprises a signal emitter and a signal detector, and wherein when the first and second passageways are aligned, the signal detector is configured to receive a signal from the signal emitter through the aligned first and second passageways. Embodiment 269. The method of embodiment 268, wherein the signal emitter is an optical emitter, and the signal detector is an optical detector, and the method further comprises performing luminance calibration of an optical beam from the optical emitter after aligning the first and second passageways. Embodiment 270. The method of any one of embodiments 265 to 269, wherein the first sensor is a label reader of the instrument, and wherein determining whether a receptacle is seated in the puck comprises using the label reader to detect a label on the carriage, the label being positioned at a location that is not in a line of sight of the label reader if a receptacle is seated in the puck. Embodiment 271. The method of any one of embodiments 265 to 270, wherein rotating the puck to position the puck in a desired rotational position comprises stopping rotation of puck when a Hall effect sensor indicates that the puck is at the desired rotational position. Embodiment 272. The method of any one of embodiments 265 to 271, wherein moving the carriage from the first location to the second location comprises positioning the carriage at the second location such that a first shelf attached to the carriage is positioned below a second shelf positioned at the second location. Embodiment 273. The method of embodiment 272, wherein positioning the carriage at the second location comprises positioning the carriage at the second location such that the first shelf is vertically spaced apart from the second shelf by a distance of from about 1 mm to about 6 mm. Embodiment 274. The method of embodiment 272 or 273, wherein positioning the carriage at the second location comprises positioning the carriage such that the receptacle seated in the puck is positioned below and aligned with a first opening defined by the second shelf. Embodiment 275. The method of embodiment 274, further comprising directing a tip associated with a fluid extraction device of the instrument through the first opening and into the receptacle to contact a fluid contained in the receptacle. Embodiment 276. The method of embodiment 275, further comprising drawing at least a portion of the fluid into the tip. Embodiment 277. The method of embodiment 276, further comprising, after drawing at least a portion of the fluid into the tip, removing the tip from the receptacle to a position above the first opening. Embodiment 278. The method of embodiment 277, wherein the receptacle comprises a pierceable cap that covers an opening of the receptacle, and wherein (i) directing the tip into the receptacle comprises piercing the cap with the tip, and (ii) removing the tip from the receptacle comprises moving the tip through the pierced cap. Embodiment 279. The method of embodiment 277 or 278, further comprising, after removing the tip from the receptacle, laterally moving the tip to a position above the second shelf. Embodiment 280. The method of embodiment 279, further comprising, after laterally moving the tip to the position above the second shelf, lowering the tip to a distance of from about 1 mm to about 5 mm above a top surface of the shelf. Embodiment 281. The method of embodiment 279 or 280, further comprising, after laterally moving the tip to a position above the second shelf, moving the tip along a predefined above the top surface of the second shelf. Embodiment 282. The method of embodiment 281, wherein moving the tip along the predefined path comprises moving the tip around a projection extending upward from the top surface of the second shelf. Embodiment 283. The method of embodiment 281 or 282, further comprising, after moving the tip along the predefined path, removing the tip from above the top surface of the second shelf through a second opening formed in a sidewall of the second shelf. Embodiment 284. The method of any one of embodiments 281 to 283, wherein a portion of the fluid drawn from the receptacle is suspended from the tip prior to moving along the predefined path, and wherein at least a portion of the fluid suspended from the tip is deposited on the top surface of the second shelf while moving the tip along the predefined path. Embodiment 285. The method of embodiment 284, wherein at least a portion of the fluid suspended from the tip prior to moving the tip along the predefined path is suspended from the second shelf directly beneath the first opening after moving the tip along the predefined path. Embodiment 286. The method of embodiment 285, further comprising moving the carriage from the second location to the first location after moving the tip along the predefined path. Embodiment 287. The method of embodiment 286, wherein moving the carriage from the second location to the first location comprises cleaving at least a portion of the fluid suspended from the second shelf beneath the first opening and depositing the cleaved fluid onto a top surface of the first shelf as the carriage moves from the second location to the first location. Embodiment 288. The method of any one of embodiments 284 to 287, further comprising decoupling the second shelf from the instrument. Embodiment 289. The method of embodiment 288, further comprising removing at least a portion of the fluid deposited on the top surface of the second shelf after decoupling the second shelf from the instrument. Embodiment 290. The method of embodiment 289, further comprising coupling the second shelf to the instrument after removing at least a portion of the fluid deposited on the top surface of the second shelf. Embodiment 291. The method of any one of embodiments 287 to 290, further comprising removing at least a portion of the fluid deposited on the top surface of the first shelf after moving the carriage to the first location. Embodiment 292. A method for providing a fluid to an instrument located adjacent a conveyor for transporting receptacles between a plurality of modules, the method comprising the steps of: (a) supporting a sample receptacle in an upright orientation on a first carrier; (b) transporting the first carrier on a conveyor extending adjacent to each of a plurality of modules, at least one of the modules being an analytical instrument; (c) stopping the first carrier at a position adjacent the analytical instrument; (d) after step (c), and while the first carrier remains on the conveyor, removing the sample receptacle from the first carrier and transporting the sample receptacle to a pick-up position of the analytical instrument; (e) transporting the sample receptacle from the pick-up position to a pipetting station located within the analytical instrument; (f) at the pipetting station, aspirating a fluid contained within the sample receptacle and transferring the aspirated fluid to a reaction receptacle supported by the analytical instrument; (g) after aspirating the fluid from the sample receptacle, transporting the sample receptacle from the pipetting station to the pick-up position; (h) removing the sample receptacle from the pick-up position and transporting the sample receptacle to a second carrier located on the conveyor adjacent the analytical instrument, the second carrier supporting the sample receptacle in an upright orientation; (i) in the analytical instrument, performing an assay with the aspirated fluid, thereby determining the presence or absence of an analyte in the aspirated fluid; and (j) transporting the second carrier supporting the sample receptacle on the conveyor to one or more of the plurality of modules other than the analytical instrument. Embodiment 293. The method of embodiment 292, wherein the first carrier is a puck having a cylindrically shaped base and a pocket formed in a top surface of the base for seating the sample receptacle. Embodiment 294. The method of embodiment 293, wherein the puck has a plurality of upwardly extending fingers for supporting the sample receptacle in the upright orientation. Embodiment 295. The method of any one of embodiments 292 to 294, wherein the conveyor comprises a stationary track for supporting the first carrier during step (b). Embodiment 296. The method of embodiment 295, wherein the first carrier is propelled on the track by a magnetic attraction between the first carrier and the conveyor. Embodiment 297. The method of any one of embodiments 292 to 296, wherein the analytical instrument is an instrument for performing nucleic acid-based amplification reactions. Embodiment 298. The method of any one of embodiments 292 to 297, wherein step (c) is performed with a stop element operationally associated with the conveyor, and wherein the stop element is actuated from an open position allowing passage of the first carrier on the conveyor to a closed position during step (c), the stop element immobilizing the first carrier in the closed position. Embodiment 299. The method of any one of embodiments 292 to 298, wherein the sample receptacle is removed from the first carrier and transported to the pick-up position with a gripper apparatus. Embodiment 300. The method of any one of embodiments 292 to 299 further comprising the step of determining whether the height and orientation of the sample receptacle is acceptable. Embodiment 301. The method of any one of embodiments 292 to 300, wherein a receptacle holder supported by a carriage receives the sample receptacle at the pick-up position in step (d). Embodiment 302. The method of embodiment 301, wherein the pick-position is located outside of a housing of the analytical instrument. Embodiment 303. The method of embodiment 301 or 302, wherein the carriage transports the sample receptacle from the pick-up position and to the pipetting station in step (d). Embodiment 304. The method of embodiment 303 further comprising the step of securing the sample receptacle in the carriage as the sample receptacle is transported from the pick-up position to the pipetting station, thereby impeding vertical movement of the sample receptacle. Embodiment 305. The method of any one of embodiments 292 to 304, wherein the first carrier and the second carrier are the same carrier. Embodiment 306. The method of any one of embodiments 292 to 305, wherein the assay comprises exposing the sample to reagents and conditions for performing a nucleic acid-based amplification reaction.

(90) The present disclosure has been described and shown in considerable detail with reference to certain illustrative embodiments. Those skilled in the art will readily appreciate that other embodiments and variations and modifications of the disclosed embodiments are encompassed within the scope of the present disclosure. The description of the disclosed embodiments, combinations, and sub-combinations is not intended to convey that the disclosure requires features or combinations of features other than those expressly recited in the claims. Accordingly, the present disclosure is deemed to include all modifications and variations encompassed within the spirit and scope of the following appended claims.

## Claims

1. A receptacle delivery system for an instrument, comprising: a carriage configured to move from a first location of the instrument to a second location of the instrument; a puck supported by the carriage, wherein the puck is configured to removably support a receptacle such that a longitudinal axis of the receptacle is substantially coincident with a vertical axis of the puck; and a first shelf positioned at the second location of the instrument, wherein the first shelf comprises (a) a base extending substantially transverse to the vertical axis of the puck and (b) a first opening formed in the base, wherein, when the carriage is positioned at the second location, the longitudinal axis of a receptacle seated in the puck extends through the first opening, and wherein a top surface of the base comprises a recessed pathway defined between a projection extending upward from the top surface of the base and a sidewall circumscribing the base.
2. The system of claim 1, wherein the first shelf is removably coupled to a housing of the instrument.
3. The system of claim 2, wherein the first shelf is removably coupled to the housing of the instrument using one or more magnets.
4. The system of claim 3, wherein the one or more magnets comprises a pair of corresponding magnets, and wherein the first shelf comprises a first projecting post, and the housing of the instrument comprises a second projecting post, the first projecting post containing a first magnet of the pair of magnets and the second projecting post containing a second magnet of the pair of magnets.
5. The system of claim 2, wherein the first shelf and the housing include mated registration elements configured to correctly align the shelf on the instrument.
6. The system of claim 5, wherein the mated registration elements include a cavity formed in the first shelf and a corresponding projection coupled to the housing, and wherein the corresponding projection extends through the cavity when the first shelf is coupled to the housing.
7. The system of claim 6, wherein a shape of an outer surface of the corresponding projection coupled to the housing generally conforms to a shape of the cavity.
8. The system of claim 6, wherein the corresponding projection coupled to the housing comprises a recess located at a base of the corresponding projection, and the first shelf comprises a projection positioned proximate the cavity, and wherein, when the first shelf is coupled to the housing, the projection proximate the cavity is positioned in the recess.
9. The system of claim 1, wherein the sidewall comprises a second opening, the second opening being sized to permit lateral passage of a distal end of a pipette tip through the second opening.
10. The system of claim 1, wherein the first shelf comprises a recessed thumb grip.

11. The system of claim 1, wherein the carriage comprises a second shelf coupled to a top surface of the carriage.
12. The system of claim 11, wherein the second shelf comprises a recessed region configured to contain a fluid.
13. The system of claim 11, wherein the second shelf is removably coupled to the top surface of the carriage.
14. The system of claim 11, wherein when the carriage is positioned at the second location, a vertical clearance between the first shelf and the second shelf is from about 1 mm to about 6 mm.